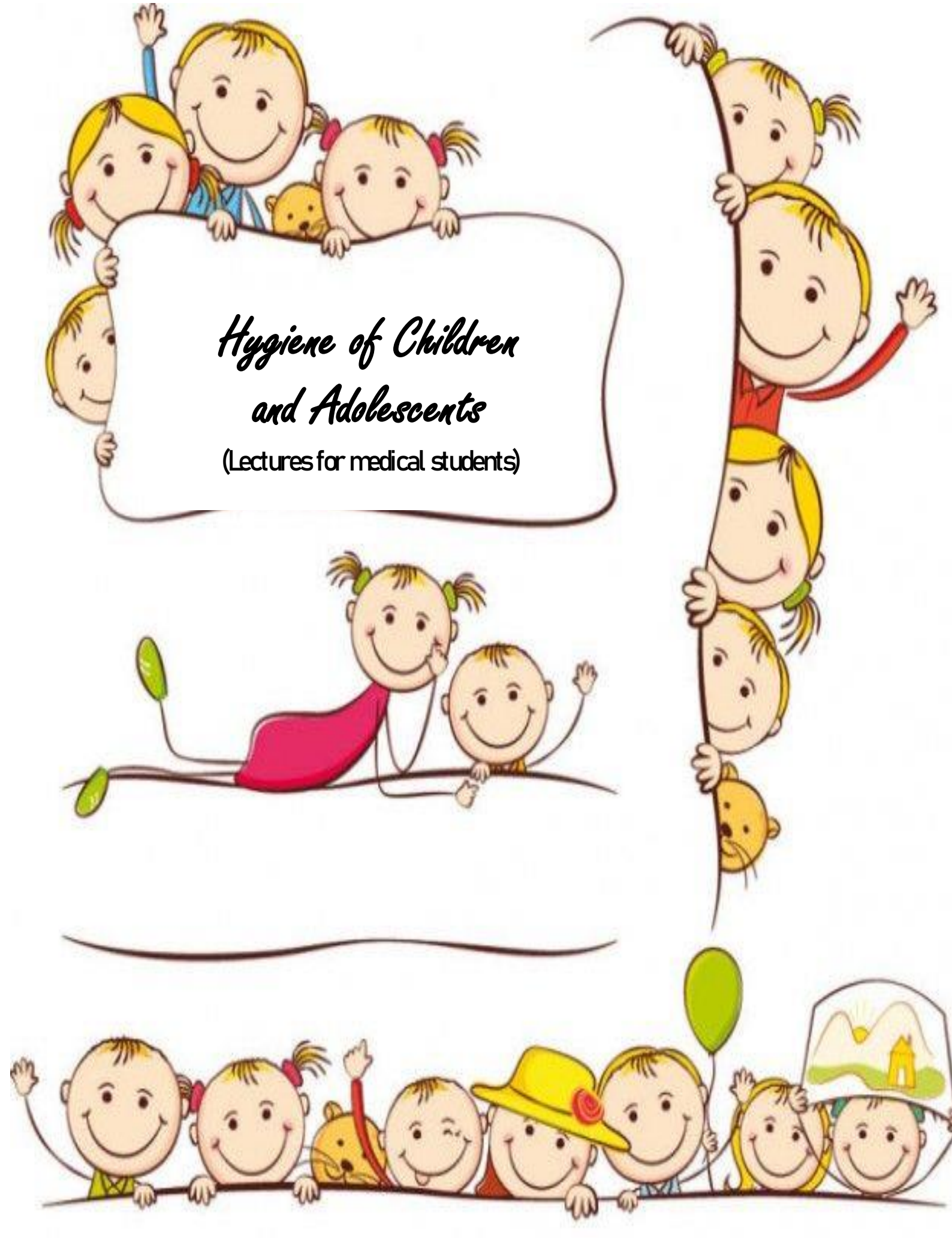

Hygiene of Children and Adolescents

(Lectures for medical students)

Ministry of Education and Science of Ukraine
Sumy State University
Medical Institute

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Sumy
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The course of lectures deals with the problems of health and physical development of children and adolescents, the hygienic foundations of organizing the educational process, planning and equipping children's educational institutions, and also the principles and methods of disease prevention.

Made in accordance with the Program on Hygiene and Ecology, approved by the Ministry of Education of Ukraine.

У курсі лекцій розглянуто проблеми стану здоров’я та фізичного розвитку дітей і підлітків, гігієнічні основи організації навчально-виховного процесу, гігієнічні аспекти планування та обладнання дитячих освітніх закладів, а також принципи й методи профілактики захворювань.

Укладено відповідно до програми з гігієни та екології, затвердженої Міністерством освіти і науки України.

Content

Introduction in Hygiene of Children and Adolescents

Children and Adolescents Hygiene is a science of protection and strengthening of the growing generation health, studying influence of surrounding factors on children' organism and developing optimal conditions for its harmonic growth. Protecting and improving the health of children have a fundamental importance. This becomes clearer if the following is taken into account:

— children under 18 are a significant part of the population (38–40%);

— children are the future of the nation.

Extension of human life and maintenance of high productive capabilities of the body for a long period of time are the final purposes of hygiene as a science.

Children and Adolescent Hygiene as a science and medical practice has a following objectives:

1. Regular study of environmental factors influence on child health in dynamics taking into consideration the sensibility to these factors is changing during growth and development.

2. Elaboration of scientific norms and health improving measures. Theoretical principles of such elaboration include the compulsory condition of any action of surrounding factor and the morphological and functional readiness of the growing organism to interaction. So, the above norms are not permanent, they are changed at different stages of age.

3. Compulsory control of health improving measures effect. The hygiene of children and adolescents is closely connected with some biological sciences such as anatomy and physiology, pediatrics, closely related disciplines (hygiene of nutrition, occupational hygiene, etc.). In the sphere of prevention children's infectious diseases, it is connected with epidemiology and medical microbiology.

The founders of this branch of science are Alexei Dobroslavin (1842-1889) and Friedrich Erismann (1842-1915). Alexei Dobroslavin was a first professor of hygiene as an independent subject at the medical-surgical academy; prominent public person. He was paid a principal attention to the problems of children, nutrition, overload, and mortality.

Friedrich Erismann was a Swiss hygienist. In the early 1870s, he studied hygiene and physiology in Munich, where his instructors were Max von Pettenkofer and Carl von Voit. He paid great attention to the problems related with children' physical development and vision. He found out that children's physical development and health depended on environment factors and daily regimen. F. Erismann was interested in problems related with the hygienic conditions of classrooms, organization of natural lighting in educational premises. He developed first science-based models of the classroom and school furniture. In 1870, F. Erismann wrote the first manual guide for medical students "The School Hygiene". The great attention to the problems of school hygiene was paid by the followers of Friedrich Erismann and Alexei Dobroslavin.

There are main factors that helped to create Hygiene of Children and Adolescents as an independent branch of the General Hygiene:

— the quantity of children population;
— peculiarities of the conditions required for this group of population (conditions of studies, work, life, etc.);
— peculiarities of the reaction of a child's body in comparison with adults in same conditions.

Children are not little adults. They are extremely sensitive to the environment during "windows of vulnerability" in the course of pregnancy, infancy and childhood. Low levels of environmental pollution that could be tolerable for adults can have life-long toxic effects on children. Children are faced with environmental risks in places where they live, learn and play. Toxic chemicals and climate change create health hazards for children in both urban and rural areas, at school and home, in conflict settings, and around waste and recycling sites.

Environmental risks are concentrated in lower-income and middle-income countries, where 92% of pollution-related deaths occur, and also in poorer, marginalized communities in all countries. Children in these communities bear the greatest burden of environmental injustice.

Anatomical and Physiological Peculiarities of Children and Adolescents

Infants and children are not miniature adults. They have some distinctive peculiarities — morphological, functional, and psychological. Anatomical, histological and biochemical differences in the child's body in comparison with the adult determine their differences in the functional parameters of organs and organ systems. The child's organism is characterized by the inadequacy of the adaptation mechanism, greater sensitivity to the environmental factors, especially to cross-interactions: the infant organism reacts even to a slight deviation from optimal living conditions. On the other hand, the infant organism is able to widely develop the mechanisms of adaptation to environmental conditions in the process of growth and development. Thus, the development of an infant is not only growth, i.e., an increase in body weight, because in the process of growth, profound qualitative changes occur. Development consists of three intercrossing processes:

— growth;

— differentiation of tissues and organs;

— shape building.

The growth process is uneven. Periods of intensive growth are alternated by periods of slowdown. During this time the intensiveness of tissue differentiation and functional possibilities of organs increases, and body shape is formed.

There are some peculiarities of children body metabolism:

— intensity of children metabolism is twice more than that is in adults (it is necessary to take into consideration calculating daily food ration);

— assimilation processes prevail over dissimilation ones (importance of quality composition of the diet).

The health state of children is controlled by different doctors: neonatologists, pediatrists, hygienists, etc. Preventive measures are different for each period.

It is very important to control of infant health before a birth (in an intrauterine period) because there is a close connection between infant and mother. This is confirmed by an association between:

— pre-birth vocation duration and new-born baby weight;

— sanitation and adverse pregnancy outcome;

— professional features of the woman job, that are toxic factors even of little concentration or ionizing radiation can cause teratogenic effects, decrease of immune reaction of the mother and baby, hypolactation.

The most numerous groups of children's population comprise the children and adolescences of school age. The school period demands the greatest attention of doctors. This period includes 2 main intervals in the development of the child's organism:

1) 6-7 years — the age between the pre-school and school period. At this age, a new and obligatory element, that is labor, appears in a child's life, and children do not have developed skills for labor;

2) 13-15 years — there is a period of puberty, when the development of the whole organism occurs quickly and unevenly. During this period, functional disorders can be observed in various body systems, and the task of the doctor is to prevent the influence of various factors under the influence of which these functional changes can be transformed into pathological ones. Unfortunately, at present, many diseases are associated with a violation of the rules in the education system. They can be observed among the students of Ukrainian schools:

— defects of bearing— 28–28%;

— diseases of ears, throat and nose — 28%;

— disorders in vision, sometimes, a very high per cent;

— rheumatism — 23%.

Among the reasons affecting the health of students, the main ones are the violation of hygiene standards, for example, overcrowding in classrooms, insufficient lighting in workplaces, discrepancy between the size of school furniture

and the length of the child's body, etc. In connection with these the physician's tasks are:

1. Analysis of children' health and physical development and organization medical and preventive measures.

2. Organization of anti-epidemic measures for prevention of infectious diseases.

3. Systematic control of daily routine and conditions of school environment.

4. Involvement of teachers and parents into control of children' health.

As it was mentioned above, the Hygiene of Children and Adolescents is closely related to other biological disciplines and it builds its tasks taking into account the peculiarities of the child's organism in different periods of his/her life.

The main feature of the child's body is its constant growth and development, which begins from the moment of its conception and ends at the age of 20–25 years. In the process of development of a growing organism, various qualitative changes occur, which are manifested in the development of various organs and systems and their interaction.

Skeleton

The process of ossification starts in the womb of the mother and comes to its end at the age of 16–17 (for girls) and at the age of 18–19 (for boys). The children's bones contain a lot of organic substances, little amount of calcium and phosphorus. As a result, they are flexible and can be bent. The spines of children are often curved. The spine has three slight curves — one in the neck, the other in the upper back and the other in the lower back. These curves are normal and can be seen from a side view. From a back view, the spine should appear straight.

If the spine has a side-to-side curve, the curve is called scoliosis. There are two main types called postural and structural. The first one can be corrected and is caused by some irregularity of posture. Structural scoliosis can be due to abnormalities or diseases of bones, muscles or nerves. Between the ages of about 9 and 14, children's bones grow rapidly. At this time, signs of developing scoliosis can sometimes appear in the spine. Early detection enables timely treatment. This

allows to control of pathology and prevention related problems development in subsequent years. Scoliosis is closely related to the violation of the position of the body.

What are the causes of the defects of posture?

1. The furniture does not fit the proportions of the body — a chair, a desk, a bed, etc.

2. Anomalous posture and bad habits, such as:

— the problems development on one leg; this habit causes the wrong position of the pelvis, as a result the flank curvature of the spine is developed;

— the wrong position when sitting at the table with one leg being on the chair-bottom; such posture violates the position of the humeral zone and the pelvis;

— the reading in bed;

— the similar movements, for example, using the same leg when riding a scooter or jumping on the same leg, etc.

The main reason for the above is the wrong proportion of furniture. Sometimes the pathological curvature begins to develop at preschool age; at school age, the process progresses. This process not only causes visible pathological curvature of posture, but also affects the functioning of the chest organs and, as a result, complicates the treatment of pathology.

As mentioned above, the main cause of scoliosis is the wrong position at the table. As a rule, in big cities children study in two shifts, and in classrooms students of different ages can sit at the same desk (for example, students of the second and fifth grades). In such cases, it is very difficult to find a solution to the problem. The development of posture defects can be observed in a situation where a student carries a heavy school bag in his hand.

Prevention of postural disorders and curvature of the spine in pre-school children, as well as in schoolchildren, is to use desks and chairs that correspond to the size of the child's body. At the beginning of the academic year, a suitable desk for each group of students must be selected.

The use of suitable furniture slows down the process of violation of posture and also the work of teachers becomes more difficult as they have to watch that children do not take the wrong position at the desk. Another preventive measure is the use of a satchel instead of a school bag.

The children with scoliosis should be sent to the special physiotherapy room for preventive gymnastics. Deformation of the osseous system includes the deformation of the thorax. The development of the thorax is a slow process, it is completed at the age of 21–25. Chest deformation affects negatively the development of the lungs, the heart and the large blood vessels. To prevent such violations teachers should pay attention to the position of a child at the desk.

When in a sitting position, the spine can take on many different postures ranging from the very upright, back supported sitting posture to the unsupported, relaxed posture. When the legs are crossed while sitting, the strain on the lumbar muscles increases and also creates a greater strain on the neck muscles. The neck must compensate to provide an upright head position. During long sitting without any type of back support, the spinal cord posture deteriorates due to muscle fatigue caused by incorrectly contracted muscles and ligaments. Pressure on the intervertebral discs of the lower lumbar spinal column increases by 30% in the sitting posture. Therefore, a lumbar support was designed to decrease muscle fatigue and strain on the intervertebral discs. This support system must be compact and easily carried around.

Muscular System

The muscular system provides the fulfillment of children's movements. The structure and functional peculiarities of muscles develop during over period of childhood. This process is uneven. In the beginning the muscles of extremities start to develop. At the age of 6–7 the development of upper extremities can be observed, then the muscular power, coordination and accuracy of movements go on. The weight of muscles increases year after year. The interrelation between weight of the body and the weight of the muscles is the following:

— a baby — 23%;

— 8-year-old boy — 27%;

— 15-year-old boy — 32%;

— 17–18-year-old boy — 44%.

The chemical composition of children's muscles differs from that of adults. They are rich in water and the percentage of albumen, fat and salt is low. Only at the adolescent age of the chemical composition of children's muscles becomes the same in comparison with grown-ups. Children's muscles become tired very quickly but because of the metabolism this tiredness is not very long. At the pre-school period the characteristic peculiarity of the muscular system is considered to be the slow development of the flexors and small muscles. Because of the late development of the muscles of bones, it is very difficult for children at pre-school age to fulfill work with small objects. The muscular system of such children is weak and such postures as sitting and standing cause tiredness. That is why the measure against tiredness is to let children move. To prevent the strain of muscles such positions of the body should be minimized. The negative development of the osseous muscles leads to the precipitation of fat in the child's organism. The excessive fat leads to the underdevelopment of the osseous muscles, negatively affects the activity of the heart, at the same time the excess weight of the child influences the work of the cardiovascular system leading to earlier and harder forms of tiredness. Lately because of the specific psychology of some parents who want their children to be plummy, the number of children with obesity considerably increased. At some places the number of such children is 4–5%.

It should be explained to such parents that excessive fat may lead to the diseases associated with metabolism and cardiovascular system.

Cardiovascular System

The weight and the shape of the heart, its position in the thorax, the structure of tissues, vessels — all this change year after year. These changes are reflected on the functional peculiarities of the cardiovascular system of children. The cardiovascular system of babies is characterized by imperfectness, but the heart muscle is quite heavy, as a result, the greater amount of blood goes through the heart

at the same time in comparison with adults. The heart of a child grows more intensively when he is one year old as well as at the period of puberty. The growth of the heart is slower than the growth of blood vessels till 6–7 years but at the period of pubescence it accelerates. As a result, the heart pushing the necessary quantity of blood into the arteries develops some mechanic power and it leads to the high arterial pressure. The scientific research showed that hypertension among grown-ups often started at an early age. The main causes of the development of hypertension are: the functional condition of the cardiovascular system, emotional and psychological influences, which can be observed at the periods of pubescence and physical tension (for example, among the youths involved in sports). One of the signs of the disease is a neurotic state of the person. It can be manifested as irritability, petulance. Another sign of the disease is considered to be sleeping disorders. Hypertension among the youths is associated with the peculiarities of the cardiovascular system, it can be caused by shocks but as usual the main cause is considered to be prolonged strains that is excessive mental and physical activity, not enough sleep, troubles in the family or at school and smoking. That is why it is very important to exclude excessive physical and emotional strains so that the development of the cardiovascular system can be normal. Pupils should constantly make physical exercises, keep to the hygienic time-table, work on the open air. Sometimes even loading at school should be changed if it negatively affects the health of a particular pupil.

Respiratory Apparatus

The peculiarities of the respiratory apparatus in children are the following: the upper airways are narrower in comparison with grown-ups, nasal sinuses are weaker, the mucous membrane of the respiratory airways is tender and can be easily injured. As a result, different infections penetrate into the organism of a child more often and catarrhal process leads to breathing disorders. The breathing of children is superficial and more frequent. Such breathing is not sufficient for proper ventilation of lungs, that is why children especially need fresh air and physical exercises outdoors.

Fresh air is necessary for metabolism. The pulmonary ventilation volume per 1 kg of body weight per 1 min is:

— in baby — 220 cm^3;

— in 6-year-old child — l58 cm^3;

—in14-year-old boy — 128 cm^3;

— in adults — 96 cm^3.

Hygiene of the respiratory organs should lead to the normal development of the thorax. The following rules should be taken into consideration:

a) the correct posture of a child at the desk, table and so on;

b) breathing exercises for the development of the thorax and its muscles;

c) going in for sports especially swimming, skiing, sledges;

It is very important to teach children deep and rhythmic breathing.

Skin

The relative surface of skin (per 1 kg of body weight) in children is bigger than in adults:

— baby — 704 cm^2 of the skin surface;

— 6-year-old boy — 456 cm^2;

— 14-year-old boy — 423 cm^2;

— adult — 221 cm^2.

This peculiarity explains great heat irradiation in children.

The heat production per 1 kg of body weight in children is also higher than in adult:

— for baby this index equals 91 kcal;

— for 1–2-year-old child — 81 kcal;

— for 14-year-old — 52 kcal;

— for adults — 35–41 kcal.

The child's skin contains more capillaries than adult's and they are wider in comparison with adults. One third part of the blood flows through the skin in adults and half and even 2/3 in children. At the same time the regulation of the circulatory system by the central nervous system (CNS) is not sufficient. It results in fast

overcooling of the child's organism. At the age of 11–14 the development of CNS reactions come to its end, the skin becomes more developed and adolescent stands cooling more easily.

The children's epidermis is thin and as a result different infectious agents can easily penetrate into the body.

The prevention of skin infections is the following:

1. The skin should be clean; the clearness protects the penetration of bacteria.

2. The skin should be trained to extreme environmental temperature. The training of skin with respect to the influences of environment should be fulfilled with the help of air bath, water bath and sun bath.

3. It is necessary to take care of the children's clothes. A special attention should be paid to the hands and feet:

a) the clothes should meet the requirements of a season, weather and work;

b) the clothes shouldn't prevent movements;

c) the clothes shouldn't prevent ventilation.

As it was mentioned above a special attention should be paid to the prevention of the hands and feet because they cool down first. The position of the hands and feet is distant and that is why the circulation of blood in them is not so good as in the other parts of the body.

Organs of Chewing

The first teeth erupt at the age of 6–7 months, by the end of the first year a child has 8 teeth and by the end of the second year — 20 deciduous teeth. The delay of the eruption of primary teeth is a sign of the malformation in the development of the organism. This sign can be observed when the child suffers from rickets, when the calcium supply is not sufficient and in some other cases. The first permanent teeth erupt at the age of 6–8 and to the age of 12–14, all 20 primary teeth are changed into permanent. The wisdom teeth (third molars) in most people appear in their late teens or early twenties (Table 1).

The children's permanent teeth are covered with thinner enamel (in comparison with adults). That is why they are more predisposed to teeth decay.

Children should be examined by the dentist no less than two times a year, only in such cases teeth decay can be revealed and treated in proper time.

Table 1

Age of Eruption of Deciduous and Permanent Teeth

Teeth	Number	Age of eruption
Deciduous (20 total)		
Lower central incisors	2	5–9 months
Upper central incisors	2	8–12 months
Upper lateral incisors	2	10–12 months
Lower lateral incisors	2	12–15 months
1st molars	4	10–16 months
Canines	4	16–20 months
2nd molars	4	20–36 months
Permanent teeth (32 total)		
1st molars	4	5–7 years
Incisors	8	6–8 years
Bicuspids	8	9–12 years
Canines	4	10–13 years
2nd molars	4	11–13 years
3rd molars	4	17–26 months

Gullet

The food is pushed from the gullet to the stomach because of peristalsis and mechanic irritation of its lower section. At early age, strong mechanic and chemical irritation of the gullet because of the tender mucous membrane can lead not to the better work of peristalsis but to the spasm of its cardiac part (achalasia). As a result, the food doesn’t reach the stomach and with the help of emetic movements it is pushed of it.

Gastrointestinal tract

The stomach volume in children is smaller than in adult one. In the beginning of life, it is just a dilatation of the gullet. The acidity of the gastric juice and the digestive power of ferments are less in comparison with adults. At the early period of life, the intestine microflora is not developed (before the birth of a child its intestine is sterile). All these factors cause the development of dysfunctions of the alimentary canal. Constipation among children can be explained by the insufficient development of the intestine peristalsis, its muscles and elastic fibers. The causes of constipation are also the weakness of the stomach and intestine walls which is the result of long sitting at the desk and insufficient usage of the active rest. Taking into consideration these peculiarities of the digestive organs, the volume of the stomach, low acidity and activity of digestive ferments, weak peristalsis it is necessary to do the following:

1) children should be nourished four times a day so that the stomach should not be overloaded;

2) children should consume easily assimilated meat food and especially dairy produce because these products demand little amount of gastric juice;

3) to exclude from the diet piquant, sour, irritating and hot dishes;

4) to strengthen the peristalsis, children should consume more fruit, vegetables, berries and cereals;

5) physical exercises that strengthen the abdominal cavity.

Organs of Sense

Newborn organs of sense are developed insufficiently. No coordination of eyes movement, no possibility to fix eyes on any objects during the first two months, non-clear sight. Insufficient development of ears. Acoustic duct is short and narrow. This duct is in vertical position. Ear-drum is in horizontal position. The middle ear cavity is filled with liquid. Later this liquid will be dried and air enters the middle ear from the Eustachian tube and the baby begins to react to acoustic irritants. Organs of taste are developed to the greatest extent and this should be taken into consideration while preparing meals for children. Skin pain sensitivity is low. The

visual organs of a newborn are not prepared to the normal activity: photophobia, coordination of eye movements is weak as well as the fixation on objects. The visual characteristics develop rapidly. The difference between black and white appears in the beginning of the first year of life. Then a child distinguishes red, then green, blue and at last — yellow. Full ability to differentiate colors develops at the end of the 3rd year of life. The main peculiarity of the anatomic and physiologic development of the children' eyes is the following: the crystalline lens (at preschool and early school age) is of a more curved shape in comparison with adults. As a result, the front back axis of the crystalline lens is shorter, it provides longsightedness. The development of eyes lasts till the age of 9–12. The refractive system of the eyes and the development of the character of refraction are formed till this period of life. At the age of 9–10 the longsightedness often transforms into normal but in unfavorable conditions it can be transformed into shortsightedness. The shortsightedness can be observed among people of different age, but as usual it develops at a school period. The examples of innate shortsightedness are quite rare.

The mechanism of the development shortsightedness in a school-age period is the following. Under the influence of visual strain while looking at different objects at a short distance we can observe the spasm of accommodation. The crystalline lens become more curved. The shortening of accommodative muscle under the influence of unfavorable conditions becomes unchanged. As a result, the accommodative muscle doesn't relax even after work, the inner membranes of the eyes are always strained. Besides the inclined position of the head worsens the outflow of blood and it leads to the increase of tension in the eyes. These factors cause the lengthening of the front-back axis of an eye that is the development of shortsightedness. The unfavorable conditions are as follows:

1) forced close examining of the object;

2) insufficient lighting, irregular lighting, the blinding-light;

3) the wrong position of children at the desk at school, the distance between a book and eyes is not correct;

4) strained visual work during a long time.

The longer visual work goes in unfavorable conditions the bigger percentage of children suffers from shortsightedness. It is interesting to point out that the percentage of short-sighted pupils is lower in the country. It can be explained by the fact that natural lighting prevails in the country schools and probably they have higher level of resistance of the organism.

The degree of the development of shortsightedness depends upon the following reasons:

1) the geographical latitude of the region, which determines the light regime of the region;

2) sufficiency of natural and artificial lighting;

3) quality of nutrition, intake of vitamins A, C, etc.;

4) regime of work and rest.

It was shown that visual acuity becomes lower in theoretical classes and at the sport classes it remains unchanged and sometimes it becomes even higher. Low acuity of vision leads to the development of shortsightedness.

The development of myopia is considered to be caused by insufficient and irregular lighting. Light is a direct and adequate irritant of the eyes. Under the influence of sufficient lighting, all the functions of the eyes are considerably increased:

a) acuity of vision (shapes, sizes of objects);

b) instability of legible sight (acuity of vision for a long time);

c) accommodation (the peculiarity of the eyes to accommodate to legible sight at different distances).

It was proved experimentally, that the change of lighting from 40 to 140 lx causes the increase of the reading speed by 15%. The dependence of the sight on lighting can easily be observed among pupils with pathologic refraction. The change of lighting in the class room from 30 to 120 caused the increase of the visual capacity of work by 14% among children with normal refraction and by 22% among short sighted children. That is why one of the main preventive measures is considered to

be the creation of optimum lighting. The basic hygienic demands of lighting are the following:

1) the sufficient level of lighting in premises;

2) evenness of lighting, avoiding sharp and deep shadows;

3) prevalence of light in the sphere of sight;

4) prevention of blinding light (tube lamps, illumination is 300 lx);

5) the spectrum of radiation of artificial light sources should be close to the natural light.

That is why children's health facilities need to be built in such a way that there is a lot of lighting. First of all, sufficient natural and electric light should be provided at schools because it is there where children have constant and long visual work for the first time of their life. Observations show that the natural lighting of classrooms depends on the season of the year. Particularly low levels of illumination are observed in autumn and winter. Therefore, during this period, natural lighting should be compensated by artificial lighting. It should be noted that there is an opinion that mixed natural and artificial lighting has a bad effect on the development of vision (this opinion is often widespread even among doctors and teachers). However, in practice this was not confirmed, on the contrary, the most optimal indicators of the functioning of vision were observed in natural light, then in mixed and, finally, in artificial light. Therefore, additional lamps should be used at any time of the day when natural light is not enough. Lighting is of great importance in specialized schools for children with visual impairments. As mentioned above, a high level of lighting has a positive effect on vision. Therefore, in these schools, the norm of illumination is higher than in ordinary schools. For example, the norm of artificial lighting is 500 lx against 300 lx in ordinary schools; light factor 1:3 versus 1:4 in a regular school.

The high level of lightening is necessary in the schools for children with poor hearing. The fact is that the main load falls to the visual analyzer, 93% of all school lessons are studied by means of sight in comparison with 40% at regular schools. The norms are the same as at schools for children with poor vision. The main task

of primary and secondary schools is to bring up the well-educated and healthy young people. However, students' health index (a quantitative indicator of the physical state of health, reflecting the level of physical development and functional capabilities of the body, the quality of lifestyle, the state of immunity) is alarming. At present only 15% of final-year pupils in secondary school can be considered to be apparently healthy. Visual organ pathology, postural disorder, neurocirculatory asthenia, alimentary tract illnesses are pathology mainly spread among students. Among causes of reduction of visual acuity, the most frequent is myopia. The prevalence of myopia increases from 3–5% among first grade students to 50% or more among high school students. It is believed that even a small degree of myopia limits the ability of first-year students to successfully master knowledge and skills.

School-age myopia tends to progress to a moderate and high degree. The contribution of moderate- and high-degree myopia to the overall structure of refractive anomalies can reach 45%. Progressing myopia still remains one of the main causes of blindness and poor vision. School-age myopia is a very common vision pathology affecting nearly 30-50 % of population in Ukraine. It starts in early school age (commonly in age 8–10 years) and in subsequent period can progresses. A correlation of the processes of school-age myopia development and progress of pedagogical, psychological, ergonomic, hygienic, somatic factors were studied using a multi-factor analysis. In addition, a new method of division of children diseases into preventive groups according to main risk-factors was developed in order to correct them. The method makes it possible to elaborate a complex of individual preventive measures for children. On the basis of the identified patterns, teaching methods for the development and promotion of the prevention of school-age myopia have been developed. This makes it possible to increase the mass character of preventive measures, their effectiveness and accessibility. The preventive program includes 3 main sections: informational and preventive, diagnostic (including monitoring) and treatment and correction.

Information is an important part of school-age myopia prevention. Thus, the syllabuses of medical and pedagogical universities should include training of future

specialists in prevention of visual disorders in children and adolescents as well as adults engaged intensive visual work.

One of the most popular and impactful associations with school-age myopia is outdoor time. Many studies have found that outdoor time has a protective association with myopia. Sherwin et al. performed a meta-analysis to summarize the published reports on the association of outdoor time and myopia in children under 20 years. Their results not only confirmed that increasing time spent outdoors reduces the risk of developing myopia, but the pooled information indicated 2% reduced odds of myopia for each additional hour of time spent outdoors per week. Xiong et al. collected data of 25 studies for meta-analysis and dose-response analysis in a period 2002-2015. Scientists concluded: spending time outdoors has a protective effect for the onset of myopia where a 50% reduced risk corresponded with 76 minutes of extra outside time daily. More time outdoors also corresponded with a reduced myopic shift of -0.3D for both myopes and non-myopes. This offers a practical intervention for myopia prevention with the many other health benefits associated with outdoor activities.

Nervous System

The nervous system development is a subject of special interest because the nervous system, from one hand, unites and controls the vital activity of the whole organism and, from the other hand, the human being psychology formation and perfection are going on the basis of the cortex development. Before the birth the central and peripheral nervous system are not developed yet, particularly, the cortex and the closest under-cortex centers. The cerebrum weight of a newborn is relatively great (1/8 of the body weight and achieves 410 g). However, the surface of the big cerebral hemispheres is relatively smooth during the first months, convolutions are not distinctive. The nervous cells of hemispheres are primitive, immature, having simple shape. The cortex is not developed well and all the vital processes are controlled by under cortex centers. In the cortex the inhibition processes prevail. Children sleep much. During growth and development, the cortex becomes more

perfect, the cerebrum weight is increasing (the first year of life — 1,100 g, the seventh year — 1,250 g, adults — 1,400 g).

The cortex develops considerably during the third year of life, at this time the language formation is going on. Lexis is about 500 words. Some words are not pronounced distinctly. For further infant development it is necessary to meet more and more people. The peculiarities of infant development are: during the nursery period the children only imitate the behavior of the adults. At this time the real irritants are very important. The infant's parents and teachers are perfect in his eyes. So proper bringing up is very important. The other feature is infant's word-building, critical attitude to the words and their meaning. The most important age for proper bringing up is up to 5 years. During junior school age the cortex development continues; some nervous cells become perfect, the new nervous ways are developing, the considerable growth of the frontal parts of the cerebrum is taking place and makes physiological basis for abstract thinking. Talking about peculiarity of the higher nervous system of children it is necessary to emphasize:

— processes of dynamic equilibrium between excitation and inhibition processes are manifested poorly;

— inhibition zone around the excitation zone is weak so children can easily pay attention to a new irritant;

— self-induction is expressed well (inhibition zone may occur inside of excitation zone);

— morphological and functional inefficiency of the brain cortex.

The nervous system unites and regulates activity of whole organism. The development of nervous system and brain in children is considered to be the process of great interest because during childhood the formation of personality has been observed.

The children' psychological peculiarities are formed on the bases of the development of the brain cortex. At the moment of birth, the development of central and peripheral nervous systems is not completed, especially it concerns the cerebral cortex.

The weight of the brain of a newborn child is 1/8 of the body weight and in adults it is 1/40. The surface of the cerebral hemispheres is comparatively smooth, convolutions of the brain are weak. The functions of all parts of cerebrum, including cortex, is not developed, that is why all living processes of children bodies are regulated mainly by subcortical centers. In the first 2–3 months conditioned reflexes can't be formed because of poor development of cortical innervations. Moreover, ordinary stimuli put the cerebral cortex into a state of deep physiological sleep. In the second half of the first year of life conditional connections between the cortex and sensitive organs (eyes, ears, skin, etc.) are appeared and developed. During this period, the foundation of speech is laid.

During the second year of life, simultaneously with the development of cerebral cortex and its activity, the creation of new conditioned reflexes can be observed. At the age of 2–2.5, a child possesses all features of the development of cortical system, and the general structure of the cerebrum slightly differs from that of adults. In the functional respect the cerebral cortex develops more intensively during the 3rd year of life. At this period the development of speech can be observed. In the last years of preschool period (4 – 6 aged children) the functional development of cerebrum is increased; analytic and synthetic activity of the brain become more complex. At early school period and at the period of puberty the continuation of the brain development through the formation of new nervous cells and pathways, i.e., the functional development of all nervous systems, are observed. At the same time, the intensified growth of frontal lobes leads to the exactness and coordination of movements. The cerebral cells finish their formation and go through the special energetic structural development, the formation of convolutions as well associative tissues correcting some parts of cerebrum comes to its end. The number of associative tissues increases at the age of 16–18. All this forms the more logical basis for the processes of associative, logical abstract thinking. The development, and physiologic activity of cerebrum at the period of pubescence are influenced by the changes in the organism — the high activity of the thyroid gland, sexual glands which raise the activity of the CNS and cerebrum. All these factors should be taken

into account when dealing with youths. Functionally, the child's brain in the pre-school and early school periods is not yet formed. The younger the child, the more excitation processes prevail over the processes of inhibition. This process can easily irradiate and spread throughout the entire cerebral cortex; it resulting in a low ability of children to concentrate their' attention; especially in case of insufficient organization of educational work. Psychomotor and intellectual development is influenced by innate intellect (the higher intellect, the faster development); family patterns (for example, late standing and talking are usually found in a certain family); environmental factors (for example, lack of appropriate stimulation may interfere with normal development); and physical factors (e.g., hypotension or deafness may alter normal development).

For the development of the nervous system and its cerebral hemispheres, it is important to do the following:

1) correctly organize the daily routine;

2) create sufficient levels of mental stress, while preventing the development of overwork;

3) correctly organize physical education, including interesting, not excessive physical work.

When children study, prepare homework, eat, go to bed every day at the same time and their daily routine is constant and regular, then all processes in the body proceed normally and rhythmically. State of children' nervous system is closely connected with the hygienic organization of educational work. The excessive educational load of children and adolescents leads to the overstrain of nervous system. It results in: quick tiredness, unsound sleep and even sleeplessness, headache, high excitability, low level of mental functions such as memory, attention, perception and learning.

The normal development of the nervous system depends on environment factors. The atmosphere in the family and at school should create high spirits in children. Cleanness and order, good attitude of teachers and parents are favorable for the normal development of the nervous system. The well-balanced nourishment

is also of great importance (especially the usage of products containing B group vitamins).

However, the most significant factor for the nervous system of children and adolescents is considered the correct organization of sleep. William Shakespeare called sleep the “chief nourisher in life’s feast”. The normal sleep provides the full rest of the organism, especially of the central nervous and muscular systems, and organs of sense. The main hygienic demand to the sleep of children and adolescents is considered to be the rate of its duration with the age. The younger the child, the longer his sleep should be.

Children and adolescents should go to bed at the same time every day. The regular succession of sleep and being awake leads to the fact that children fall asleep more easily. Insufficient duration of sleep leads to inertia, tiredness, lowering of mental functions, exhaustion of the nervous system, low level of resistance of the organism. For the proper organization of sleep, the time after the evening meal consumption should be spent in a calm environment, excluding the possibility of excitation of the nervous system (mental work, reading of books, noisy games, telecasts should be avoided). The best past time before going to bed is walking for a 15–20 min. At this time children may listen to the calm music, speak to the parents, etc. At the same time parents should not let children eat before going to bed, because after eating the diaphragm rises and loads the heart and lungs violating their normal functions and it leads to restless sleep. It is forbidden to give children before sleep such food, exciting the nervous system, as chocolate, coffee, strong tea (contains theobromine and caffeine) etc. The children’ supper should be light and no later than one hour before going to bed.

Ventilating the bedroom for 10-30 minutes before sleep can remove excessive amount of carbon dioxide and reduce moisture of the air. The temperature in the room should be no more than 15–16°C and remain constant over total period of sleep. At night a number of indoor plants in the bedroom fills the premise with carbon dioxide and can causes poor sleep.

Age Periodization. Critical Periods in Postnatal Development

Periods of development of the children' body

Age periodization in medicine is based on age-appropriate anatomical and physiological characteristics of the body. For the periodization of childhood, the degree of adaptation to environmental conditions is taken into account, with which the specifics of the care and upbringing of the child are associated. Conditional periods of children biological age include:

1. *Prenatal period:*

- phase of embryonic development 0-2 months;
- phase of fetal (fetal) development 3 - 9 months

2. *Postnatal period:*

- neonatal period 0-28 days;
- breast period 28 days -1 year;
- early childhood 1-3 years;
- preschool childhood 3-6/7 years;
- early school childhood (6/7 - 10/12);
- adolescents: female 10-16 years; male 12-17 years;
- youthful: female 16-20 years; male17-21 years

Periodization criteria are signs regarded as an indicator of biological age: body and organ size, weight, ossification of the skeleton, teething, development of endocrine glands, degree of puberty, muscle strength. This scheme takes into account the characteristics of boys and girls. Each age period has its own characteristics. The transition from one period to another is considered a critical period. The duration of individual age periods varies.

There are some especially sharp jumps in anatomical and physiological transformations of children body, so called "critical periods" or "age crisis" due to the increased vulnerability of children organism and the increased risk of violations of its functions.

First critical period (informational) is observed in a child aged 2 to 3.5 years, when the child begins to actively move, learns the surrounding world; there is an

intensive formation of speech and consciousness. At this time, a huge amount of various information from the outside world falls upon the child. This leads to the intensive work of the central nervous system. Overexertion can lead to impaired mental development and the appearance of various mental illnesses. The passive immunity received from the mother is weakened and infections can occur. Increased antigenic load (freedom of movement, communication with adults, children). The system of local immunity remains undeveloped, children are sensitive to viral and microbial infections, especially of the respiratory organs. During this period, primary immunodeficiencies, autoimmune and immunocomplex diseases may appear for the first time. Signs of allergic diseases become clearer. According to immunobiological characteristics a significant part of the children of the second year of life is not ready for kindergarten.

Second critical period (school-age) coincides with the beginning of schooling and is observed on the age of 6-8 years. During these years, the child's lifestyle changes. There is a period of "breaking" of the usual daily routine, when new duties appear, the information flow sharply increases. At the same time the moving activity reduces. All these factors together lead to intense activity of all physiological systems of the child's body, especially the central nervous system. Therefore, the period of adaptation to school conditions requires a particularly attentive and careful attitude to the child.

Third critical period (puberty) is associated with a change in the hormonal balance in the body, with the maturation and restructuring of endocrine glands function. This usually happens at 11-15-years-old children, i.e., at puberty, when the amount of sex hormones in the blood increases sharply. Pituitary hormones stimulate the growth of the body, the activity of the thyroid gland, adrenal glands and gonads. There is an imbalance in the development of internal organs: the growth of the heart outstrips the growth of blood vessels. High pressure in the vessels and the rapid development of the reproductive system leads to heart failure, dizziness, fainting, and increased fatigue. Sex hormones have easy access to the brain and their receptors are expressed by cortical neurons. Sex hormones excite the nerve cells of the cerebral

cortex. The emotions of adolescents become changeable: sentimentality borders on hypercriticism, swagger and negativism. In this time, there is an increased vulnerability of the nervous system and an increased risk of mental illness. In addition, the puberty jump is combined with a decrease in the mass of lymphoid organs. Sex hormones stimulate the humoral immunity, but suppress cellular one.

At this age, the impact of harmful exogenous factors increases (nicotine, etc.). There has been an increase in the number of autoimmune, lymphoproliferative diseases, increased sensitivity to mycobacterium tuberculosis.

In the Hygiene of Children and Adolescents, an age periodization system corresponding to the modern network of preschool institutions has a practical importance. In this system there are 6 age periods in child's life which differ from each other according to their morphological and functional features: the intrauterine period; the newborn period; the infant age; the nursery age; the preschool age; the school age.

Resistance, Reactivity, Adaptation, and Cross-adaptation

During the critical periods (mentioned above), the three main functional properties of the children organism, which are resistance, reactivity and adaptation, significantly decrease.

Resistance is a capacity of a body (or a tissue, or a cell) to withstand the effects of a harmful environmental agent. The most dangerous factors for a child are pathogenic viruses and bacteria. Therefore, this property is provided mainly by the immune system.

Reactivity (from Latin "reaction" – opposition) is the property of an organism to adequately respond to environmental stimuli by changes in vital activity. This property provided by the central nervous system and is developed in the course of evolution as the highest form of irritability and has a mainly protective and adaptive nature. Reactivity ensures interaction of the body with the surrounding world. It significantly affects the development and course of diseases.

Adaptation is the process by which a child becomes fitted to its environment. This is a process of increasing functional reserves of the body. Adaptation processes in childhood are usually faster than in adults. However, due to the incomplete processes of growth and development, as well as the mechanisms of their regulation, the impact of certain environmental factors makes adaptation difficult. For example, newborn child has completed system of thermoregulation. However, in comparison to adults, children have a greater ratio of body surface area (through which heat is removed) to body weight (where heat is produced). This leads to more intense cooling of the child's body at low ambient temperatures, and more intense overheating at high ambient temperatures. In addition, the heat-insulating layer of subcutaneous fatty tissue in children is much thinner than in adults. In children, shivering and other mechanisms of heat maintenance are activated only when there is insufficient heat production from brown fat. Due to such features, children have poor reaction to overheating or overcooling (they may not cry). Therefore, children, especially the in first year of life, need parental care aimed at maintaining the temperature regime.

In critical periods, all three functional properties of the child's body are reduced. There is a relationship between a specific age crisis and the degree of decline in a particular property. So, for example, in the first critical period, the resistance of the organism is significantly reduced. In the second critical period, the adaptive capabilities of the organism decrease most sharply, while in third crisis reactivity suffers.

Cross-adaptation. If adaptation process for a certain environment factor is moderate, during the process of its development an increase resistance to other factors can be detected. This phenomenon is called *cross-adaptation*. Cross-adaptation is a change in the specific resistance of an organism to a certain factor against the background of adaptation to another factor. The cross-adaptation is possible due to the fact of its non-specific character. Due to the cross-adaptation phenomenon can be explained the positive influence of sport activities to increase resistance to cold and other adverse environmental conditions.

Diseases in Children and Risk Factors

Young people under the age of twenty account for more than one-third of the world's population. In 2020, more than 2.1 billion children were affected by non-communicable diseases (NCDs). NCDs, a set of diseases resulting from the interaction of a combination of genetic, physiological, environmental and behavioral factors, present a significant burden on individuals, communities and economic resources.

In 2021, the World Health Organization (WHO) set the 5 x 5 framework for tackling NCDs including five diseases (cardiovascular disease, chronic respiratory disease, cancer, diabetes, and mental and neurological conditions) and five key risk factors (unhealthy diet, tobacco use, harmful use of alcohol, physical inactivity, and air pollution).

Cardiovascular disease (CVD) is a term used to describe disorders of the heart and blood vessels. In adults it is often linked to the buildup of fatty deposits inside the arteries (atherosclerosis). Within CVDs, there are four main types:

- Coronary heart disease occurs when the flow of oxygen-rich blood to the heart muscle is blocked or reduced (e.g., heart attack or angina).
- Stroke occurs when the blood supply to part of the brain is cut off. This can cause brain damage and death.
- Peripheral arterial disease is caused when there is a blockage in the arteries to the legs or arms.
- Aortic disease affects the largest blood vessel in the body and can lead to serious circulatory problems.

In children, CVD can arise as a complication of rheumatic heart disease. Similarly, although the causes may be different, stroke is also an issue.

Cancer is a term used to describe a large group of diseases that involve the growth of abnormal cells. These abnormal cells grow beyond their usual boundaries and then invade other parts of the body. Cancer can affect almost any part of the body and there are many different types, all need specific treatment and management strategies.

Chronic respiratory disorders (CRDs) are chronic conditions affecting lungs, airways and related structures. CRDs range from rhinosinusitis, asthma, and chronic obstructive pulmonary disease (COPD) to lung cancer.

*Diabetes (*diabetes mellitus) is the result reduced levels of insulin production or ineffective insulin sensitivity. Increases in blood glucose resulting from problems with insulin can damage many of the body's systems. There are two main forms of diabetes:

• Type 1 diabetes occurs when the pancreas does not produce the hormone insulin. This type develops most commonly in children and adolescents.

• Type 2 diabetes is caused by the body not responding properly when insulin is released from the pancreas.

Type 2 diabetes becoming more common in children. Unlike type 1 diabetes, many cases of type 2 diabetes may be preventable. Diabetes may also develop during pregnancy in a condition known as gestational diabetes. Untreated gestational diabetes puts mothers and children at risk for complications and developing type 2 diabetes later in life.

Unmanaged diabetes, regardless of type, can lead to serious and debilitating complications including nerve damage (neuropathy), cardiovascular and cerebrovascular disease, amputation of extremities, kidney disease (nephropathy), and blindness.

Mental health is a term used to describe a state of well-being that allows a person to realize their own potential, cope with the normal stresses of life, work productively, and participate in the community. Mental health disorders comprise a broad range of problems that affect mental health (including anxiety, depression, bipolar disease, schizophrenia and other disorders). Symptoms range from any of or a combination of abnormal thoughts, emotions, behavior and relationships with others.

Injury is defined as “the physical damage that results when a human body is suddenly subjected to energy in amounts that exceed the threshold of physiological tolerance – or else the result of a lack of one or more vital elements, such as oxygen”.

They can be a result of intentional (acts of violence against others or oneself) or unintentional road traffic crashes, burns, drowning, falls, and poisonings.

According to the Ministry of Health of Ukraine, only 14% of children are practically healthy, while more than 50% have various functional abnormalities, 26.6% of schoolchildren have functional abnormalities in the cardiovascular system, and 35–40% have chronic diseases, among which a top ranked diseases are: ocular chronic diseases, failure to thrive, rickets consequences, chronic disease of Waldayer's lymph nodes, gained deformations of the spine. Studies found a high percentage of pupils with disharmonic development, weight deficit in pupils from all grades and all counties taken into study.

A *risk factor* is any characteristic or exposure of an individual that increases their likelihood of developing a disease or injury. These include but are not limited to environmental pollution, non-rational nutrition, physical inactivity, mental overload and overfatigue, poor sanitation, including poor illumination, inappropriate microclimate, deficiency of ventilation, non-ergonomic furniture, low-quality toys and books, and also tobacco and alcohol consumption and others. These risk factors often combine to increase the chances that children to develop certain NCDs. Understanding risk factors is key to the prevention and control of NCDs. Policies geared towards risk factors can have benefits for the whole population, but understanding which groups are most at risk can also provide a targeted approach to prevention.

Epidemiological triad after holidays is an active surveillance method into schoolchildren collectivities that enables information on epidemiological potential and risk for school children health. Diseases diagnosed at triage are found in 1.5‰ of scholar population and are mainly infectious, both contagious and parasitical. Incidence of tonsillitis is increasing so that in 2,000 it reaches the value of 0.56‰. Pediculosis and scabies are at constant percentage: 0.03-0.07‰ scabies and 0.8–1.2‰ pediculosis. There are though differences between counties related to local/regional particularities. There is a need for sanitary-hygienic, epidemiological,

and sanitary-educational measures of national dimension aimed at reduction the incidence of these diseases and at the eradication the scabies and lice.

Main Patterns of Children Growth and Development

Human life is a continuous process of development, in which the following stages pass sequentially: maturation, maturity, aging. Hygiene of Children and Adolescents deals with the study of the first stage of human development, that is a maturation. The child's body develops in the specific conditions of the social environment, which continuously influences it and determines the course of its development. All manifestations of life, including growth and development, must be considered in connection with the environmental factors affecting it. Therefore, Hygiene of Children and Adolescents faces an important task — not only to determine the conditions conducive to normal growth and development, but also to create these conditions.

Growth and development are two interrelated and interdependent aspects of the same process. *Growth* is a quantitative change associated with an increase in the size of cells and the mass of organs, tissues and the whole organism. *Development* - qualitative changes, morphological differentiation of tissues and organs, as well as their functional improvement. Growth and development proceed unevenly.

The basis of growth and development, as well as the basis of life in general, is the metabolism. It consists of two phases - assimilation and dissimilation. In the body of an adult, these processes are balanced. The metabolism of a growing organism is qualitatively unique. It occurs with a significant predominance of assimilation processes over dissimilation processes. It is necessary for the formation of new cells and the growth of organs. The energy expenditure for increasing the mass of organs is the greater, the younger the child.

The basal metabolic rate in children is relatively higher than in adults. In an adult it is 23 kcal / kg per day, but in newborns it is 38-42 kcal / kg per day. At 1.5 years, the basal metabolism rises to 55-60 kcal/ kg per day, and in subsequent years it gradually decreases.

At the same time, the intensity of basal metabolism within the same age can vary depending on a number of factors: body weight, body surface area, season, living conditions, etc.

The total energy requirement of the body increases with age, while the relative (calculated per 1 kg of body weight) decreases as the growth rate decreases.

Metabolism changes under the influence of endogenous and exogenous factors. An essential role in the regulation of growth and development processes belongs to the endocrine glands. Each age is characterized by a certain ratio of activity of the endocrine glands. The most insignificant violations in the activity of the endocrine glands cause serious metabolic disorders, the process of growth and development.

The leading role in the regulation of metabolism belongs to the nervous system and its higher department — the cerebral cortex. Due to the fact that the metabolism is a basis of growth and development, the nervous system has a regulatory effect on these processes.

In children suffering from a limited lesion of a part of the cerebral cortex, there is a growth retardation of the organ that is functionally associated with the affected part of the cortex. Children with microcephaly lag behind normal children in growth and development.

Exogenous factors affecting metabolism include physical activity, exposure to open air, nutrition, etc. Intense physical activity increases metabolism: board games, sitting at a desk — by 20-50%; manual labor, laboratory work, games of moderate mobility — by 75-125%; walking — by 125-175%; outdoor games, running, lifting on the stairs — by 300-380%.

Being outdoors increases metabolism. Ultraviolet radiation and high degree of air ionization also activate metabolic processes. The most active metabolic processes occur during active movements in the fresh air, so physical culture is an important factor contributing to the growth and development of children.

There are the following patterns of growth and development of children:

1. *The younger the child, the more intensive the growth and development.*

The most intensive growth rates are in early childhood. At the end of the first year of life, body height increases by 47% in relation to the initial one, in the second year of life — by 13% in relation to the first year, in the third year of life— by 9% in relation to the second year. At the age of 3-7, the annual increase in growth is 7.5-5%. In the future, it decreases, increasing during puberty.

The greatest increase in body weight also occurs in the first year of life: at 5-6 months, body weight doubles, at 1 year it increases 3 times. In subsequent years, the intensity of body weight gain decreases and increases again during puberty. The same regularity is observed in the change in the circumference of the chest: in the first year of life, it increases by 1 cm every month, then its growth sharply decreases.

The formation of the musculoskeletal apparatus occurs throughout the entire period of development, most intensively in the first years of life. Bone growth in length occurs first due to the reproduction of cartilage cells and their replacement with bone tissue in the sections adjacent to the diaphysis, and then due to the epiphyseal zone (growth zone). The intensity of bone growth in length decreases with age and stops with the disappearance of the epiphyseal zone.

By the time of birth, only the diaphysis of tubular bones is ossified. The spine is 39% cartilage, while the femoral head and wrist are made entirely of cartilage. In the first years of life, in connection with the development of motor function, intensive ossification and growth of the skeleton occurs.

Morphological maturation of muscle tissue occurs throughout the entire period of maturation of the child and is closely related to the development of movements.

The heart of a child grows almost in proportion to its general growth, i.e., most intense in early childhood. The mass of the heart of a newborn is approximately 25 g, at 1 year it doubles, at 3 years it triples. With age, all dimensions of the heart increase, especially the thickness of the left ventricle. The histological structure of the heart also changes: the diameter of the fibers of the heart muscle increases, the number of nuclei decreases.

2. *The processes of growth and development proceed unevenly*

Each age is characterized by certain anatomical and physiological features. Periods of increased growth do not coincide with periods of increased differentiation: periods of increased growth are accompanied by relatively slow differentiation, and vice versa - increased differentiation will cause growth to slow down.

At the age of 0-2, when the heart grows intensively, and its histological structure changes slightly. The processes of macroscopic growth dominate the processes of histological growth.

In the period of 2-6 years, the processes of growth and differentiation increase moderately.

At the age of 7-10, the volume of the heart and its dimensions gradually increase, there are no significant structural changes in the heart muscle, but the nervous apparatus of the heart reaches a high level of development.

At 11-13 years old, the heart is observed to grow rapidly again, the finest differentiation of cellular structures occurs.

The increase in the mass of the brain and spinal cord basically ends by the age of 8-10, while the improvement of the nervous system takes a long time.

The uneven development also lies in the fact that the growth and development rates of some organs and tissues are not the similar in different periods. For example, an increase in body weight, the weight of the heart and some other organs occurs constantly and relatively evenly, at the same time, the mass of the brain and spinal cord by age 8-10 years almost reaches the mass of these parts of nervous system in adult and their further increase is very insignificant.

Lymphatic tissue reaches its maximum development at the age of 10-12 years, then its involution is observed. The gonads, on the contrary, develop very little until the age of 12-13, but after this age they develop rapidly. The development of different organ systems is not straight and not parallel to each other.

The growth rates of individual parts of the body are also different. This leads to the fact that in the process of growth, the proportions of the body change. The head in newborns is 1/4, and in adults 1/8 of the body length. Over the entire period

of growth, the length of the legs increases 5 times, the length of the arms - 4 times, and the length of the body - 3 times.

Such heterochronism in the development of different morphological formations, and, consequently, their functions, determines age-related anatomical and physiological features.

3. There are some gender differences in growth and development processes.

The main morphological indicators (height, body weight, chest circumference) at average birth in boys are higher than in girls. Such relationships persist until puberty. The period of puberty is accompanied by a sharp endocrine restructuring and significant increase in the processes of growth and development. Length and weight of the body, changes the functional state of organs and systems intensively increase. Sexual maturation in girls is earlier than in boys. In this regard, the growth and mass of girls becomes greater than that of boys. There is an intersection of the physiological curves of these indicators: from the moment of the onset of puberty, the growth of boys increases again and at the age of 14-15 they again overtake girls. Body weight changes similarly. A sharp malnutrition and diseases can change the normal course of the dynamics of these indicators, push back the indicated intersection of the curves. Some functional indicators (muscle strength, lung capacity) in boys remain than in girls throughout the entire period of maturation.

The huge accumulated material on the features of children growth and development made it possible to formulate a general law of individual development - the *law on the reliability of a biological system*. It says, all normally developing and functioning body systems have a wide range of life possibilities. For example, 10 ml of human blood contains such an amount of prothrombin that can cause clotting of all human blood. An excess of prothrombin ensures the reliability of the coagulation system. The wall of the carotid artery is able to withstand a pressure of 20 atmospheres, while in reality it rarely and slightly exceeds 1/3 of an atmosphere. The eye is able to see at illumination from a few lx to 40,000-50,000 lx. Reliability in the activity of the brain is ensured by the presence of inhibition processes, which

play a protective role. There are many such examples. They show that the reserve capabilities of the body's systems are enormous. The reserve capabilities and reliability of the systems ensure the individual development of the organism. In the absence of such reliability of systems, such wide boundaries, the development of the organism would be impossible due to the constant danger of the termination of life.

Basic principles of the reliability of a biological system: 1) superfluity of elements of the regulation and elements of ongoing process; 2) duplication and interchangeability of elements of regulation and process; 3) perfect and rapid return to a state of relative constancy; 4) the dynamics interaction of the system’s elements.

Methods of Evaluation of Children Physical Development

The physical development of children and teens is estimated using the following groups of parameters:

— anthroposcopic (somatoscopic);

— anthropometric (somatometric);

— physiometric;

— data of medical examination.

Anthroposcopic parameters

Anthroposcopy is a visual observation of the children body such as somatic constitution, skin status, body shape and posture type, form of chest, legs, feet, muscular endurance, degree of fat deposition, degree of sexual development, tooth development etc. Information received during anthroposcopy of children allows to obtain the general impression of physical development in contrast to more objective and precise anthropometry which is about the measurement of the children body.

Somatic constitution is not only the actual body type of child, but also the program of his future physical development. Basic constitution types are asthenic, normosthenic and hypersthenic. The proportional constitution smoothed bony prominence (claviculae, spinae iliacae, spinae scapularum, etc.), thickness of the skin fatty fold up to 2 cm is characteristic for the child with a normal constitution and satisfactory nourishment. Children have clearly expressed bony prominences,

the thickness of the fold does not exceed 1 cm. Well-nourished children have smoothed bony prominences, significant thickness of skin fatty fold. The chest can be normal, conic, cylindrical, infundibular, rachitic in shape. The legs can be normal, O-shaped or X-shaped. The back can be estimated as round, flat or normal. Physician should assess expression of physiological curvatures (cervical and lumbar lordosis, thoracal kyphosis), presence of pathological curvatures of a backbone (hyperlordosis, hyperkyphosis, scoliosis).

Posture evaluation

Posture is an essential aspect of a child's life. A good body posture will bless the child with higher energy levels, confidence, and prevents injuries. When children are in growing stages, it is essential to focus on their posture as their bones and muscles remain in a developing stage.

A bad posture can lead to abnormal growth of the spine and other parts, increasing the possibility of arthritis later in life. On the other hand, a good posture will not only keep their body aligned but will also reduce the risk of degeneration. There are other benefits also that will pay off throughout their lifetime.

A posture depends on the spinal shape, muscular tonus and uniformity of development. There are several types of the posture: correct (balanced), slouchy, lordotic, kyphotic and upright.

In *correct (balanced) posture* in side view, the plumb line (line of gravity) should pass through the following points: ear canal, midway through the shoulder, bodies of the lumbar vertebra, hip joint, knee joint, and just in front of ankle. If the posture is correct the body is straight, the stomach is gathered, the head is raised with square shouldered at the same level. The depth of the cervical and lumbar flexure is 3-4 cm (in juniors), and 4-4.5 cm (in the middle and senior schoolchildren).

Lordotic posture (sway back). Normally, the spine is slightly curved in the neck, upper back, and lower back. The curves (figure 1) creating spine's S shape are called the lordotic (cervical and lumbar lordosis) and kyphotic (thoracic and sacral kyphosis). They help a body absorb shock, support the weight of the head, align your head over your pelvis, stabilize and maintain its structure, move and bend flexibly.

But if the normal lordotic curve arches too far inward, it's called lordosis, or swayback. Lordosis affects a lower back and neck: lumbar flexure is significantly increased with simultaneous cervical flexure. The upper part of the body slightly projects backwards and belly projects forward.

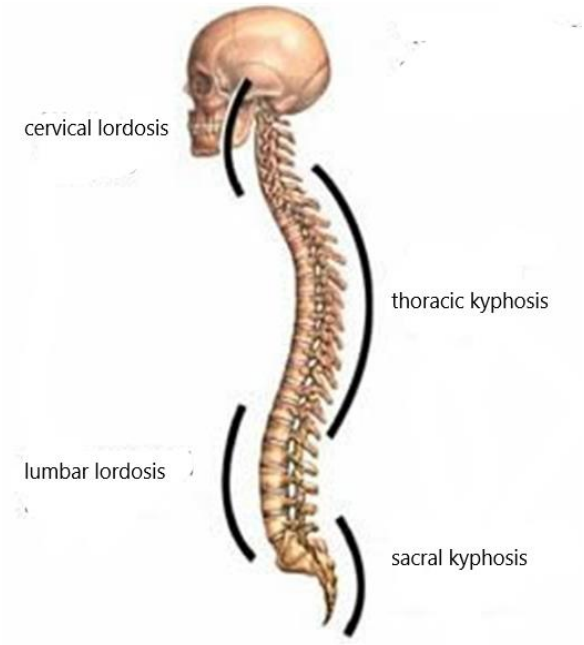

Figure 1. The four normal curvatures of the spine: cervical and lumbar lordosis, thoracic and sacral kyphosis

Kyphotic posture. There are two types of kyphotic posture: round back and slouch. In children with kyphosis, the spine curves outward more than it should. The cervical and lumbar flexure is significantly increased. The head and shoulders are kept down. As a result, the upper back looks overly rounded. The abdomen projects forward from the body. Excessive curvature can make standing difficult.

In *slouched posture*, the thoracic curve is also increased backward and the lumbar curve is increased forward. A round back has the same changes, but at the same time, the center of gravity of the body shifts in a person, and in order to restore balance, he needs to walk and be on his legs bent.

In upright (flat back) posture all physiological flexures are flattered. The back is severely straight. The chest projects forward from the body. Note in flat back posture, the entire body leans forward, which is an unstable position and causes

tightness in the back muscles trying to keep the body from falling further forward, and weakness in the front muscles that are underused.

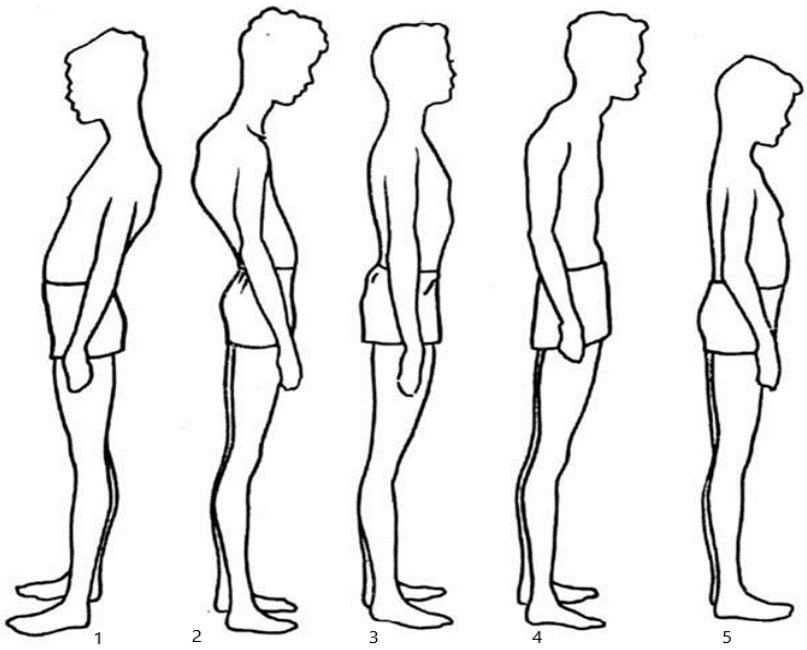

Figure 2. Types of postures: 1) lordotic (sway back); 2) kyphotic;3) correct (balanced); 4) slouched;5) upright (flat back).

Scoliosis is a deformity of the backbone (spine), when the spine has a side curve (Fig.3). The normal spine appears straight when viewed from behind. But in a child with scoliosis, the spine is S- or C-shaped.

Figure 3. C-shaped scoliosis in child

In addition, the following are the most common symptoms of scoliosis:

— difference in shoulder height;

— the head not centered with the rest of the body;
— difference in hip height or position;
— difference in shoulder blade height or position;
— difference in the way the arms hang beside the body when the child stands straight;
— difference in the height of the sides of the back when the child bends forward.

Sexual development evaluation

For an estimation of sexual development of the girls the development of following secondary sexual signs is used: Ma — mammary gland, Ax — axillary pilosis, P — pubic pilosis, Me — menarche. For examination boys the development of the following secondary sexual signs can be used: Ax — axillary hair, P — pubic hair, F —face hair, V —change in voice, L — prominence of the larynx (more commonly known as the Adam's apple).

Degrees of development secondary sexual signs:

— mammary gland development: Ma_1 — edematous areola and increase of its sizes, under the nipple a small site of a mammary gland tissue; Ma_2— conic breast, the areola is pale, the nipple is flat; Ma_3 — form of the breast is hemispheric, the areola is pigmented, the nipple is towers above it;
— age of first menses (Me_{11}, Me_{12}, Me_{13});
— axillary zone: Ax_0– no hair growth in the armpit; Ax_1 — a single direct hair in the armpit; Ax_2— sparse hair on the central part of the armpit; Ax_3 — thick straight hair throughout the armpit; Ax_4 — thick curly hair throughout the armpit;
— pubic zone: P_0 – no hair growth in the pubis; P_1 — a single straight hair in the pubis; P_2 — sparse straight hair at the base of the penis; P_3 — thick straight hair over the pubic zone without clear boundaries; P_4 — thick curly hair over pubis in the form of a triangle; P_5 — thick curly hair extending to inner thighs, and to the navel;

— facial hair: F_0 – no hair growth; F_1 — growth of single hairs above the upper lip; F_2 — coarse hairs above the upper lip, appearance chin hair; F_3— widespread hair growth above the upper lip, on the chin, the beginning of the growth of sideburns; F_4 — merging of hair growth zones above the lip and in the chin area, pronounced growth of sideburns; P_5 — merging all areas of facial hair;

— growth of the thyroid cartilage of the larynx: L_0 — no signs of growth; L_1 — beginning protrusion of the thyroid cartilage L_2 — distinct protrusion of Adam's apple;

— changing of the voice timbre: V_0 — children voice; V_1 — mutation (breaking) of voice; V_3 — male voice timbre

Anthropometric parameters

Height is measured with the help of the stadiometer. The back of the head, interscapular region, buttocks, and heels should be touching the upright. The top of the tragion and the lower edge of the eye-pit should be in the one horizontal plane. To study the body proportions sitting height is measured, for this standard height meters have tip-up seats.

Weight is measured with the medical scales in the fasted state. The person under examination should stand quietly in the center of the scale platform. Weighing in clothing or shoes is not allowed.

Diameters are measured with the help of the caliper.

Thoracic diameter (anterior-posterior and transverse) is measured by the caliper. For measuring anterior-posterior diameter one leg of the caliper is fixed by fingers on mid-sternal point (it is located at mid-sternal line on the level of the top of the IV rib), and on the backbone on the same level.

For measuring transverse thoracic diameter both legs of the caliper are fixed on the mid-axillary lines on the level of mid-sternal point.

Chest breadth is measured by comparing anterior-posterior and transverse diameters. If the difference between them is less than 3 cm, the chest is narrow. If the difference is more than 5 cm, the chest is broad.

Shoulder diameter (biacromial) – is the distance between shoulder points. For measuring shoulder breadth both legs of the caliper are put on acromial process of scapulars. To ensure that the caliper legs are placed properly but not on the head of humerus the persons under examination are offered to rotate their arms. In this case only the heads of the humerus will rotate not the places where the caliper legs are put on should be stable.

For measuring *pelvic width,* the caliper legs are fixed on iliac bone ridges at the widest part of the body.

Circumferences are measured with the metal tape or the measuring tape.

Chest assessment is one of the basic signs of harmony of physical development. It characterizes body capacity, pectoral and dorsal muscle development, as well as functionality of thoracic organs.

Chest circumference is measured with the tape at quiet breathing state (in pause), and during maximum inhalation and exhalation. Chest rise is a difference between inhalation and exhalation findings. The tape should be put on inferior angles of the scapulars and at the level of the nipples (in young children and males) or on the level of the fourth rib ends at the breastbone (in young females). It needs to begin with measuring chest circumference in pause, it would be better to talk to an individual at this moment to take his attention off. Then chest circumference during maximum inhalation and exhalation is measured. All of these measurements should be done at one take of the tape. Arm circumference is measured in a state of maximum tension and relaxation. It begins with measuring of a shortened arm in the widest part in a state of maximum tension. Then arm circumference is measured when the arm is relaxed and down. The result is recorded in fractional form: arm circumference in tension as a numerator; arm circumference in a relaxed state as a denominator. The difference between these two numbers is usually called *spread of shoulders*.

Forearm circumference is measured with the tape at the widest part of the arm. The arm is relaxed and down.

Waist circumference should be measured at the narrowest waist point over iliac crest with the tape all around the body horizontally.

Abdominal circumference is measured with the tape at the navel level or, if a person is obese, at the level of lumbar vallecula (on the back) and at the widest place of the belly.

Hip circumference is measured standing with leg position at shoulder length. The tape is placed horizontally under gluteal fold.

Calf circumference is measured in the same position (legs at shoulder length). The tape is fixed on the widest part of the calf (calf muscle).

Physiometric parameters

Lung capacity is measured with the spirometer. At first participants need to inhale and exhale, then take the deepest inhale and exhale into the sensor. After the measurement has taken 3 times the best result is recorded.

Arm muscle strength shows a degree of muscular development.

Hand grip strength is measured with the hand dynamometer. A person should take the dynamometer with the dynamometer index towards the palm. Then they should put out their hands and grip the device with the right and left hand each after other with maximum force.

Back strength is measured with the torso dynamometer which is set at the knee level. A person under examination should extent his knees with maximum force but without abrupt movements. Legs should not be bent at the knee joint.

Physical development evaluation methods include: sigma deviation methods, regression scales methods, complex method, and centile method.

Sigma deviation method (anthropometric standards). It is based on comparing each individual index of physical development with weight-average findings for this index at certain age/sex. These weight-average finding tables are obtained by screening programs of different age/sex groups in certain region every 7-10 years. Obtained data is processed by variational statistic methods. As a result, average value (M) and a value of mean square deviation – sigma (σ) are found. Anthropometric parameters of children are compared with average value (M) and

the difference is found (with sign + or –). This difference is divided by σ which is the criteria for difference assessment. The conclusion about the level of physical development can be made according to the level of sigma deviation. Physical development is considered to be average if individual index corresponds to M or differs from it in one sigma. So, a distinction is made between following levels of physical development:

— high, more than M+2 σ;

— above average, within M+1 σ and M+2 σ;

— average, within M±1 σ;

— below average, within of M–1 σ and M–2 σ;

— low, less than M–2 σ.

It should be noted that method of sigma deviations has a fundamental defect as the connection between separate indexes of physical development (weight and length, weight and chest circumference) is not taken into consideration.

Regression scale evaluation method. Regression scales are based on the calculation of the correlation coefficient between anthropometric indicators. It is known that the main indicators of physical development (length, weight, chest circumference) are directly related to each other, that is, when one indicator changes, the other also changes. The regression scale method allows assessing the level of physical development according to individual data, as well as taking into account the relationship of these data. Therefore, this method is also called the correlation method. Given the fact that height data are more stable than body weight and chest circumference data, body length is used as the main result. Thus, the size and degree of the ratio of chest circumference and body weight in a certain age group depends on the change in height by 1 cm. These measurements are considered a regression coefficient ($R_{x/y}$). The regression coefficient shows how much the parameter of child's body changes when the body length changes by 1 cm. The regression coefficient is calculated on the basis of the correlation between body length and other indicators. The regression coefficient is an integral component of the standard regression scales. The regression scale is designed in a form of a table, in which it is

calculated in advance what should parameter of physical development be when body length is changed by 1 cm. If the child's body weight (or chest circumference) does not correspond to his body length, then in order to determine the degree of disharmony of development, it is necessary to compare the individual absolute deviation (d) of the feature with the regression coefficient's sigma (σ_R).

The assessment of the harmonicity of child's physical development is performed as follows. The individual deviation of body length (d) is multiplied by the regression coefficient ($R_{x/y}$) for body weight (or chest circumference, or other parameters of child's body), taking into account the math sign "+" or "-". The resulting number ($R_{x/y}d$) shows how much the child's body weight (chest circumference or other parameters) should differ from the average value calculated for children of the same age. If $R_{x/y}d$ is positive, then it is added to the average value of the body mass and the body mass corresponding to the body length is obtained. If $R_{x/y}d$ is negative, then it is subtracted from the average value of body weight. The proper body weight is compared with the actual one and it is determined by how many kilograms the child's body weight is less (or exceeds) the required one (according to the body length). The resulting difference is divided by σ_R. Development is considered harmonious if the difference between the required and actual value of the parameter of child's body does not exceed one σ_R.

Complex method. Complex method of children's physical development assessment includes both evaluation of biological age and peculiarities of morphological and functional state of the child's body.

Chronological age is a passport age. It is calculated as a difference between the date of birth and the date of the study. Criteria of biological age of a school-age child are following: body height, annual increase in body height, number of permanent teeth, degree of sexual development, and skeletal age. The last criterium includes assessment of ossification points by comparing the obtained X-ray film of the hand and wrist with the standard. The prevail indicators of biological development in early and pre-school age are the level of neuro-psychological development, period of eruption and change of deciduous teeth, body height and

annual growth. In early school age — the body height, annual growth and number of permanent teeth. In middle and senior school age — ossification of hand and wrist and also degree of sexual development.

Level of physical development according to the body length may be determined using regression scales or method of sigma deviations.

Centile evaluation method. Physical development can be assessed according to centile scales (Table 2). No less than 100 people of different age and sex are examined, and then all results of each finding (height, weight, chest circumference) are arranged in ascending order and divided by 100 intervals (centiles).

Table 2

Supporting table for screening assessment of physical development

Body length centile lines	Centiles	Centile corridors (zones)	Weight centile lines							
			Centiles							
			3	10	25	50	75	90	97	
			Centile corridors (zones)							
			1	2	3	4	5	6	7	8
	3	1	Low length Low weight	Low length Under-weight	Low length	Low length	Low length	Low length	Low length Increased weight	Low length Large weight
	10	2	Reduced length Low weight	Reduced length Under-weight	Reduced length	Reduced length	Reduced length	Reduced length	Reduced length Increased weight	Reduced length Large weight
	25	3	Low weight	Under-weight	NORMAL PHYSICAL DEVELOPMENT				Increased weight	Large weight
	50	4	Low weight	Under-weight					Increased weight	Large weight
	75	5	Low weight	Under-weight					Increased weight	Large weight
	90	6	Low weight	Under-weight					Increased weight	Large weight
	97	7	Low weight	Under-weight					Increased weight	Large weight
		8	High length Low weight	High length Under-weight	High length	High length	High length	High length	High length Increased weight	High length Large weight

It is usually used only seven fixed centiles to characterize range ordering of each physical development traits in centile scales (P–3, P–10, P–25, P–50, P–75, P–90, P–97). Intervals between centile probability are called “centile corridors (zones)”, each of them corresponds to certain level of physical development. After

the measurement procedure zone of measurement results (centile corridor) is found; physical development assessment is placed on the crossing of height value and age, weight and height. Position of measurement results at the 2nd interval zone means “reduced” parameter, at the 1st interval zone – “low” parameter, at the 7th interval zone – “increased” parameter, at the 8th interval zone – “high” parameter. The worst indicator of physical development is low height and low weight (1st zone), large weight (8th zone) at any length of body.

Hygiene of Children Educational Establishments

Kindergarten

Kindergarten is an institution of preschool education. In Ukraine there are both types of kindergartens — private and governmental. They should be placed in the residential area far from sources of noise and pollution. Area size is determined by the number of children. If a kindergarten has up to 160children so area for each child should be 45 m^2, if more — 35. A kindergarten serving area has a radius of 300 m. The area is subdivided into such functional zones: economic (includes warehouses, garage, boiler building, laundry, kitchen), the zone of playgrounds, the zone of vegetations and zone of kindergarten building. The kindergarten area should have 2 entrances as minimum. Percentage of building area does not exceed 25%, minimum percentage of the area occupied by vegetations is 55%. The maximum quantity of floors for kindergarten building is 2. Premises for children of young age should be placed at the ground floor.

The kindergarten building should have centralized water supply (in the country — local water supply system), sewage disposal. They provide kindergarten with hot water (autonomic boiler or two independent intakes of hot water pipes.

The main principle of building planning is «group isolation”. It means that every age group has own set of premises. In the observation it makes possible do not close kindergarten. A set of premises includes a dressing room, a group room (used as a dining-room and class room also), a bedroom, a service room and lavatory. Every “group section” has two entrances — one to the street and another — to

internal corridor of the kindergarten. If two groups have common exit, they should use it by the schedule. Toys in the group room should be according to the children's age. It's prohibited to use toys from the other groups. Every week all premises should be washed with disinfectants, regular cleaning is made 3–4 times during a day. Disinfectants are changed every 7 days, laundry — every 10 days. Drinking water for children should be stored in the group, it's forbidden to use tap water for drinking. Children eat in the group room, after every meal all dishes are washed and disinfected.

A medical room should have an isolator. It's situated at the ground floor and has a separate exit to the street. If they inoculate children in the kindergarten (not in the polyclinic), all vaccines have to be stored in the refrigerator. The temperature inside a refrigerator should be no more than +5°C, it's measured daily and data are recorded in the special register. Also, the nurse of the kindergarten has a register of anthropometry and complete set of medical documentation (individual charts of children and medical books of staff). Every morning before reception to the group the nurse inspects children for signs of infection (fever, coughing, rhinitis, rash, etc.). Data of examination are recorded in the register.

Demands to personal hygiene of staff and children are very strict. A staff person should be ensured that a child's hands are washed before meals, snacks, after toileting and after being diapered. Cloth towels and washcloths should be labeled with the child's name, used only by the named child and washed weekly. The operator shall arrange a laundry schedule with the parent. Paper towels may be used as towels and washcloths. Paper towels should be discarded after each use. A child shall have a labeled toothbrush. Toothbrushes should be stored with the bristles up and exposed to circulating air. Paper cups for drinking water are discarded after one use, or water fountains should be used for between meal drinking by children who are not bottle-fed. Lavatory for staff should be isolated from children's lavatories.

School

Good health is essential for learning. Health is not only the absence of disease but also complete physical, mental, and social well-being. When school aged

children are not in good health, they become distracted, unable to concentrate in school, keep up with their demanding schedules, and sometimes even unable to attend school. Years ago, the biggest threat to the health of school children came from contagious diseases such as tuberculosis, diphtheria, measles, mumps, and rubella. Today most health risks have their roots in social or behavioral conditions. When these problems emerge, they can disrupt students' lives, classrooms, and the school environment. When students are sick, distracted, or absent, schooling becomes ineffective. For students to become productive, responsible citizens, schools must help them develop health-promoting skills and behaviors and attend to the physical, mental, and social components of their lives. For the past decade, education and health experts have suggested that a coordinated school health program that goes beyond classroom instruction and integrates eight components in the most efficient way for schools to ensure the health of their students. There are:

— *Comprehensive School Health Education*. This classroom instruction addresses the physical, emotional, and social dimensions of health; develops health knowledge, attitudes, and skills, and it's tailored to each age level. It is designed to motivate and assist students to maintain and improve their health, prevent disease, and reduce health related risk behaviors.

— *Physical Education*. This instruction that promotes lifelong, safe, physical activity. It is designed to develop basic movement skills, sports skills, and physical fitness, as well as to enhance social and emotional abilities.

— *School Health Services*. These are preventive services, education, emergency care, referral, and management of acute and chronic health conditions. They are designed to promote the health of students, identify and prevent health problems and injuries, and ensure care for students.

— *School Nutrition Services*. These services integrate nutrition education, nutritious and appealing meals, and an environment that promotes healthy dietary behaviors for all children. They are designed to maximize each child's education and health potential for a lifetime.

— *School Counseling, Psychological, and Social Services*. These activities focus on the cognitive, emotional, behavioral, and social needs of individuals, groups, and families. They are designed to prevent and address problems and to facilitate learning and healthy behaviors and development.

— *Healthy School Environment*. This is the physical, emotional, and social climate of the school. Designed to provide a safe physical plant as well as a healthy and supportive environment that fosters learning.

— *School-Site Health Promotion for Staff.* This includes assessment, education, and fitness activities for school faculty and staff. It is designed to maintain and improve the health and well-being of school staff who serve as role models for students.

— *Family and Community Involvement in Schools.* These are partnerships among schools, families, and community groups and individuals. They are designed to share and maximize resources and expertise in addressing the healthy development of children, youth, and their families.

Schools have evolved from purely educational facilities into sources of employment, social and health services, cultural opportunities, and recreation and entertainment for their surrounding communities.

A healthy school environment encompasses both the physical and psychosocial surroundings in which students and school personnel are expected to work. A healthy school environment supports learning and contributes to students' health by: minimizing distractions; minimizing physical, psychological, and social hazards; creating a climate in which students and school staff do their best work; expecting that all students can succeed; implementing supportive policies.

The physical school facility represents the external, tangible environment. Physical conditions can include school bus safety, adequate water and classroom supplies, physical security of the building, as well as acoustics, ventilation, heating and air conditioning, and lighting. As mentioned before, at least half of the nation's public schools contains an environmental hazard, such as asbestos, contaminated water, or poorly ventilated indoor air. Psychosocial conditions, on the other hand,

encompass the attitudes, feelings, and values of the students and staff and may require more extensive changes. The presence of gang violence as well as weapons, drugs, alcohol and tobacco on school grounds contribute to this aspect of a school's environment. Class size and the availability of community-based extra-curricular activities also facilitate the psychosocial environment of a school. To ensure healthy development, a number of model health practices can be integrated into core curriculums. For instance, schools could promote participating in active lifestyles, eating well-balanced meals, abstaining from alcohol, tobacco and other active drug use, and minimizing risk-taking behaviors, including sexual activity.

Equally important are student and staff perceptions of the interactions that take place within the school environment. This less tangible component of environmental health is frequently referred to as school climate. Climate encompasses both social and physical elements, and creates an infrastructure that makes physical, social and emotional health.

Ergonomic studies comprised scholar adaptability and scholar's psycho-intellectual capacity, approaching issues of mental load and psychological fatigue. Specific investigation methodology was established and evaluation criteria of adaptability and mental fatigue were structured. Scholars' psychological limits are conditioned by their functional particularities of nervous system and sensorial and motor abilities. Disregard of these limits makes improbable determination of scholar activity dysfunction.

Studies of secondary and high school pupils revealed that normal physically and psycho-intellectual developed students showed both objective (cardiovascular, muscular, sensorial indicators) and subjective (health status self-evaluation) modifications that demonstrate scholar fatigue. Collective administration of anxiety test Cattel showed increased anxiety on the studied group indicates disorders varied from mild anxious neurosis to severe anxious neurosis that requested psychiatric assistance. Relation between high school performance with high level of anxiety in schoolgirls has been demonstrated.

Study of knowledge functional modifications indicators (attention tests, test on work capacity) has showed modifications in work capacity curve even in the conditions of reduction of working week from 6 to 5 days. Previous studies showed that the academic performance increases from Monday through Wednesday, under the new conditions Tuesday is the maximum, starting Wednesday performance decreases gradually, so that on Friday it is the lowest.

Study of time allocation revealed manifestations of overload syndrome on the account of scholar manuals, subject's planner both saturated with information, data, and inappropriate structure of scholar schedules. Another finding of our researches was scholar maladaptation syndrome considered as a form of social maladjustment that creates premises for further difficult integration. Children's confrontation with scholar demands generates typical sets of attitudes that lay at the basis of behavioral changes, related to the pupils. The level and establishment of scholar education are significantly influenced by definitory variables for socio-familial environment especially cultural factors and mainly the level of parental instruction. The study on pupils who were institutionalized since pre-school period and now attending mass general schools, disclosed a decreased level of adjustment to scholar demands, situated 0–12 months below normal.

Inclusion of these children into mass general schools has had an obvious benefit input towards their IQ which became 10–20 points greater than a pre-school period scores (93.8 in first grade of school over 82.5 in pre-school). Acquisitions on speech level are shown by increased values of IQ in the first and second grade of primary school (97.2 and 92.8). Delayed behavior and psycho-intellectual development of institutionalized children are explained by the monotony of life conditions, lack of exercise, the absence of individualization in care and education, insufficient development of affective and social contact, lack of warmth from care staff, lack of contact between children who play one next to another and not one with other. Researches need to be orientated in the future, with priority, towards the activity that implies a high level of mental load and a high volume of abstract and creative thinking.

School building should be placed in the residential area far from sources of pollution. The service area has 500 m in radius, for lyceum and colleges — without limits. School area has from 0.5 to 3 ha and is subdivided into economic zone, zone of vegetation, zone of sports grounds and school building zone. The built area can occupy up to 25% of school area, vegetation takes 55% as minimum. Sports zone takes about 30% of the area. In Ukraine it is established that maximum height of school building is 3 floors. School building has two or more entrances.

There are three architectural systems of school building:

a) centralized (all premises are situated in one building); it is typical for the most urban schools;

b) decentralized (school has some buildings: for primary school grades, secondary school grades, catering unit, administrative unit, sports unit, dormitory (hostel) for board schools, etc.);

c) combined (has features of the both systems).

School should be equipped with systems of water supply, sewerage, gas and electricity. Primary grades classrooms are placed at the ground floor; their area is 2.4 m^2 per one pupil. For secondary school this ratio is 2.4 m^2 per one pupil in general classrooms and 2.8 m^2 for educational laboratories. The height of school premises should be no less than 3.5 m. For classrooms of chemistry, biology, informatics, physics two premises are used (study room and laboratory, server room for IT class).

Ventilation volume in classrooms should be 20-30 m^3/hour per 1 child. Carbon dioxide concentration in the air should not exceed 0.1 %. Chemistry laboratory should be equipped with a local exhaust ventilation and placed on the upper floor of the school building.

Quality of classrooms' illumination should meet hygienic standards. Hygienic requirements to natural lighting: lighting coefficient 1:4-1:5, daylight factor – 1.25-1.5%, depth factor – no more than 2; angle of incidence – no less than 27º, angle of aperture – no less than 5º. Hygienic requirements to general artificial illumination: 150 lx (incandescent lumps), 300 lx (luminescent lamps).

Requirements to school sports hall. It should be located on the ground floor in pavilion construction system, in a separate block in block-system of construction. Its area should be 4 m^2 per 1 pupil, height – 4.5-6 m; there should be a locker room and a room for keeping sports stock. Peculiarities of microclimate: the air temperature should be 16ºC to prevent overheating of children at intensive physical activity; ventilation rate should be 4-5 per hour.

Requirements for school desks. Desks in a classroom should be placed in 3 rows, with distance of 0.7 m between rows, 2.5 m between the 1st desk and the blackboard, and 0.5 m to the walls. The *school furniture* should be ergonomic, that is must comply with children height. Main sizes of school furniture:

— *Differentia* is a distance between table and chair by the vertical; it should be equal to distance from the child's elbow to the seat plus 5-6 cm for free movement; high differentia causes right-side scoliosis development; low differentia leads to left-side scoliosis;

— *distance of the seat's back* is a distance between back edge of the table and back of the chair;

— *distance of seat* is a distance between the front chair's edge and the projection of edge of the table's back on the chair surface); it should be always negative (2–3 cm) when child performs written work; when distance of seat is positive it causes thoracic hyperkyphosis formation;

— *deep of the seat* is a distance between the front edge to back edge of seat; it should be ⅔ – ¾ of the hip's length; very deep seat causes compression of the neurovascular bundle of the popliteal fossa, which leads to numbness, paresthesia and pain in legs, impaired blood circulation, edema; small deep od the seat changes the center of body's gravity and causes overstrain on the back muscles;

— *height of the chair's back* should meet the level of lumbar spine and provide the support for the thoracic spine;

— *angle of the table surface* should be 15° to ensure the optimal distance to the book (30-35 cm) and the minimum tilt of the head; it ensures stable accommodation and prevents the development of myopia.

Sizes of school furniture should meet the children height (Table 3).

Table 3

The Sizes of School Desks

Grade	Pupil's height	Sizes and color of marking
1	Up to 115 cm	1-orange
1 - 3	115 to 130 cm	2-violet
2 – 6	130–145 cm	3-yellow
4 -12	145–160 cm	4-red
7-12	160–175 cm	5-green
9-12	176 cm and more	6-blue

There are 6 groups of school furniture, which are marked with the colored ring (diameter 25 mm) or strip (20 mm width). Size's number can be calculated by the equation: N = (body height-100)/15 + 1. For example, child 148 cm height need 4^{th} size furniture with red marking: N = (148-100)/15 + 1 = 4.2 ≈ 4.

School Syllabus. The hygienic organization of education at school is aimed at the saving the working capability during the whole working day, to remove the fatigue, i.e., to make this work hygienic and pedagogically effective. Working capability is the state of the children body in which he/she is able to perform a given educational work with the parameters established by the requirements. The following preventive measures can be used in order the working capability has been achieved:

1) the correct organization of the lesson;

2) the regulation of the total number of lessons per day and per week:

3) the regulation of the duration of lessons, breaks and homework:

4) the rational construction of classes during the day and week;

5) the regulation of number and of duration of holidays.

Weekly working load. The weekly working load of school students should be determined by the school curriculum. The maximum permissible workload depends on the schoolchildren grade and duration of working week. For a 5-days working week it should be: 20 hours in grade 1st; 22 hours in grade 2nd; 23 hours in grades 3rd and 4th; 28 hours in grade 5th; 32 hours in grades 6th and 7th; 33 hours in grades 8–12th.

Duration of lessons and breaks. Optimal duration of a lesson in the 1st grade should not exceed 35 minutes. The best regimen for the 1st grade pupils is the following: 3 classes 30 min each in September and October; 4 classes 30 minutes each in November and December, and 4 classes 35 minutes each from later. Short breaks during lesson are used for fatigue prevention. Should be a minimum work complexity on Monday and Friday and the maximum — on Wednesday. It is very important to change kinds of children activities: intellectual work should be exchange by the physical work. For example, mathematic, foreign language, physics, chemistry, and other intellectually loaded subjects should be alternated with the drawing, physical culture lessons or labor training classes.

It was shown the working capability of children is low in the morning. This is a first phase of work — inclusion into the work (Figure 4).

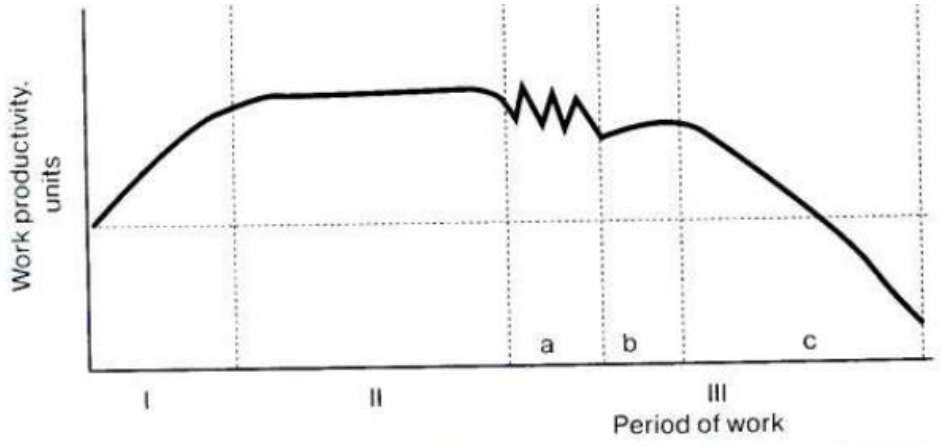

Figure 4. Dynamic of working capability in children and adolescents: I phase — inclusion into the work; II phase — high and stable working capacity; IIIa phase — unstable working capability; IIIc phase — temporary increasing in working capability; IIIc phase— drastically drop in children' working capability.

In this phase, quantitative (speed and volume) and qualitative (number of errors) indicators of lessons or and down, before each of them reaches its optimum. At the end of 1st class working capability rises and stay high during 2nd and 3rd classes— this is a phase of high (optimal) working capability, when work speed and volume became high and number of mistakes reduces. After 3rd class working capability became instable and then drastically reduced in 4th and 5th classes. Only in children of middle and senior school age the working capability getting better in 5th class due to the inclusion of compensatory mechanisms; in 6th class it drops. The low efficiency of the 6th lesson is confirmed by numerous studies.

It is forbidden to place difficult subjects after sports classes, in 1stlesson and in last lesson. It is necessary to avoid doubling of lessons. The breaks between classes should be no less than 10 min, and 30 min break — for lunch. For children rest recreation premises should be organized. The optimal number of students in a class should be 25.

Homework. Homework is an important part of the learning process, and you should expect to have homework assignments each day. On the average, students in grades 5 and 6 should expect 1 to 1.5 h of homework each night; students in grades 7 and 8 should expect 2 to 2.5 h of homework each night. Summer reading assignments will be the only ones required during vacation time. Homework assignments may require reading and/or writing. Sometimes you will need to spend time reviewing classroom assignments material so that you are prepared for quizzes and tests. You will also be given some long-term assignments like special projects and reports. Learn to tackle these assignments by doing a little each day instead of waiting until the last minute. It would be helpful for you to block out your work time on a calendar for long-term projects. Budgeting and organizing pupil's time are very important skills which he/she should develop during school years.

Organization of children' work with computers

IT products certification. Computer products should be certified in accordance to the TCO standards (was initially created by the Swedish Confederation of Professional Employees). Certification guarantee that computer products maintain

ecological standards and were sufficiently ergonomic to prevent long term health issues for users' electronics.

TCO Certified includes a comprehensive set of sustainability criteria that cover social and environmental responsibility in the supply chain and throughout the product life cycle. Criteria go beyond legislation and industry standards and cover hazardous substances, circularity, socially responsible manufacturing, environmentally responsible manufacturing, and much more. To drive incremental change and push sustainability where it matters most, a new generation of criteria is released every three years. There are 8 groups of criteria. All of them are mandatory— certified product models must meet all criteria.

Criteria of protecting the health and safety for users includes:

— electrical safety;

— electrical insulation and other arrangements must be in place to prevent the user from touching live components;

— specific absorption rate measurement is a measure of the rate at which energy is absorbed per unit mass by a human body when exposed to a radio frequency electromagnetic field. It can also refer to absorption of other forms of energy by tissue, including ultrasound.

— reduced specific absorption rate values to minimize electromagnetic energy absorption into human tissue;

— acoustic noise;

— limited acoustic noise levels for user comfort;

— acoustic impulse test;

— protection against high sound levels and sound spikes;

— alternating electric and magnetic fields;

— reduction of electromagnetic fields;

— vertical tilt and height;

— it must be possible to tilt the computer display;

— individual adjustment and adaptation;

— headsets must be adjustable and adaptable for user comfort.

Workstation ergonomic

The top of monitor should be approximately on the eye level and illuminated by the indirect light. The elbow angle should be physiological (70–90°) and wrist angle does not exceed 10°. The chair should support the correct posture — horizontal hip and knees bent at an angle 90° or more. Feet should be located on the floor or foot rest.

School maturity

Before a 6 years old child is admitted to Ukrainian primary schools, the school maturity is checked. *School maturity* is a complex characteristic of readiness for learning at school. To evaluate school maturity following criteria are used:

1) medical:
   - number of permanent teeth;
   - level of physical development;
   - state of child's health;
2) psychophysiological:
   - express Kern-Irasek test to assess the level of mental development, the degree of maturity of motor skills and thinking;
   - quality of sound pronunciation;
   - development of the muscular-ligamentous apparatus of the hand by using a monometric test "Cutting a circle";
   - level of memory and thinking.

The indications for delay of school are as following: absence of the permanent teeth; body length less than M–1σ (by local standards); annual growth less than 4 cm per year; infectious hepatitis; pyelonephritis, diffuse glomerulonephritis; myocarditis (nonrheumatic); epidemic meningitis, meningoencephalitis; tuberculosis; rheumatic fever blood diseases; frequent respiratory viral diseases (more than 4 times per year); vegetative disfunction syndrome; valvular defect (congenital or rheumatic); chronic bronchitis, bronchial asthma, chronic pneumonia (if it's exacerbation or there is no steady remission in the year); ulcerous diseases of

the stomach or duodenum, chronic gastritis, chronic gastroduodenitis (in aggravation stage, with frequent relapses and with uncomplete remission); anemia (Hb 8.0–10.7g%); adenoid vegetation of III degree, chronic adenoiditis; hypertrophy of faucial tonsils of III degree; endocrinopathy, goiter, diabetes mellitus, etc.; neurosis (logoneurosis, hysteria, etc.); retardation of the mental development; child's cerebral paralysis; trauma of the cranium; epilepsy; enuresis; eczema, neurodermitis (if there are widespread skin lesion); myopia with progressing tendency (> 2.0 D).

The study should be held twice a year (at the beginning and at the end of the year). Children with deviations in health, lagging behind in school maturity, constitute a risk group of unpreparedness for schooling. If school immaturity, determined a year before school, persists until the start of the school year, it is necessary to postpone school entry and keep the child in kindergarten for another year.

Kern-Irasek test. Equipment: sheet of paper (A4), cards 8×14 cm with the inscription: "He ate soup" (letter height 1 cm, capital letter height 1.5 cm) and grouped dots (the dots have a diameter of 2 mm, the horizontal distance between the dots and 1 cm vertically). The child is given a sheet of paper. The pencil is placed so that the child can easily take it with his right or left hand. The child is instructed to: 1) draw a person as best you can; 2) copy words; 3) copy points. Other clarifications, help or remarks are prohibited. If the child cannot start the work, the researcher can cheer him up like this: "Good. You have started very well. Keep drawing." If the child wants to draw a woman, the researcher should explain to him/her that everybody draws a man and he/she must draw a man.

Evaluation (figure 5): the best result is 1, the worst — 5 scores (by every subtest). If the child has more than 9 scores, he is unready for school.

To estimate the quality of pronunciation, a child is asked to call the subjects (on the pictures) in whose names the following sounds are used: "l", "r", "s", "th", and "z". Each of the sounds would be used at the beginning, in the middle and the end of the word. All the faults in pronouncing the word are recorded. The existence

of the defects in pronouncing at least one of the above-mentioned sounds means that the task hasn't been fulfilled.

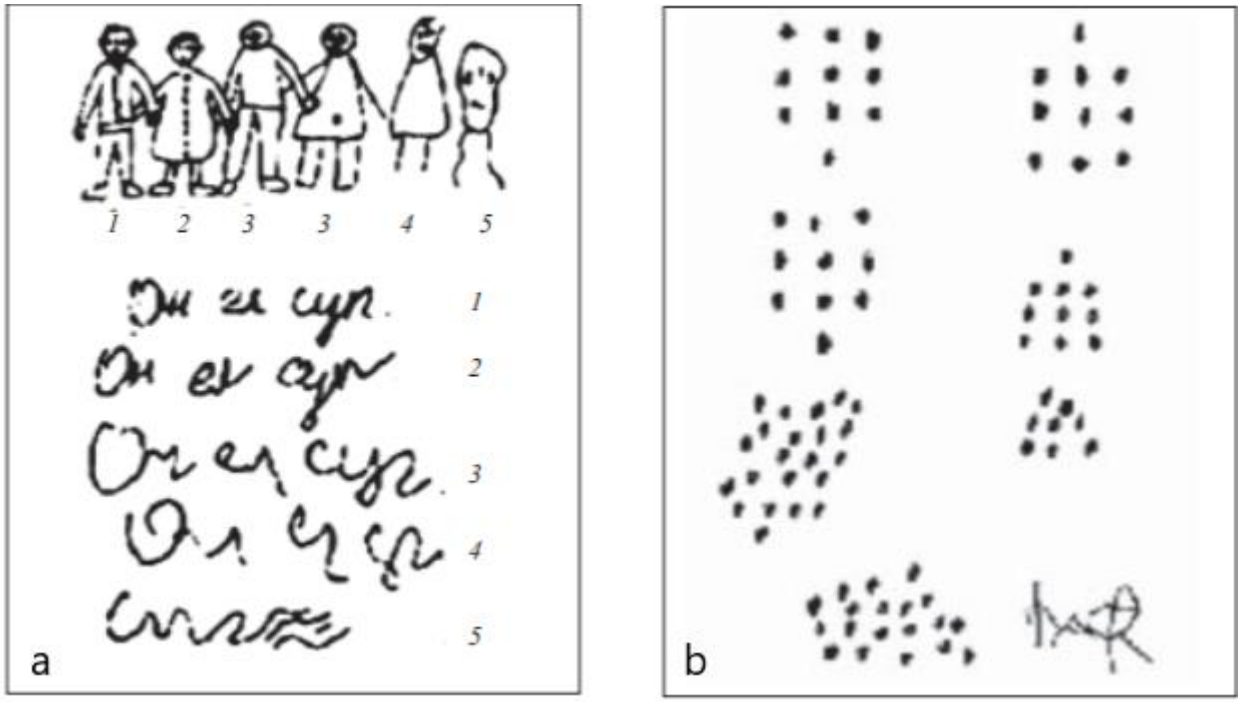

Figure 5. Variants of Kern-Iracek's test fulfillment: a) 1st and 2nd subtests; b) 3rd subtest

Fatigue and Overfatigue in Schoolchildren

Physiological basis of fatigue and overfatigue

Fatigue is the process of a temporary decrease in functional capabilities of the body under the influence of intensive or prolonged work, which is manifested by a decrease in working capability, deterioration of quantitative and qualitative indicators of work, and subjective feeling of tiredness, that disappeared after rest.

When fatigue develops, the body's energy reserves decrease, as well as the rate of physiological reactions, which ensures the body's ability to move from a state of rest to a state of excitement and perform new actions. Fatigue causes a decrease in motor functions, activity of brain, vegetative dysfunctions, attention and accuracy of actions. At the same time, the threshold of sensitivity to external influences increases. So, fatigue in school students during a lesson can be caused by the minimum (at the level of the threshold of sensitivity) action of any stimulus (noise,

monotonous and static work, cold or hot microclimate, excessive intensive training process, etc.).

Causes of fatigue during the lesson are:

1) a decrease in the functional activity of nerve centers that do not can send impulses to executing organs (muscles, glands) and manage their work;

2) shifts in physiological parameters (pulse, blood pressure, blood glucose, etc.);

3) violations of learning conditions (microclimate of the room, feeling of hunger, high level of noise in the classroom, etc.).

Signs of fatigue - a feeling of fatigue, motor restlessness, absent-mindedness, reduced work efficiency, mistakes, incomplete work. Fatigue is a reversible process; it is disappeared during outdoor activities and positive emotions. In case of insufficient active rest, excessive workload or illness, fatigue leads to overfatigue (exhaustion).

Types of fatigue. Depending on the forms of organization of educational activities, the following types of fatigue are distinguished: physical, mental and sensory. Physical fatigue occurs as a result of the forced immobility of the student's body during the lesson and the tension of various muscle groups or it can be caused by exertion during physical exercises. Intellectual fatigue is caused by mental activity, for which the associative zones of the cerebral cortex are responsible. Sensory fatigue is fatigue associated with tension of the visual, auditory, and other sensory systems.

Depending on the physiological state of the body, fatigue is compensated or uncompensated. Compensated (or latent) fatigue is a that, in which working capacity is maintained enabled strong-willed the efforts of the student. Uncompensated (non-latent) fatigue is characterized by a sharp decrease in working capacity, manifested at the end of the school day, or at the end of a quarter, or at the end of the school year.

According to the speed of development, fatigue is:

—rapidly developing in strenuous work, or unusual work, and

—slowly developing in the usual, but too long work.

Fatigue develops rapidly in those schoolchildren who have health problems, poor work and rest regimen, and no training skills.

When fatigue occurs during mental activity, there is a decrease in the functional activity of individual neurons, nerve centers and the whole brain. The weakening of the regulatory systems of the brain's functional state that is a frontal area of the cortex, a limbic system, nuclei of the thalamus, a hypothalamus, a midbrain, etc. is particularly to be noted.

When fatigue and overstrain of schoolchildren' body systems are continued, it can cause condition characterized by rapid exhaustion of nervous processes, increased tiredness, weakening or loss of the muscle or mental activity (asthenia).

Fatigue as a physiological phenomenon is usually accompanied by a subjective feeling of tiredness. However, fatigue and tiredness do not always coincide in time. When work is interesting and accompanied by positive emotions, children do not feel tired for a long time, although objective fatigue has already set tiredness. However, the contrary, during a boring and monotonous work, subjective felling of tiredness sets in much earlier than a physiologically caused decrease in functions (i.e., fatigue) occurs.

The limit of working capacity of a cerebral cortex cell changes with age, depends on the state of health, the type of higher nervous activity, past diseases, the nature and duration of work.

The activity of the cerebral cortex is provided by two main processes - excitation and inhibition. These processes are closely related and are in constant dynamic balance. Maximum working capacity is ensured by the optimal ratio between them. In children, excitation prevails over inhibition and the irradiation of nervous processes prevails over their concentration (the stronger the younger they are).

The cells of the cerebral cortex are also characterized by induction processes. *Induction* is the occurrence of inhibition under the influence of the excitation process (negative induction) or the occurrence of excitation under the inhibition process

influence (positive induction). Both types of induction are similarly important for the construction of educational work with children. The negative induction has particular importance, because it has some peculiarities in children. Negative induction usually occurs at the periphery of the excitation focus. This is the physiological mechanism of attention and concentration, since the areas of the cortex lying around the focus of excitation are inhibited and do not perceive irritations.

On the other hand, inhibition in the focus of excitation (negative self-induction) appears easily in children, especially if the previous irritation was long. Special observations and experiments have shown that negative self-induction occurs the sooner the younger the child, and most quickly when it was preceded by a long and complex activity of the cerebral cortex. That is why long and monotonous activities in young children should be avoided.

It has been established that children of 5-7 years old can maintain active attention for 15 minutes, at 8-10 years old - 20 minutes, at 11-12 years old - 25 minutes, at 12-15 years old - 30 minutes.

Phases of fatigue development. In case of violation of the educational process organization and construction, children' fatigue develops rapidly in two phases:

1) Excitation. First, active internal inhibition weakens, excitability increases, motor restlessness characteristic of the first stage of fatigue appears.

2) Protective inhibition. The second phase of fatigue is associated with a weakening of excitation and an activating of inhibition, which are a decrease in the strength of conditioned responses, in the speed and accuracy of work, and an increase in the latent period of reflex actions. Inhibition, replacing excitation, protects cells from exhaustion, weakening and destruction. Such protective inhibition naturally arises during various pathological processes as a protective reaction against harmful agents. It prevents the damage or destruction of nerve cells during overwork requiring the exceed of limit of their performance.

However, fatigue should not be reduced only to a change in the performance of the cerebral cortex's cells. Fatigue causes changes in cortical-subcortical

relationships. This is manifested in the inhibition of the activating function of the brain's reticular formations.

Thus, *fatigue is a state of the body in which the functional state of the cerebral cortex decreases, the interaction of the cortical and subcortical centers of the nervous system is disrupted, and the functions of other body systems are reduced*.

Fatigue is a normal reaction of the body to any long and strenuous activity. It should not be avoided, as this would have to give up activities, and consequently, the development of children would be delayed. Fatigue is not dangerous for the body, since the changes in the functional state caused by it disappear after sufficient rest and sleep. If for one reason or another (excessive load, insufficient rest, illness) the restoration of normal functions does not occur, the child develops overfatigue, that is an excessive fatigue when carried beyond the recuperative capacity of the individual. Therefore, in order for the activity not to lead to a state of overfatigue, but to have a positive effect on the growth and development of the child, it must be normalized.

Hygienic regulation of activities should be based on ensuring the optimal state of the child's body in the education and individual. Therefore; mental and physical stress should not exceed the functional capabilities of the child. At the same time, the activity should achieve a developing, training role, ensure the favorable development of a growing organism.

Hygienic regulation should take into account a number of factors:

— calendar and biological age (hygienic norm, based on average age morphological and functional data, is not optimal for all children of the same age group);
— gender (due to functional differences in the body of girls and boys);
— health status (children with chronic diseases and weakened children have reduced functionality);
— value of restoration period allowing to return a body function to an initial level;
— cyclicality of physiological functions in different hours, days and weeks.

Physiologists' studies show the restoration of a reduced functional state of the body also consists of two phases:

1) restoration of the functional level;

2) strengthening the achieved state of restoration.

This means that if the rest is limited to only the first phase, i.e., restoration of working capacity, it does not bring the expected results. A new load, even an insignificant level, quickly returns the body to a state of reduced performance. It takes so much time for rest to ensure not only the restoration of the initial functional level, but also the strengthening of the restored level of body functions.

Overfatigue prevention

The theoretical basis for the hygienic standardization of the educational and work load of schoolchildren is the concept of self-regulation of body functions. There are 3 phases of working capacity: entry into work, optimal work and fatigue. Analysis of the various physiological function's levels and their coordination in the process of work made it possible to establish the transitional states of the body from the phase of entry into work to the phase of optimal performance, and from the phase of optimal performance to fatigue (pre-fatigue). Activity should be stopped not in the phase of fatigue, but when pre-fatigue is developed, i.e., during the period of compensatory restructuring of the child's body.

When hygienic rationing, it is advisable to take into account the cyclical nature of the physiological functions of the body at different hours, days and weeks. If the rhythm of life is consistent with the biological rhythms' characteristic of the body, then the activity is characterized by high efficiency. The biological optimum zone has individual fluctuations. In adults, there are morning and evening types of biological rhythms. In children of primary school age, 5 types of biological rhythms have been established. A rational mode of study and work should be built taking into account the individual biorhythmological characteristics of the child.

The main condition for the prevention of fatigue is the strict compliance with a rational daily regimen. The mode of the day is the distribution of time for all types of activities and rest during the day. The daily regimen is based on conditioned reflex

activity. The formation of the nervous system, the increase in the period of wakefulness, the establishment of connections with the outside world cause changes of child's activity constituents. The developed and strengthened conditioned reflexes for the time of eating, sleeping, engaging in work acquire features of a dynamic stereotype. The *dynamic stereotype* is the most vivid manifestation of the extremely subtle analyzing and synthesizing activity of the cerebral cortex and is the product of very complex interactions between the areas of the cortex. The dynamic stereotype is the physiological basis for the automation of skills. The formation of a dynamic stereotype allows you to correctly and economically allocate time, quickly get involved in work and perform it efficiently, as well as reasonably and effectively rest. Thanks to the developed conditioned reflex for time, the child's body at every moment is, as it were, prepared for the type of activity that he/she has to perform. In this regard, all processes (classes, nutrition, sleep, etc.) proceed faster and easier. This is the great hygienic significance of the daily routine (preservation of the necessary life stereotype).

The development and growth of the child, changes in living conditions cause new time-associated connections in the cerebral cortex, old connections fade and even completely disappear, forming a new dynamic stereotype. Breaking the old dynamic stereotype is not indifferent to the child: it has an adverse effect on the child, the stronger the younger the child. An important law of a child's life is a properly constructed and constant daily routine.

The daily routine is considered correct if it provides sufficient time for the necessary elements of life and high working capability over the entire period of wakefulness. A properly organized daily regimen creates a cheerful mood, interest in educational and creative activities, games, and contributes to the normal development of the child.

When building a daily routine, the following elements should be considered:

—various types of activities, their optimal duration, rational alternation and regularity;

—rest with maximum stay in open air;

—regular nutrition;

—hygienically full-fledged sleep.

Daily regimen should include time for self-service and hygiene procedures, as well as free time for creative activities.

Children Daily Routine

Children develop in the course of organized activity of various forms and duration. This activity (if its organizers keep in mind children's anatomic and physiological peculiarities, their possibilities and health) can stimulate the development of nerve system, speech, analyzer, promotes a normal growth and development. But children's activity is far from being unlimited, and tiredness comes after it. Tiredness after a mental work is a result of the violation of cortex-subcortex interrelations followed by breeches in a cortex neurodynamic and efficiency on the one hand and negative changes in the reactions of vegetative system on the other hand. The prophylaxis of tiredness prevents from the violation of high nervous activity and vegetative functions, cardiovascular system; it helps to maintain the capacity for work. To observe the day's regimen means to divide the day time into certain fixed periods and to spare each period some sort of activity or relaxation so that all kinds of rest and activity would be embraced taking into consideration children's age and state of health. The regimen is considered to be right if it gives enough time for all the necessary elements of life activity and at the same time maintains a high capacity for work:

— various kinds of activity (studies at school and at home for schoolchildren), their optimum duration, reasonable alternation and regularity;

— rest with the maximum stay in the open air;

— regular and sufficient feeding;

— sleeping of full value.

Children of 6 years old are to sleep 11.5 h (10 h at night, 1.5 hour in the afternoon). Studies at school are conducted according to a curriculum. To restore

capacity for work and prevent tiredness rest must be given. It's efficiency to a great extent depends upon its organization. When children rest in the open air and their rest is planned and organized carefully it may have an additional positive effect on children's organisms. Such rest promotes blood oxygenation, increases lungs ventilation. Children must stay in the open air no less than 2–2.5 h (best of all before the beginning of classes, after them and before going to bed. Children must have some free time (1–1.5 h a day for younger schoolchildren and 1.5–2.5 h a day for senior ones), which they stand by their own option. But there are some kinds of activity within this time which must be under control. This is seeing films and especially TV-programs. It's known that children under 7 spend about 12–24 h a week in front of TV-set which leads to tiredness, but not relaxation. According to the modern researches younger schoolchildren may watch TV maximum 1 hour while senior pupils can do it 2 h a day, no more than 2–3 times a week. Age peculiarities, state of health must be taken into consideration as well as what children are interested in, how well they do at school etc. Enough time for self-service, hygienic procedure must be envisaged in the regimen. It's necessary to keep strictly to the routine for those children who are in extended-day groups at school. The requirements here are the same as for children who go home after classes. So, schools where such groups exist are to have special conditions.

Wrong organization of the daily regimen has a negative effect on the health, causes tiredness, delays growth and development of children. So, the daily regimen is an indispensable condition for bringing up children successfully.

Hygienic Concept of Organization of Children' Physical Activity

Physical training is one of the factors of external environment, which can strengthen a condition of health, raise stability of the organism to the influence of the adverse factors. The basic way of physical education is the physical exercises

and training of the organism. Under the action of physical training positive changes take place in the organism:

— the metabolic processes are normalized;

— immunological properties of the organism are raised;

— the functions of the organism are improved;

— the coordination of movements is improved;

— the endurance, stability to the factors of external environment is increased;

— new conditionally-reflexive connections, the improved nervous-emotional tonus, protective mechanisms.

The following principles should form the basis of physical training: systematic training; gradual training; integrated approach; individual approach.

Medical control of physical training includes the following complex of measures:

— medical supervision on the condition and dynamics of health;

— study of reactions of the organism on physical loading;

— participation in measures on preventive maintenance of traumatism during employment, in tourist campaigns;

— sanitary supervision at places for physical training. Therefore, before starting physical education the doctor should:

— carry out medical examination of children;

— divide them into groups of health;

— divide them into groups for training;

— define a kind of physical exercises and training procedures indicated to this or that child.

In accordance to the health stage and degree of physical development, children can be divided into 3 groups of physical activity:

— *The basal group* of physical activity includes healthy children with insignificant functional deviations in the cardiovascular system or insignificant deviations in physical development. They are allowed to perform all kinds of physical activity.

— *The preparatory group* of physical activity includes poor trained children, with functional deviations of the cardiovascular or respiratory systems, which has chronic bronchitis or recover after acute infection. They need moderate physical load, limitation of running, jumping, etc.

— *The special group* of physical activity includes children with rheumatic fever, etc. The physical training classes for them should be limited in time or sometimes absolutely forbidden.

When health and physical development of children improve, doctor can transfer them from the third group to the second one, from the second group to the first one after examination. The main criterion for making such a decision is a result of functional tests with a dosed muscle load.

For children of pre-school age, the *Levi-Gorinevskaja's test* can be used for determination functional reserves of cardiovascular system. Heart rate and blood pressure should be measured before and after the physical load (30 jumps in10 seconds or 60 jumps in 30 seconds). Heart rate is measured first in a sitting position before load (three times until stable values are obtained), and then in a first 6 c immediately after the load and in a first 6 c of each following minute until fully recovering. Blood pressure is measured also before load and then each following minute of recovering period in the interval between 15th and 40th second. There are three types of reactions of child's body:

1) the reaction of a usual type: the pulse becomes frequent in the first 10 c blood pressure increases by 5–10 mm Hg; recovering is observed between 1st and 2nd minute; there is no health disorders;

2) the insignificant deviations: heart rate and blood pressure increase inadequately to the physical load and recover in 3rdminute but; there is no health disorders;

3) significant dyspnea, deterioration of health, arrhythmic pulse, disturbance of blood pressure: a perverse reaction of blood pressure, or reduction in systolic pressure, or sharply reduction in diastolic blood pressure; recovering from the 4th minutes and later.

A *VO_2 max test*is used for evaluation of effectiveness of children training programs. A VO_2 max testis a maximal exercise test performed on a treadmill or bike while is connected to a machine capable of analyzing expired air. The test is used for provides data on how much oxygen person use as exercise and determines the maximal oxygen he/she can consume during exercise. This is a gold-standard measurement of endurance; however, it is rarely used in physicians' practice due to time requirement, space needs and cost.

For determination group of physical activity in schoolchildren combined *Letunov's test* and *Harvard step test* are used so they are faster and cheaper.

Combined *Letunov's test* procedure is following. At the beginning doctor measures a child's blood pressure and counts pulse rate (3 times in 10 seconds) in calm condition. Then test child performs three loads: 1st load — 20 squats in 30 seconds (this warm-up); 2nd load — 15-second running at pace with a high hip lift and with a maximum tempo (speed load); 3rd load — 3-minute running at a pace with the rate of 180 steps per minute (endurance load). After each loathe pulse rate and blood pressure are measured again every minute of recovering period. Recovery intervals between 1st and 2nd load should be 3 minutes, between 2nd and 3rd - 4 minutes, after 3rd load - 5 minutes.

Harvard step test procedure. The test child repeatedly steps onto and off of a platform in a cycle of two seconds. The height of the platform is 51centimetres for boys and 41centimetres for girls. The rate of 30 steps per minute must be sustained for five minutes or until exhaustion. To ensure the right speed, a metronome is used. Exhaustion is the point at which the subject cannot maintain the stepping rate for 15 seconds. The child immediately sits down on completion of the test, and the heartbeats are counted for 1 to 1.5, 2 to 2.5, and 3 to 3.5 minutes. The results are written down as *time until exhaustion in second* (t) and *total heartbeats counted* (h). It is plotted into a simple fitness index (FI) equation:

$$FI = \frac{t \times 100}{h \times 2}$$

The outcome of the equation is rated as follows:

Rating	Fitness index
Excellent	> 96
Good	83–96
Average	68–82
Low average	54–67
Poor	< 54

The school doctor should also provide:

1. Scheduled primary and repeated surveys of children for division into groups of physical training. It's necessary for the admission to lessons of physical training in sports sections, to participation in competitions, in tourist campaigns, for a direction into sports schools).

2. Control of lessons of physical training, realization of "physical culture pauses", competitions, etc., prevention of traumatism, consultive work with the teachers.

To prevent sport traumatism the following actions are forbidden: a) the premature admission to training of recovering children, suffering from chronic diseases, poor trained; b) lengthening of training, disturbance of rules of personal hygiene (exercises after meal, on an empty stomach, in poor sleeping, training with children having skin lesions, excoriations, etc.).

Construction of physical training lessons. The correctly constructed lesson consists of four parts:

— the introduction — 3–4 min; it includes organization of lesson;

— the preparatory part — 12–15 min; it provided general physical training;

— the main part — 20–25 min, it includes 2 periods: formation of locomotion skills and motor game; major physical load should be given in the main part;

— the final part — 3–5 min; during this part child body is recovered up to initial condition.

Other parameters of physical training class evaluation include:

— total and motor density of class;

— dynamic of physical load and physiological curve of the class;

— results of functional tests performance;

— assessment symptoms of fatigue.

Physical activity should increase towards the main part of the lesson. In this regard, the heart and breath rates increase, as well as metabolism increases. When construction of the lesson is correct, the functional state of children in the final part of physical training class approaches the initial level.

The pulse rate curve that characterizes every part of the physical training class is called the *physiological curve of the class*.

Double physical training classes are prohibited. Physical training class duration up to 2 hours is possible only if skiing skills are mastered. It is important to determine the place of physical training class in the children' schedule, since switching children from mental to physical activity contributes to a longer maintenance of working capacity. It has been established that it is most expedient to conduct sports activities in the third and fourth classes. Studies have shown that the daily fourth class of physical training partially compensates for the negative effect of prolonged mental activity on the brain blood supply: by the end of the working day and working week, the blood filling of the posterior parts of the brain and the volumetric blood flow in both hemispheres of the brain increase.

It is unbearable to replace physical training classes with other subjects.

Hardening of Children

The purpose of prophylaxis is to create conditions for proper development of the child and for prevention of diseases. It can be aimed at the factors of the environment that can be changed in a way to meet the needs of the child (exposition

prophylaxis) or to increase the resistance of the child's organism (disposition prophylaxis). Hardening is an essential element of the disposition prophylaxis that increases the resistance of the organism to the adverse effects of the environment related to the chilling of the child (cold, wind, humidity, temperature fluctuations).

The hardening of the child starts immediately after the birth. The daily change of clothes and showers are the initial general hardening procedures, and the essential hardening procedures, such as air baths, partial water rubbing and partial sun baths, can be initiated 3 months after the birth. The most appropriate season for hardening procedures is the summer, but winter babies should not be deprived of them given that the main principles of hardening are observed. The absence of adherence to the hardening procedures and especially the prolonged interruption causes loss of the achieved effect.

Main principles of hardening

Gradualness – at the beginning the hardening procedures have short duration and gradually the time of impact increases.

Systematicity – the hardening procedures should not be interrupted unless there are contraindications to them. If the interruption is long (15 days), the hardening effect disappears and the procedures should be started from the beginning. Sequence should be in compliance with the strength of the irritant – from weak to strong (air-water-sun).

Complexity – use of warmth, cold, sun energy, water, air movement in various combinations in various conditions.

Individual approach – the type and intensity of the hardening procedure is specified individually for each child.

The best prophylaxis against colds in children is hardening, consisting of a system of procedures, performed regularly since the birth of the child. Hardening is achieved through two types of regimens: general hardening regimen and special hardening regimen (hardening procedures with loading) – dosed hardening.

General hardening regimen – the following should be ensured:

• optimal temperature and humidity of the premises where the child is being raised;

• access to clean air (aeration);

• suitable clothing.

The most suitable temperature for raising a mature baby is 23-24°C, for immature baby – 25-26°C; for children above 1 year of age – 20-22°C, and during sleep 3-4°C lower; fluctuations of the temperature from 2°C to 3°C while awake are allowed. The air humidity should be in the range 40-60%. The aeration is made through regular ventilation of the premises and systemic outdoor walks. The newborn can be taken out after the second week if the temperature is 12-15°C and not higher than 27°C. The suitable clothing is very important for the child hardening. It helps the free movements and protects the organism from overheating, chilling and coddling. Signs for chilling: cold nose and ears. Signs for overheating: red face and anxiety.

Special hardening regimen – dosed hardening:

—hardening through air – air baths;

—hardening through water – rubbing, rinsing, walking in pools, rivers, sea;

—hardening through sun.

Types of hardening procedures

Hardening through air (air baths). The effectiveness of hardening through air depends on the physical factors of air – temperature, humidity, air flow velocity. Hardening through air during the summer or the warm first autumn days at temperature 20-30°C is carried out outdoors for 20 min and then slowly and gradually the duration could be increased to 2-3 hours.

During the winter the hardening through air could be carried out indoors in aerated premises at air temperature not lower than 18°C. The duration of the air baths is 10-15 min at the beginning and then increases to 20-25 min with gradual decreasing of the air temperature. A specific form of hardening through air is

sleeping at open window throughout the whole year and wearing light clothes during the cold months.

Hardening through water. The water procedures are the most efficient. They cause general and local reactions induced by the great thermal capacity and thermal conductivity of water. Besides, the various water hardening procedures have mechanical impact on the skin and the subcutaneous tissues. Various water procedures are used: moist rubbing, rinsing, baths in waters outdoors, water walking.

Rubbing of the body is made with wet towel, sponge or hand for 5 min. At the beginning the water temperature should be 25-30°C. It should be decreased gradually by 1-2°C every 2-3 days until reaching 15- 16°C. The duration of the procedure is 2 min at most.

Rinsing is made with shower or water can, starting with water temperature 28-32°C that should be decreased by 1°C every other day until reaching 17-18°C.

Baths in waters outdoors have the greatest hardening effect because of the fast and strong body cooling. At the beginning the water temperature should be 23-25°C. Staying in the water should not exceed 3-5 min at the beginning and should be increased gradually until reaching 15-20 min. Before entering the water, the body should be warmed and while bathing the children should swim or move all the time.

Swimming. The preventive effect of swimming: the physical activity is increased many times when using waters outdoors – pools, sea, rivers, where the favorable impact of the water is combined with the effect of the sun, air and nature that are the main factors of hardening the human organism, anti-stress and resistance to infectious diseases. Physicians recommend swimming as a hardening mean – it improves the activity of all organs and systems (increases the metabolism, trains the cardiovascular system). Compared to the other procedures, the recovery processes when swimming are faster.

Sunlight. Hardening through sunlight – besides increasing the resistance to the sun radiation, hardening through sun also causes multiple positive changes in the organism that are determined by the biological impact of the sun radiation: stimulation of various physiological functions that improve the general condition of

the organism, increase the working capacity, strengthen the immunobiological protection, reduce the morbidity of infectious diseases and colds, have bactericidal effect on the pathogenic microorganisms. Exposing to sun light is considered one of the basic means for prophylaxis and treatment of rickets. It should be preceded by preparation – taking off the clothes at partial shade in the first 3 days, respectively for 10, 20 and 30 min. The child is exposed to direct sunlight on the 4th day, starting with 1-2 min, as this duration increases by 2 min every other day until reaching 15-20 min; the total number of procedures should be 15-20, respectively for children at 3-6 months and for children above 6 months of age. It is advised the hardening procedures to be carried out under physician's monitoring, taking into consideration the age, the functional possibilities, the individual reactivity and the health condition of the child.

Walking barefoot – this is an effective hardening method. Walking barefoot on contrast paths is widely used nowadays. These paths have sections with differing temperature regulation – from cold to hot. It is thought that shoes isolate the human organism from the negatively charged layer of the earth's electric field, and the positively charged atmosphere takes away part of the human's negative ions. Walking barefoot provides to the human being the lacking negative ions, and electric energy at the same time. Various ways of this hardening method are recommended today – walking barefoot at home, on the beach, on dewy grass in the morning, even on snow.

Evaluation of the effectiveness of children hardening

Evaluation of morbidity rate. The effectiveness of hardening is evaluated on the basis of data on the incidence of acute respiratory diseases during the year (acute respiratory viral infections, acute tonsillitis, laryngitis, tracheitis, bronchitis). The ratio of the number of days missed due to these diseases to the total number of absences due to illness, as a percentage, should be calculated.

Determination of temperature asymmetry in the armpits. The child is simultaneously measured temperature in the right and left axillary fossa. In hardened

children, the temperature is the same. For non-hardened, the temperature difference is 0.2-0.3 C.

Determination of the skin reaction to a cold stimulus.

A metal cylinder 8-10 cm high and 2 cm in diameter is filled with ice. The cylinder is placed on the child's wrist in the supination position and held for 30 seconds. With an electrothermometer the skin temperature before the test should be measured. It is necessary take into account the time of ischemia after exposure to cold, the time of the appearance and disappearance of hyperemia, the skin temperature after the test, and the time to restore skin temperature.

Indicators of lability is calculated. The *lability index* is the ratio of the difference in skin temperatures before and after exposure to cold to the total time of temperature recovery. The lower the lability index, the more perfect the thermoregulation of the child, the better the child is hardened to cold.

Hygienic Requirements to Children's Toys

The concepts of games and toys have a very important role in children's lives. It contributes to the development of cognitive, motor, psychosocial, emotional, and linguistic skills. It also plays a key role in raising self-confident, creative, and happy children. Therefore, attention should be paid to the concepts of games and toys, which are so important for the child to be a part of society as a healthy individual at every stage of his development. On the other hand, providing playgrounds where children can play comfortably and safely are essential in reducing the risk of accidents related to toys.

Physicians and assistant health-care professionals in child health follow-up clinics should have sufficient and vigorous information about games and toys. It should encourage and guide the child in exercising his right to play.

The effects of games and toys on children

Physical Effects. Physical activity has a very important effect on children's health and development. Lack of physical activity brings many ailments. If the

physical activity includes playing, its effectiveness increases even more and children do it with great pleasure. In this respect, game preferences that include physical activity are important. The movements that require effort such as walking, running, swinging, rolling, jumping, and crawling on the ground during the game strengthen the muscles and improve motor coordination. For the development of fine motor movements, carrying, grasping, writing, drawing geometric pictures with a pencil, cutting paper with scissors, playing with dough and sand, stringing beads, and eating suitable foods with a fork would be helpful. With the pleasure created by all these, children also develop cognitively. On the other hand, since some of these activities are carried out outdoors, both the rates of obesity are reduced and the need for Vitamin D is met thanks to sunlight. In addition to the physical activity habits of children who have contact with nature, their love for nature and animals develops in the early stages. At the same time, the depression and anxiety rates of children decrease and their sleep quality increases.

Although the social, physical, and cognitive positive effects of playing on children have been known for a long time, the rate of active playing decreases with modern life compared to previous years. In a study, it was found that children play 8 h fewer games on average per week than children 2 decades ago. This “lack of play” has been blamed for some physical and cognitive problems.

Cognitive Influences. Cognitive development can be interpreted as learning and thinking ability in children. It improves children’s ability to understand things and solve simple problems. In this sense, playing also supports cognitive development as in all aspects of growth. The game can be played with one or many people, it can be played freely, and it supports development with its effects on children. Children learn many things naturally through games. It is the theory of the Swiss philosopher Piaget that reveals the effect of the game on cognitive development in the best way. In his research on play, Piaget defined the need to create order within people as a balance impulse. Humans have a biological tendency to organize and adapt to achieve balance. Children can make some mental adjustments by interacting with the environment thanks to the game. These mental

arrangements are built on previous experiences. Thus, through the game, it can be easier to gain acquisitions by passing some stages. According to Piaget, cognitive development in children is divided into four periods, as summarized in Table 4.

Periods occur in a certain order and each period progresses in a way to include the gains of the previous period.

Psychosocial and Emotional Impacts. Play-related researches make it all the more critical for young children in schools to play games rather than just educational activities. Researches have shown that children who engage in complex forms of sociodramatic games have better social skills, more empathy, more imagination, and a finer capacity to understand things. They are less aggressive and show more self-control and higher levels of thinking. Therefore, the necessary environments for playing games with children should be prepared without an excessive struggle for academic loading.

Table 4

Piaget's cognitive theory

Periods	**Ages**	**Cognitive Features**
Sensory	0–2 years	He just tries to get to know his surroundings and himself. The beginning of the thought is at this stage
Pre-procedure	2–7 years	Intense egocentrism prevails. Language develops rapidly. Symbolic plays and animations take place at this stage
Concrete trading	7–12 years	It can solve concrete problems. Gets rid of self-centeredness
Abstract processing	12 years and older	Inductive and deductive thinking and abstract thinking skills improve

Playing is a social activity. With games and toys, the child steps out of his inner world and starts communicating with the outside world. Through the game, it is learned to greet, introduce oneself, participate in the game, respect the people

around, wait their turn, share, and gain the ability to solve problems, obey the rules, and defend their rights against others. Role begins to develop through imitation to learn the real world. With the house game, they learn roles such as mother, father, brother, and sister. They rehearse life with games such as cooking, washing, ironing, and car repair. By choosing roles suitable for their gender in the game, they use it effectively.

Love, joy, laughter, sadness, crying, fear, anger, stubbornness, jealousy, and aggression are signs of emotion. During play, children not only reveal feelings that make them happy but also reveal their fears, jealousy, and negative emotions that they cannot cope with. They learn to deal with their fears, to control their jealousy, and to control their emotions. Parents can recognize and help their new sibling child's jealousy by playing with them or drawing pictures. When it cannot be solved with adult support, they can apply for professional support from pedagogues or child psychiatrists. The game is very important in detecting and solving this problem early. Hospitalization, vaccination, and surgery sometimes create a bad experience for the child and family, and it has been shown that games and toys reduce anxiety in this process.

Linguistic Influences. The effects of games and toys on language development are enormous. Neuroscientists and psychologists who study the brain and mental development of children have proven the connection between fine motor skills and language. In addition, advancements in mathematics are considered directly correlated to the development of the fine motor skills.

In an anatomical point of view, about a third of the entire area of the motor projection of the cerebral cortex is occupied by the projection of the hand, located very close to the speech zone. Therefore, the development of a child's speech is inextricably linked with the development of fine motor skills. The connection between finger motor skills and speech function has been proven by scientific studies of children and adolescents' physiology. That is why it is essential that children acquire the fine motor skills that are needed to interact with the environment at an early stage.

Examples of children toys which help to develop fine motor skills in children are following: stacking and nesting toys, puzzles, sorting and building toys, finger toy, plasticine, etc. (Figure 6).

Figure 6. Examples of children' toys used for fine motor skills development

Risks related to toys

All toys must have the CE mark. Toy manufacturers and retailers increasingly import toy products and parts from all over the world. To ensure they are safe for children to play with, the Ukraine in 2018 introduced the "Technical Regulations on the Safety of Toys", a legislation where the safety requirements are essentially similar to those in European Union's Toy Safety Directive 2009/48/EC, which aims to establish minimum safety standards relating to toy features, flammability, substances, documentation, etc. The safety directive for toys requires manufacturers to certify their products with a CE mark, which demonstrates the toy complies with these standards. A CE toys mark is mandatory for selling in the EU, and producers must carry out tests and produce documentation to demonstrate they are compliant. The letters CE (as the logo CE) mean that the manufacturer or importer affirms the good's conformity with European health, safety, and environmental protection standards. It is not a quality indicator or a certification mark. The CE marking is required for goods sold in the European Economic Area (EEA), but is also found on products sold elsewhere that have been manufactured to EEA standards' toys testing can reveal any problems before you go to market, saving you money.

The specific risks toy carries should be specified for child's age.

Mechanical and physical properties. It is the responsibility of manufacturer to create products that do not stab, mangle, trap or choke children. Along with this, toys should come with safety warnings and symbols.

It is imperative to create toys with high mechanical strength so; they do not break during use. Toys must be designed in a manner that extended out edges, protrusions, hanging parts do not cause physical injuries. No part of toy should make child strangle themselves.

The size of detachable parts must be large enough to prevent it from being swallowed. Toy should not contain small and sharp parts that could pose an aspiration risk to young children and should be sturdy. Also, it should not contain small magnets that could be swallowed. In 2020, the US Consumer Product Safety Commission reported 33 cases of illness in children who were injured from

swallowing magnets. A 20-month-old child died and at least 19 other children aged 10 months to 11-year-old required surgery to remove swallowed magnets. In many cases, magnets have fallen out of large toy components. Some children have swallowed intact toy parts that contain magnets. If two or more magnets or magnetic components, or a magnet and another metal object are swallowed separately, they can be attracted to each other (figure 7) through the walls of the intestine. These are traps magnets in place and can cause perforations, twisting and/or blockage of the bowel, infection, blood poisoning (sepsis) and death. If multiple magnets are swallowed, surgery is required to remove them, and sometimes to remove part of the bowel.

Figure 7. Magnets fallen out of large toy components

Flammability of toys. Toy should consist of non-flammable materials. Ukrainian National Standard EN 71-2:2018 “Toys safety” specifies the categories of flammable materials which are prohibited in all toys, and the requirements concerning flammability certain toys have to meet when exposed to a small source of ignition. This Standard includes general requirements relating to all toys and specific requirements and test methods relating to toys that are considered to present the greatest hazards, including:

— toys to be worn on the head (hats, moustaches, beards, masks, wigs, etc.);
— toy disguise costumes and toys intended to be worn by a child in play;
— toys intended to be entered by a child;
— soft-filled toys.

The following materials shall not be present in toys:

— celluloid (cellulose nitrate), except when used in varnish, paint or glue, or in balls of the type used for table tennis or similar games
— highly flammable solids
— materials with a piled surface which produce surface flash when a flame is applied to the tested material.
— toys shall not contain flammable gases, extremely flammable liquids, highly flammable liquids, flammable liquids and flammable gels

The requirements to toys to be worn on the head (beards, moustaches, wigs, made from pile or flowing elements, masks, hats, hoods, headdresses, etc.) are following. When a product incorporates several features, for example a hat with an attached mask and hair, each part shall be tested separately to the applicable clause relevant to that particular part of the toy. When tested, the duration of flaming shall not be more than 2 s after the removal of the test flame.

When tested, toy disguise costumes and toys intended to be worn by a child in play (and parts thereof), shall not exceed 30 mm/s rate of spread of flame or the test specimen shall self-extinguish. In all cases if the rate of spread of flame is between 10 mm/s and 30 mm/s, the appropriate component(s) of the toy and the packaging shall be permanently marked with the following warning: “Warning. Keep away from fire!”

When tested toys intended to be entered by a child (toy tents, puppet theatres, wigwams, tepees and play tunnels), the rate of spread of flame of the test specimen shall not exceed 30 mm/s or the test specimen shall self-extinguish. If the test specimen has a rate of spread of flame greater than 20 mm/s, there shall be no flaming debris or molten drips. If the material has non-identical surfaces, both sides shall be tested. If the rate of spread of flame is between 10 mm/s and 30 mm/s, the appropriate components(s) of the toy and the packaging shall be permanently marked with the following warning: *“*Warning. Keep away from fire!”

When tested soft-filled toys, the rate of spread of flame on the surface shall not be more than 30 mm/s or the toy shall be self-extinguishing.

Electrical properties of children toys. The Ukrainian directives guide the manufacturers regarding maximum voltage allowed in electric toys. The voltage of toys should not exceed 24 volts direct current (DC) or equivalent alternating current (AC). Moreover, electricity powered toys should not heat up the surface of the toy to a level where it may cause burn injury.

Ink migration. Nowadays, kid's eatables come in packets with toys inside. If these toys are not compliant with the standards, inks might migrate into food items and cause contamination. This test ensures that no inferior quality inks are used on toys. The test is also applicable on feeding bottles, soothers and teethers used by infants.

Finger Paints. Finger paints and colors are used by children for drawing and painting. According to directives, these paints should contain some bittering agent to avoid swallowing. This method tests and regulates the constituents used in paints.

The chemical substance must either not contain or, if it does, must comply with the legislation at a level that does not pose a danger.

Activity toys. The toys such as baby-walker, see-saw, and slides should be designed with no extended-out parts. The toys with protruding parts may stab, trap, or mangle child.

Due to the risk of aspiration, it is necessary to avoid toys such as balloons. Balloons mold to the throat and lungs and can completely block breathing. Because of the danger of suffocation, children under the age of eight not allowed to play with uninflated balloons without supervision. In addition, balloons and other rubber toys made from latex can cause allergies. Latex allergy can occur in these ways:

— Direct contact. The most common cause of latex allergy involves touching latex-containing toy.
— Inhalation. Latex toy, especially balloons, release latex particles, which can be breathed in when they become airborne.

Latex allergy symptoms range from mild to severe. A reaction depends on how sensitive child is to latex and the amount of latex child touch or inhale. Reaction can become worse with each additional latex exposure.

Mild latex allergy symptoms include: itching, skin redness, hives or rash, More-severe symptoms include: sneezing, runny nose, itchy, watery eyes, scratchy throat, difficulty breathing, wheezing, and cough. The most serious allergic reaction to latex is anaphylaxis, which can be deadly. An anaphylactic reaction develops immediately after latex exposure in highly sensitive people, but it rarely happens the first-time person were exposed. Signs and symptoms of anaphylaxis include: difficulty breathing, hives or swelling, nausea and vomiting, wheezing, drop in blood pressure, dizziness, loss of consciousness, confusion, rapid or weak pulse.

Children Health Management System and Monitoring

Children Health Management System and Monitoring consist of the following measures:

— preventive examination of secondary school and college students according to a plan developed by the authors of the program that allows to examine the whole staff quickly and completely within the period of 7–10 days;

— creation database for a subsequent multi-factor analysis;

— identification risk groups among students and subsequent development recommendations for individuals and staff;

— establishing a dispensary system for teachers. To monitor the state of their visual functions.

Initial and further examination can be held both at a school and in the Center during teachers training in pre-school preventive medicine class. Treatment and correction consist of the following:

— determination of main negative factors helping multi-factor analysis;

— determination anomalous visual and motor stereotype of children;

— psychological correction;

— development recommendations which allow to improve school and home hygienic conditions;

— school pathology to prevent the diseases progression in the clinic of school preventive medical center.

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