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Phenomenology of health

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Content:

Abstract

Health, as a phenomenon of a planetary scale, reflects the life of mankind, the world of animals and plants. Human health issues from the mid-20th century began to come out of the exclusive medical control. The increase in the average life expectancy of the population of developed countries, the globalization of economic, political, cultural life, the emergence of pandemics of viral infections - all these factors have shown that in maintaining the health of the population, the actual medical contribution is no more than 10%. The rest of the influence is exerted by economic, environmental, social and hereditary factors. The burden of disease of the population causes significant damage to the economies of even the most developed countries.

Human health is a comprehensive, integrative assessment of the quality of his being for each specific time and age period. Thus, we consider health as *a derivative of the ontogenetic scale*. A feature of this scale is the unification on the time axis (***x***) of both calendar and biological ages. The axis (***y***) reflects the magnitudes of the influence of known determinants of health that accompany a person at each stage of his ontogenetic movement.

One of the most important conditions for the functioning of the human body and animals is the constancy of the internal environment, defined as homeostasis. It is thanks to homeostasis that every cell of the body is in a relatively constant environment, which is an extracellular fluid. Earlier we drew attention to the fact that all the parameters of extracellular fluid can be divided into indicators of water-salt homeostasis (osmolality, concentrations of ions Na, K, Ca, pH). The task of water-salt homeostasis is to ensure water balance, both intracellular water content and the total amount in the body.

The second group of homeostasis indicators is represented by metabolites (glucose, lipids, amino acids, proteins, urea, creatinine, bilirubin, etc.). On the one hand, metabolic indicators are quite stable, which made it possible to attribute them to homeostasis, but on the other hand, their most important feature is that they are very closely related to the functional state of the body (organs, tissues, cells), since the main task of metabolism is to adequately provide the organs and tissues of functioning systems with the necessary amount of energy and plastic substrates. Accordingly, with changing functions, the levels of the main metabolites should also change. At the same time, the main criterion for the adequacy of the metabolic support of functioning systems is not their homeostating concentration, but compliance with the changing needs of organs and tissues. That is, in the body it is necessary to ensure a sufficiently strong relationship between function and metabolism.

In the literature, the subjective assessment of whether social factors affecting health can be avoided through structural changes in policy and practice appears to be the dominant way to determine the social determinant of health. In addition, the term "social" remains ambiguous and difficult to define within the clear boundaries of health care.

There are already concerns about the requirements and approaches to their screening, as well as their benefits and unintended harm. A long list of CLE can prevent doctors from prioritizing screening for social determinants and referring patients to support services. Politicians may also be less inclined to continue working with such a long and growing list. In most government agencies, there are inherent barriers to adopting a social determinant approach in policymaking.

A long list can add additional restrictions on adoption. A clear understanding of the "social determinants of health" is critical for all key stakeholders, including the public.

Key words: health, social health, homeostasis.

Introduction

Health, as a phenomenon of a planetary scale, reflects the life of mankind, the world of animals and plants. Human health issues from the mid-20th century began to come out of the exclusive medical control. The increase in the average life expectancy of the population of developed countries, the globalization of economic, political, cultural life, the emergence of pandemics of viral infections - all these factors have shown that in maintaining the health of the population, the actual medical contribution is no more than 10%. The rest of the influence is exerted by economic, environmental, social and hereditary factors. The burden of disease of the population causes significant damage to the economies of even the most developed countries.

Traditionally, within the framework of educational programs of medical universities, the doctrine of public health is presented within the framework of the discipline "public health", where three categories of health are considered.

Individual health **is an assessment** of the health of a particular person. It is evaluated by the presence of complaints, an assessment of personal well-being, the data of an objective examination by medical workers (clinical and paraclinical signs of the presence or absence of diseases, the degree of physical development, mentality, etc.). The health of an individual is traditionally considered by clinical disciplines from the position of the "doctor-patient" system, i.e. searching for symptoms of various infectious and non-infectious diseases and eliminating health disorders.

Group health **is** the health of homogeneous cohorts of people selected separately for different reasons: gender, age, profession, etc.

Population health **is a territorial** characteristic of the health of people living in a certain territory (district, region, region, zone, country, continent, etc.).

The science of health is claimed by a relatively young direction - valeology, the object of study of which is the characteristic of the internal reserves of the human body and the possibility of their increase.

It should be noted that if the conclusion on the state of health of an individual is not difficult, since there is a significant basis of established clinical, laboratory and instrumental criteria, then there are a number of problems for the aggregate assessment of public health, since it reflects the statistical group processing of the health of individuals of which the population consists, but is not the sum of the health of these people.

1. METHODS OF STUDYING BIOLOGICAL HEALTH

1.1. Anthropological and ontogenetic approaches

Man, as a biosocial intelligent being, is studied by various sciences. The most general approach belongs to anthropology, the task of which is to integrate the biological essence of man with the evolution of his cultural development and social relations.

Such a wide field of the unitary philosophical approach, formed by Aristotle since the time of ancient philosophy, from the middle of the 20th century began to differentiate into smaller specialized sectors. In particular, social anthropology, cultural, political, philosophical, media, visual, feminist, judicial, cybernetic, religious, pedagogical and other types of anthropology appeared [1].

In this regard, the study of human health and the health of various population groups will relate to the biosocial aspects of anthropology, the purpose of which is to study the category of "human health" through the prism of the socio-biological essence of man, reflecting the boundaries of his harmonious existence in the natural (natural) and artificial (socio-cultural) environments.

In our previous work on the concept of human health on the model of the space-time continuum (SPVC), an approach to combining the biological and social determinants of health on the basis of the time axis, which includes the main known stages of human development, was substantiated. Thus, the concept of PVC is based on an ontogenetic platform that suggests the possibility of studying human development from its inception to death: from embryonic development to age-related involutional changes in the body of elderly people.

Modern views on the essence of human health are extremely diverse. And the category of "health", as well as "anthropology", has undergone a split into many narrow utilitarian directions. There were directions that study the "health of chromosomes", "cell health", "health of organs and tissues", "healthy food", etc.

In this paper, we adhere to the view that the category of health is initially applicable exclusively to the person himself. The generalized health of various groups of people or group health indicators (morbidity, birth rate, mortality, etc.) do not carry the same depth of understanding of health disorders at the biological level, but more reflect epidemiological and socio-economic relations in the regions where people live.

Human health is a comprehensive, integrative assessment of the quality of his being for each specific time and age period. Thus, we consider health as *a derivative of the ontogenetic scale*. A feature of this scale is the unification on the time axis (***x***) of both calendar and biological ages. The axis (***y***) reflects the magnitudes of the influence of known determinants of health that accompany a person at each stage of his ontogenetic movement (Figure 1).

Such spatial visualization helps to assess the multifactoriality and strength of the influence of determinants in different periods of life and to understand the essence of the indicator of the reliability of the vital systems of the body. From this point of view, health is an indicator of the reliability of the adaptive psychophysical and social mechanisms inherent in a person at this particular, ontogenetic moment in time.

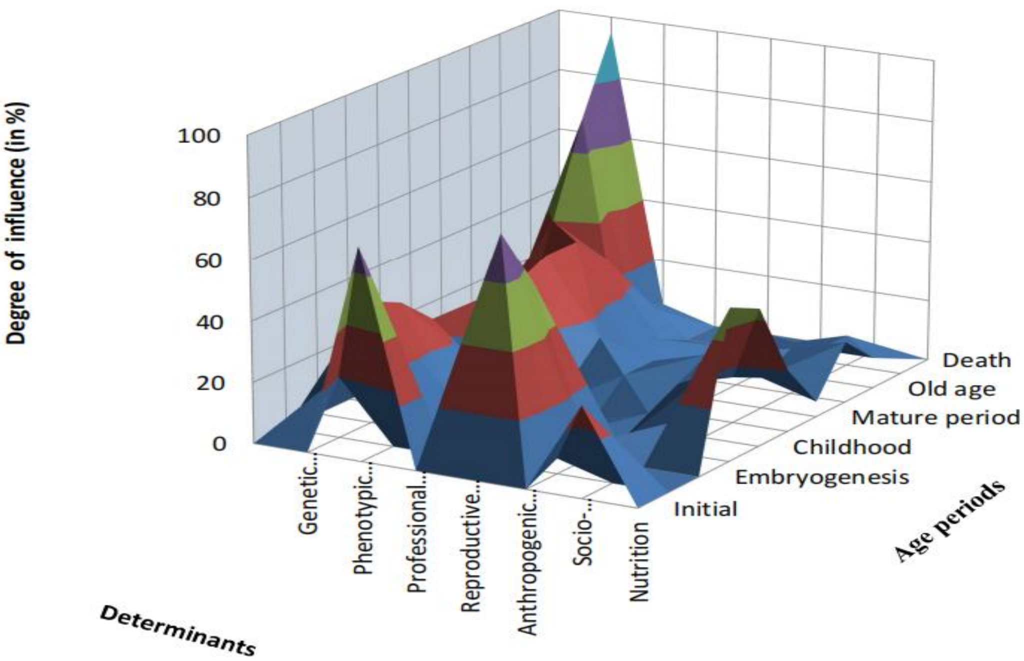


Figure 1. Anthropogenic factors in the formation of the spatial-temporal continuum of man (A. I. Gozhenko, V. S. Biryukov, 2019) [2].

From a biological point of view, human ontogeny is no different from the ontogeny of the animal world. It includes several mandatory, irreversible, sequential stages. At each of these stages, there are well-identified risks that disrupt or destroy health. But for humans, in addition to the biological determinants of health, there are many social determinants that must also be taken into account when developing an ontogenetic model of health using the example of PVC.

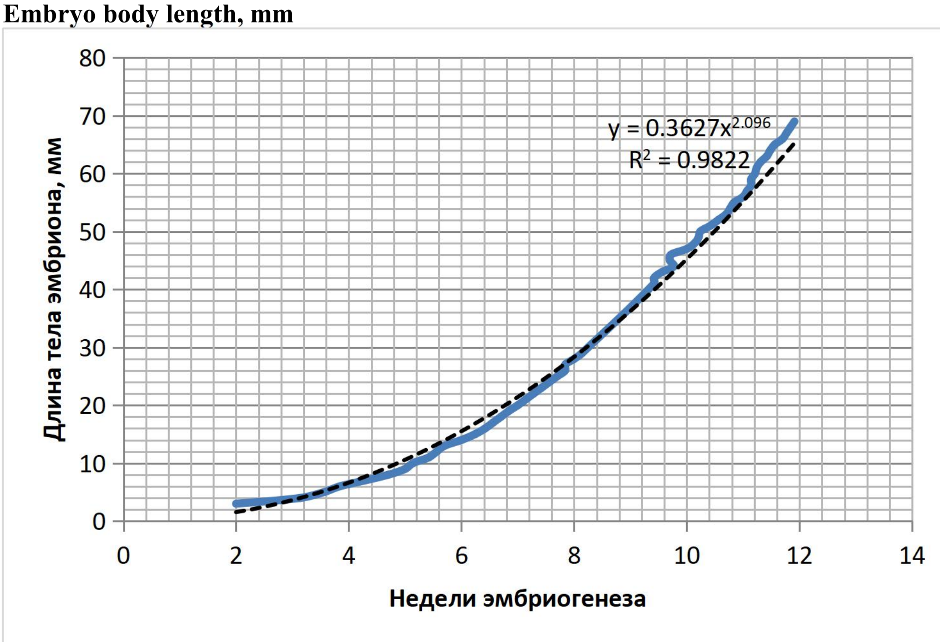
In human ontogeny, the following irreversible successive periods should be distinguished:

1. Early progenesis reflects the formation of gametes of the parent pair (the period of development and maturation of germ cells - eggs (ovogenesis) and spermatozoa (spermatogenesis).
2. Late progenesis - fertilization, the formation of a single-celled organism - zygotes.
3. Mother-placenta-fetus system. Transformation of the zygote with the formation of a blastocyst (multicellular human embryo).
4. Mother-placenta-fetus system. Embryogenesis (phase of histogenesis, up to 22 weeks of gestation).
5. Mother-placenta-fetus system. Fetal development. Fetal period. From 22 weeks of gestation to delivery.
6. Neonatal period (the first 28 days of life).
7. Infancy (from 29 days to a year).
8. Junior pre-school age.
9. Senior pre-school age.
10. Junior High School
11. High School (Teen)
12. Adolescent
13. Mature age
14. Old age
15. Longevity
16. Dying and death (it does not come suddenly, there are palliative and hospice periods that facilitate the quality of life of dying people).

The ontogenetic "lifeline" presented above includes 16 stages, each of which, at a certain period of time, is capable of having a significant impact on human life and health in a specific way characteristic of a given ontogenetic period of time [3].

There are numerous tabular data reflecting the relationship between the age of the human embryo and its size. Visualization and mathematical processing of these data [3] reflect the rapid exponential growth of the embryo ($\mathbf{y = 0.3627x^{2.096}}$, where **y is** the body length of the embryo, and **x** is a week of life), especially in the period 5-8 months ($\mathbf{y = 0.2132x^{2.337}}$) (Fig. 2).

Embryo body length, mm



Weeks of embryogenesis, w

Figure 2. The growth rate of the human embryo body in the first three months of development. For the graphic image, tabular data of the source are used [3].

This period reflects the most important stage in the development of the human embryo - organogenesis. It is at this stage of life that the mother's state of health plays a crucial role for the health of the unborn child. Stress, malnutrition, intoxication (smoking, drugs, alcohol, a number of medications), inflammatory processes in the uterus, TORCH infection can dramatically affect the spatial structure of the embryo's body, its organogenesis and viability.

At the end of organogenesis, the embryo passes into the fetal stage and before delivery, the development of the unborn child depends entirely on the "mother - placenta - fetus" system. However, after birth, not only biological factors come into force, but also social factors (determinants) of health, which become decisive factors in maintaining health and significantly change the structure of the spatio-temporal continuum of human health (see section 2).

1.2. Homeostatic approach – hierarchy of stability

1.2.1. Stability of chemical elements in biological systems

In our earlier works on the idea of human health [2], it was proposed to use indicators of the reliability of organs and systems as a measure of the health reserve. This approach was based on engineering developments in the field of reliability calculations of complex systems.

The concept of reliability of any complex system is the main temporal characteristic of its adequate functioning. How long can our body maintain its vital activity during cardiac arrest? When breathing stops? With kidney failure? When suppressing the immune system? These temporal characteristics form the features of the tactics of emergency therapy, provide a key to understanding the reversibility and irreversibility of pathogenetic processes. The concept of the reliability of complex systems is similar to the principles of the concept of homeostasis or stable states of the body, proposed by the American physiologist Walter B. Cannon in 1932. According to this concept, the stability of the organism is ensured by coordinated physiological processes.

The concept of the role of homeostasis as a regulator of the health of the human body is firmly established in the theory and practice of medicine. The stable state of the body is characterized by the constancy of its internal environment, which is a complex dynamic system of biochemical relationships between simple and complex substances, substrates and enzymes, minerals, proteins, fats and carbohydrates, free radicals and antioxidants. How stable are these material processes that provide homeostasis?

The study of the microcosm helps researchers to better understand the laws of the chemical world, to explain the essence of chemical processes. The multi-level structure of chemical objects is revealed, explaining their multifaceted impact on many complex phenomena of the surrounding world.

In the early 50s, by introducing radioactive atoms into living objects and observing their movement, scientists managed to look into the metabolism of simple atoms and molecules. It was found that on average, 98% of the atoms in the body – small particles of matter that form the molecules and cells of the body – are replaced every year. Most new atoms are taken along with the air we breathe, the food we eat, and the liquid we drink.

The principle of the stability of matter, originally called the principle of the stability of a chemical, was created on the basis of the extended theory of J. S. Miller. W. Gibbs and was first formulated by professor of physical chemistry G. Gladyshev (1977). Later, this principle was extended to all hierarchies of the living world [4,5].

The principle of stability of matter has a simple qualitative physical justification from the standpoint of the law of conservation of energy. It is postulated that each atom, molecule or structure-forming particle of any hierarchy has a strictly limited potential ability to participate in interactions with similar particles of its hierarchy and particles of adjacent hierarchies. For example, the less stable molecules are formed from atoms, the more stable supramolecular structures arise from the interaction of these molecules. Thus, the possibilities of molecules to form bonds within the temperature regimes of our body are far from unlimited.

One of the formulations of the principle is the statement:

"Nature , in the formation or self-assembly of the most thermodynamically stable structures of the highest hierarchical level (j), for example, supramolecular level, in accordance with the second law, spontaneously uses mainly the least thermodynamically stable structures (available in a given local region of the biological system) belonging to the lowest level, i.e. the molecular level (j-1). These comparatively unstable structures are embedded in the next higher level, that is, the supramolecular level (j)."

Conversely, stable molecules form comparatively unstable supramolecular structures. It is argued that if particle *i* of some hierarchy *j* (or podirarchy *j*) spent a lot of energy to form a bond with another particle (or particles) of the same hierarchy *j*, then this *i* particle has relatively little energy left to form bonds with other particles of its hierarchy or particles of higher hierarchies *(j + 1)*.

The principle is qualitative, since it is applicable to substances of variable composition. The author assesses the stability of simple and complex molecules based on the assessment of the value of the free energy of their formation. He presents a directed series of reducing the stability of the chemical elements in question in living systems in the form of:

O (0.89) > H (0.97), C (1.16) > S > (3) > N (10) > P (13.6).

The series corresponds to the increase in the number of relatively unstable phosphorus and nitrogen atoms in organisms in their evolution, phylogeny and ontogenesis (with aging). The sign > means a decrease in the stability of the elements when moving from left to right: from oxygen to phosphorus. This approach makes it possible to trace the evolution of "supramolecular" structures during evolutionary changes in living beings.

The most stable "supramolecular" structure is DNA and RNA molecules, which is proved by studying the label with radioactive carbon C14. So, unlike other atoms and molecules that are constantly transformed, human DNA remains unchanged from the moment the cell is born: after the division of parent cells - and until the end of its life.

1.2.2. The concept of homeostatic regulation of health

The stable simple and complex molecules of chemicals mentioned in the previous chapter often serve as markers for determining a particular type of metabolism. Clinical practice shows that the content of such persistent compounds (oxygen, carbon dioxide and monoxide, sodium chloride, glucose, urea, bilirubin, malondialdehyde, etc.) in the intercellular fluid, blood and serum is extremely variable and can fluctuate within significant limits, sometimes tens of times.

Does this phenomenon, proposed by Claude Bernard about 150 years ago, reject the concept of the constancy of the internal environment of the body necessary for full health?

The internal environment of man and animals is understood as an extracellular fluid, the relative constancy of which is primarily due to the fact that this environment washing the cells, formed in the process of evolution, corresponds to the conditions in the water of the Primary Ocean, in which multicellular organisms arose, which then came to land, but at the same time retained a part of the Primary Ocean around the cells of a multicellular organism. For most terrestrial organisms, especially humans, the stability of extracellular fluid has become the main condition for existence and an unshakable theoretical concept of physiology [6].

A more complicated question is what is meant by controlled parameters. Since sometimes they are understood even as morphological constants, but still most authors refer to them as concentrations of substances in the environment surrounding the cells.

Thus, it is the ionic parameters of the extracellular fluid that are controlled homeostatic quantities. Such constants of extracellular fluid include those characteristics that were inherent in the surrounding fluid around cells and cellular systems that arose during their existence in the waters of the Primary Ocean, in which there was initially no organic matter, but there were initially stable concentrations of ions: sodium, protons, potassium, calcium, magnesium.

It should be noted that in evolution, mechanisms were formed in the cells of living systems that ensure the ability to exist precisely in such water systems that were characterized by similar in ionic composition to the Primordial Ocean. Subsequently, this became a prerequisite for the vital activity of multicellular organisms, in which cells are in a stable environment with a fairly constant ionic composition. Moreover, the control of these ionic parameters of the extracellular fluid is different in the accuracy of regulation. Currently available data allow us to consider the concentration of sodium ions to be the most accurate regulated parameter. According to existing ideas, this is due, on the one hand, to the fact that in the waters of the Primary Ocean the main ion was sodium, and in cells its concentration was much lower - so in the cells of modern mammals on average 10 times, and potassium became the predominant intracellular ion. The latter, according to a number of authors, indicates that, apparently, cells originally arose in an aqueous medium with a predominance of potassium.

The next stage after the emergence and evolution of cells is associated with their existence in the waters of the Primary Ocean. As a result, mechanisms were formed in cells that ensure a non-equilibrium distribution of basic ions between the cell and the extracellular fluid, which for them was the environment of the Primary Ocean (highly specialized ion channels and pumps with all the necessary regulatory mechanisms), which is largely due to the physiological role of individual ions in cells. Such conditions of existence allowed cells to actively develop up to the emergence of multicellular organisms. At the same time, the stable state in the composition of the Primary Ocean allowed cells with their system of regulation of ionic composition to function successfully with the development of specialized vital systems. The subsequent release of multicellular organisms on land was accompanied by the preservation of their constant internal, that is, the surrounding cell environment, which was actively maintained in a relatively stable state. In this regard, a special role in the homeostasis of extracellular fluid, indeed, is assigned to sodium [6].

Consequently, it can be concluded that sodium, as the main ion in the water of the Primary Ocean, has become the main constant of extracellular fluid in terrestrial organisms, especially in humans and mammals. However, when analyzing information on maintaining the concentration of sodium in the extracellular fluid of a person, attention should be paid to those fluctuations that are usually detected - from 125 mmol / l to 145 mmol / l, i.e. they correspond to a fairly large range of changes ranging from 10 to 15%, and sometimes more. These data do not quite correspond to the ideas about the stability of the parameters of the internal environment of a person. In this regard, attention should be paid to another constant of extracellular fluid in humans - osmolality, which is a characteristic of the aggregate ability of all water-soluble substances that bind water. Indeed, according to existing ideas, the value of osmolality in humans varies within narrower limits, from 1 to 3% [6].

1.2.3. Functional-metabolic continuum

One of the most important conditions for the functioning of the human body and animals is the constancy of the internal environment, defined as homeostasis. It is thanks to homeostasis that every cell of the body is in a relatively constant environment, which is an extracellular fluid. Earlier we drew attention to the fact that all the parameters of extracellular fluid can be divided into indicators of water-salt homeostasis (osmolality, concentrations of ions Na, K, Ca, pH). The task of water-salt homeostasis is to ensure water balance, both intracellular water content and the total amount in the body.

The second group of homeostasis indicators is represented by metabolites (glucose, lipids, amino acids, proteins, urea, creatinine, bilirubin, etc.). On the one hand, metabolic indicators are quite stable, which made it possible to attribute them to homeostasis, but on the other hand, their most important feature is that they are very closely related to the functional state of the body (organs, tissues, cells), since the main task of metabolism is to adequately provide the organs and tissues of functioning systems with the necessary amount of energy and plastic substrates. Accordingly, with changing functions, the levels of the main metabolites should also change. At the same time, the main criterion for the adequacy of the metabolic support of functioning systems is not their homeostating concentration, but compliance with the changing needs of organs and tissues. That is, in the body it is necessary to ensure a sufficiently strong relationship between function and metabolism.

We have defined this functional relationship as a functional-metabolic continuum (PMC) [7]. It follows that with changes in function, appropriate changes in metabolism aimed at metabolic support should occur. Support for PMC is a prerequisite for the vital activity of the body. At the same time, this is an extremely difficult task, due to the fact that, firstly, metabolites, as components of food, enter the body in a variable mode, while changes in function, as a rule, are not associated with the nutritional metabolic needs of functioning systems. At the same time, PMC is achieved through a complex system that provides a combination of function and metabolism. The regulatory mechanisms that provide PMC of the body are represented by neurogenic, hormonal, mediator metabolic mechanisms.

Relatively conventionally, the tasks of PMC can be divided into energy and plastic support, which are very closely interrelated. However, it is the energy supply that is both a priority and a very urgent and permanent one. In fact, each cell (tissue, organ, system) must be supplied with energy substrates in accordance with the function. The organization of this provision is such that one of the important conditions is the relative stability of the concentration of these substrates in the extracellular fluid and, first of all, the level of the most important energy substrate glucose. Accordingly, glycemia is a condition for adequate energy supply and a criterion for PMC's functioning.

In this case, glucose provides the first and fast phase of energy supply to cells. However, all cells of the body in functional terms can be conditionally divided into two groups: cells of organs and tissues that function in a relatively stable mode, which can be activated, but in a relatively limited range - brain cells, endothelium, liver, kidneys, lymphoid tissue. The second group is muscle tissue, the function of which can increase tenfold with intense muscle work compared to a resting state. In this regard, the provision of these tissues is different. All tissues of the human body are divided into insulin-independent (the first group) and insulin-dependent (the second group). The latter is represented by muscle and fat, the functions of which are sharply different. The energy supply of muscle tissue at the first stage occurs due to the mobilization of glycogen in myocytes, followed by an increased intake of glucose into muscle tissue by stimulating transmembrane insulin transfer.

In adipose tissue, insulin increases the flow of glucose into adipocytes and the synthesis of neutral fat as a reserve depot of energy. Such an insulin-dependent pathway of energy supply is included in food hyperlipemia and then, as a rule, in both muscles and adipose tissue, glucose is actively deposited in the form of glycogen or neutral fat. In the case of mobilization hyperlipemia with systemic somatic activation (stress), an increase in glucose intake into the muscles also provides the energy needs of muscle contraction. The amount of glucose necessary for cells, primarily insulin-dependent tissues, in the period between meals is provided by mobilizing liver glycogen stimulated by counter insular hormones, primarily catecholamines, glucagon. To maintain glycemia during long periods between meals and especially fasting, the source of glucose is gluconeogenesis from amino acids influenced by the effect of glucocorticoids.

At the same time, it should be noted that the main amount of energy in the cells is formed during the oxidation of lipids.

First, especially for non-insulin-dependent tissues, ketone bodies are extremely important substrates. Importantly, ketone bodies are not only energy substrates, but also inhibit the oxidation of glucose by cells, especially the brain. This is very important during fasting, when the supply and source of glucose are limited. Another source of energy especially for tissues with intensive metabolism (muscles that contract) are fatty acids, which are released in tissues (capillary lumen) from lipoproteins under the influence of lipoprotein lipase, fixed on the endothelium of capillaries as the level of free fatty acids in the blood plasma. too low and within 1mm.

Accordingly, in the human body, depending on the intake of energy substrates from the outside (nutrition) and the functional activity of tissues, a complex regulatory system functions that ensures that each cell of an organ receives the necessary amount of energy substrates. At the same time, in the blood plasma, the level of glucose and lipids change, although they are contained within certain limits. The purpose of such regulation is not to maintain a strictly constant (hemostatic) level of substrates, but their compliance with the functions of organs and tissues, which is the essence of PMC.

If the energy needs of the cells of the body are sufficient and the PMC is preserved, then we can talk about physiological correspondence. PMC deficiency, in turn, is a manifestation of pathology or leads to it. The following variants of PMC are possible [7]:

• Balanced functional state - 2-3-4 hours after eating with normal functional load - stabilized PMC.
• Excessive intake of energy substrates with food:

A) physiological deposition even before obesity - hyperglycemia, hyperinsulinemia;
B) pathological excess of energy substrates - TS - hyperglycemia, hyperlipemia, hyperinsulinemia, glycosing of proteins, insulin resistance of membranes (DM), arterial hypertension.

It can be assumed that an imbalance in PMC may be manifested by a stereotypical disorder through an increase in ketone bodies, fatty acids (total lipids) with the activation of POL. These changes lead to endothelial dysfunction, and then to endothelial insufficiency with the development of atherosclerotic vascular lesions. Endothelial dysfunction is one of the pathogenetic mechanisms of the development of hypertension, other vascular lesions (diabetic nephropathy, retinopathy, vascular lesions of the lower extremities, etc.) with the occurrence as a consequence of CRF, myocardial infarction and stroke [7].

A separate issue is the development of protein deficiency due to the activation of gluconeogenesis, which with the rest is manifested by immune deficiency, a decrease in regenerative processes with a transition to organ-tissue dystrophy.

1.2.4. Cellular "health"

The elementary living particle of our body is the cell. As for all living things, a universal process is prepared for cells: nucleation, functioning, aging, wear, destruction and death. It was revealed that the rate of these processes for different types of cells is not the same - from several days to several years [8].

However, cellular life is not a limiting factor in human life expectancy, since unstable cells in the body combine into more stable structures – organs and tissues.

The greatest activity is noted in the cells of the embryo, when there is an hourly formation of organs, tissues and an increase in the weight of the embryo's body. After the completion of the laying of body structures and the differentiation of cell functions, their life expectancy changes significantly.

The longest life, throughout a person's life, is noted in such body structures as the lens and vitreous body of the eye, neurons of the cerebral cortex, muscle cells [8,9].

Centenarians include cells of the skeletal system, capable of slow regeneration within 8-10 years. The renewal process slows down as we age, leading to a well-known pathological condition called osteoporosis. The cutaneous epidermis, exposed to constant exposure to the external environment, is renewed every 2-4 weeks. Skin derivative – hair is renewed every 6 years for women and 3 years for men.

The shortest life in the cells of the intestinal epithelium: 1-2 days. But the intestine itself, as the structure of the digestive system, remains unchanged, due to the constant renewal and rapid regeneration of its working surface. It is estimated that up to 70 billion cells are renewed in it per day.

An intermediate place in life expectancy is occupied by blood cells: in healthy erythrocytes, the life cycle lasts up to 3 months, in platelets - up to 8-10 days.

Liver cells are capable of active regeneration. Their life expectancy is up to 1 year.

Thus, the death of cells of different organs and systems is a normal process for maintaining human health. Violation of this process - accelerated destruction and death of cells, their delayed recovery or excessive proliferation - are signs of a violation of health at the cellular level.

Although the survivability of different cells is not the same, they are all equally important for the body. And neurons that can work for a whole century, and epithelial cells that serve only a few days.

The work of the Swedish molecular biologist D. Friesen, who studied the renewal of body tissues by measuring the level of radioactive material - carbon-14, showed that the human body for the most part renews itself every 7-10 years.

1.3. Biokinetic approach. Human health from the point of view of reliability of complex systems

The definition of human health by WHO experts as "a state of complete physical, mental and social well-being, and not only the absence of diseases and physical defects" is not able to cover the entire period of a person's life. It applies only to young and middle-aged people, since for the elderly, senile and advanced age, significant amendments are needed in the understanding of the term "full well-being" against the background of a number of serious physical, mental and social "age-" losses.

This discrepancy is particularly evident in the analysis of human health, which combines the concept of reliability of complex systems (CRCS) and the model of the space-time continuum (STC) of human health, covering his life from the moment of conception to biological death.

With this approach to the study of health, it is necessary to introduce definitions additional to medical terminology.

Reliability (Reliability, dependability) - The property of an organ or body system to maintain in time within the established limits the values of all parameters that ensure the performance of the required functions in physiological modes.

Reliability, as the most general concept, integrates a number of additional parameters: reliability, durability, the possibility of correction or certain combinations of these properties.

Reliability: The property of an organ or system to continuously maintain a healthy state for some time. It is an element of reliability.

Durability (Durability, longevity) - the element of reliability. The property of an organ or system to maintain a working state until the onset of the limit state with the established system of preventive observation and treatment.

Maintainability is an element of reliability. A property of an organ or system that consists in the ability to restore and maintain a working state under the influence of directed therapy.

To the traditional clinical assessment of health, a number of new assessment approaches of the CRCS are added.

Good state : The state of an organ or system that meets all the clinical and laboratory criteria of a healthy organism adopted in medicine.

Abnormal state (Fault, faulty state) - a state of an organ or system in which inconsistencies are identified according to at least one of the criteria of a healthy organism.

Up state - a state of an organ or system in which the values of all parameters characterizing the ability to perform specified functions correspond to physiological standards.

Down state - a state of an organ or system in which the value of at least one parameter characterizing the ability to perform specified functions does not correspond to physiological standards. At the same time, the object under study is able to partially perform the required functions.

Limiting state: The state of an organ or system in which its further operation is unacceptable or impractical, or the restoration of its operational state is impossible or impractical.

Damage is an event that disrupts the normal state of an organ or system while maintaining a healthy state.

Failure - an event consisting in a violation of the working state of an organ or system.

Failure criterion is a sign or set of signs of a violation of the working condition of an organ or system established in medical regulatory documents.

Failure effect - phenomena, processes, complications, events and conditions caused by the occurrence of organ or system failure.

Sudden failure is a failure characterized by a jump-like change in the values of one or more parameters of the activity of an organ or system.

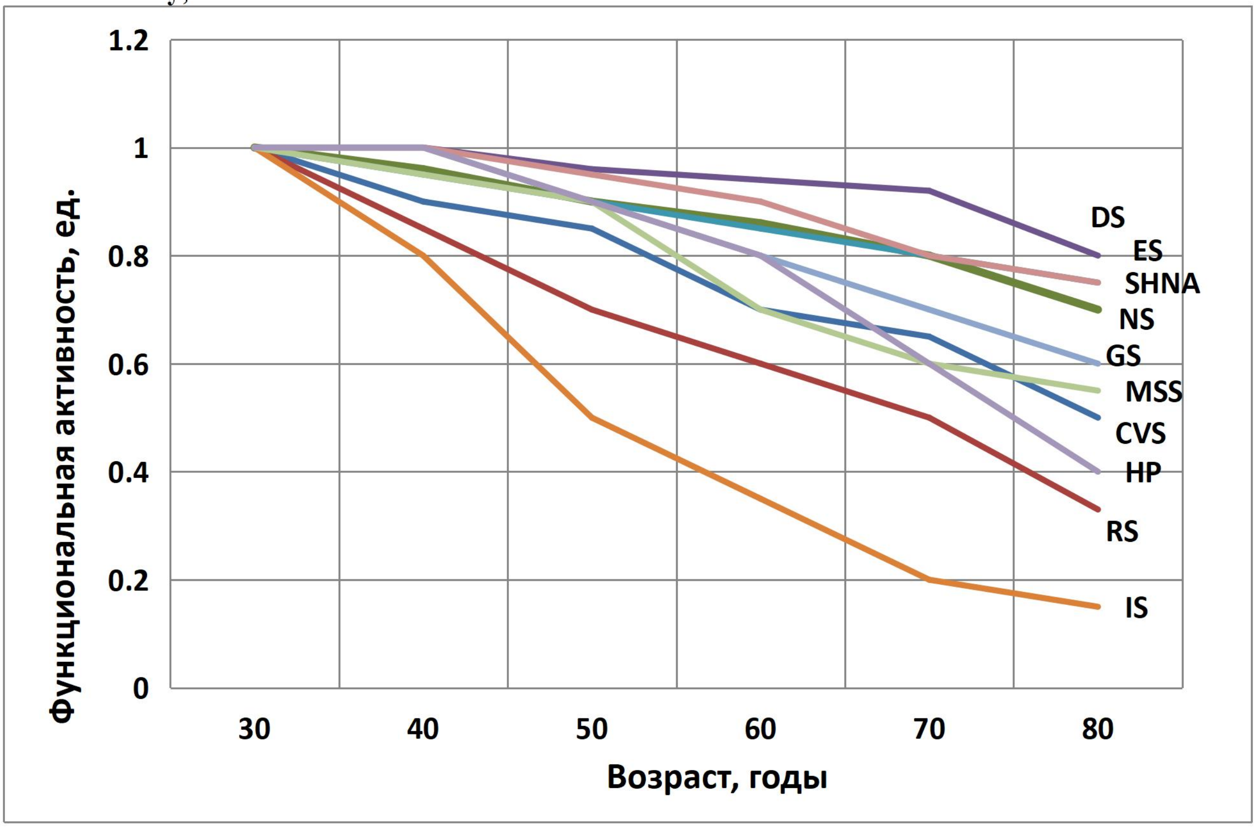
Gradual failure is a failure resulting from a gradual change in the values of one or more parameters of an organ or system.

With the above approach, a multifactorial analysis of maintaining a healthy life is carried out. In particular, the literature contains a huge amount of material on the age characteristics of the functioning of the main life support systems (here in after referred to as the LSS):

- cardiovascular system (CVS);
- respiratory system (RS);
- nervous system (NC);
- digestive system (DS);
- endocrine system (ES);
- immune system (IS);
- genitourinary system (GC);
- system of higher nervous activity (SHNA);
- musculoskeletal system of MSS);
- hematopoietic system (HPS).

There is a widespread belief that all of these human life support systems function most reliably and flawlessly by the age of 30 [10,11,12]. Many researchers, as a standard of reliability of the human body, associate the "golden time" with the age of 30 years. Further monitoring of age-related health is carried out only in a comparative aspect with the capabilities of a particular system at the age of 30. A graphical representation of this most common approach is shown in Figure 3.

Functional activity, units.



Age, years

Figure 3. Comparative activity of human life support systems in the age aspect: DS - digestive system; ES - endocrine system; SHNA - system of higher nervous activity; NS - nervous system; GS - genitourinary system; MSS - musculoskeletal system); CVS - cardiovascular system; HP - hematopoietic system; RS- respiratory system; IS - immune system.

The quantitative representation of the functional systems of the body allows us to use these data to calculate the reliability of the general life support system of a person at each time period of his life or PVC. For this approach, mathematical modeling is successfully used in calculating the reliability of complex systems [13,14]

For the human body, the systems that ensure the health and life of the system are far from equivalent in terms of the risks of sudden failures, durability and correction capabilities. Based on the ideas of the concept of reliability of systems, as well as from the experience of practical disaster medicine, it is necessary to divide the multicomponent human life support system into two levels.

The first level is represented by a block of sequential elements, where a sudden failure of any of them leads to the failure of the LSS as a whole.

The second level includes a block of parallel elements, when the failure of the LSS occurs only when all elements fail.

The first level should include LSS, the failure of whose activity leads to an immediate cessation of vital activity and is not compatible with life: cardiovascular system (CVS), respiratory system (RS), nervous system (NS).

According to the concept of reliability of systems, such a strict regulation of the vital activity of the organism is characteristic of a consistent structure (Fig. 4).

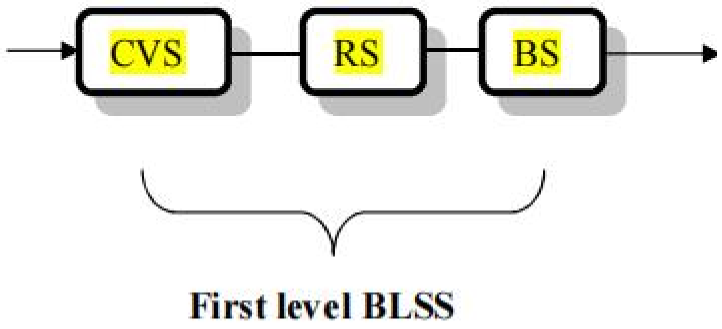


Figure 4. The consistent structure of the first level of life support of the human body. Violation of the reliability of any element of the chain causes the failure of the entire life support system. The meaning of the designations CVS, RS, NS in the text.

The second level of life support of the body can be represented by a parallel system (Fig. 5).

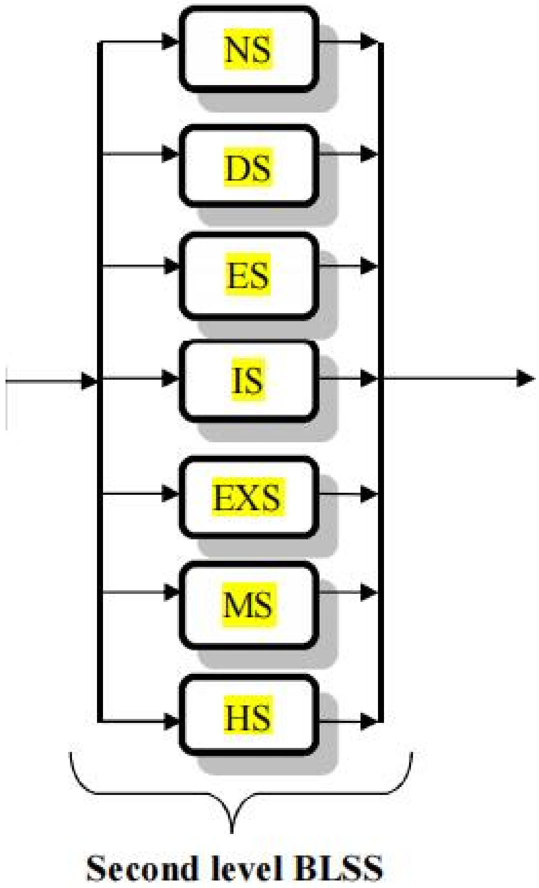
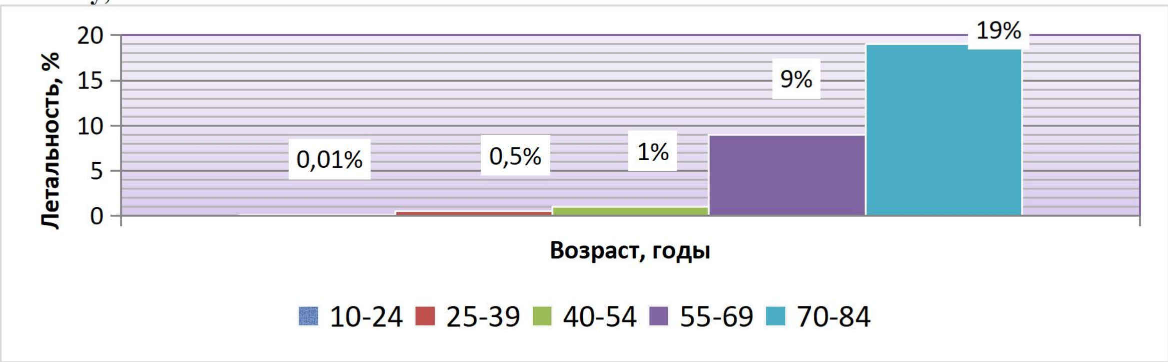


Figure 5. Parallel structure of the second level of life support of the human body. The meaning of the designations in the text. With such a life support structure, the failure of one of the elements disrupts the system as a whole, but is not fatal.

The ability to quantitatively measure some parameters of human health clearly shows the lack of ideas about him as a factor in the "state of complete well-being". The time period of a person's life is limited. It is homogeneous in the social time scale – passport age, but not homogeneous in biological time. The ontogenetic time scale is clear and confirms this with numerous examples.

In particular, the analysis of mortality of the population as a result of domestic injuries, accompanied by falls and fractures of tubular and flat bones, showed on a large statistical material an exponential increase in adverse outcomes with the age of patients (Figure 6).

Lethality, %



Age, years

Figure 6. Mortality from bone fractures as a result of domestic injuries (falls).

An exponential increase in age-related mortality from hip fractures in the United States was noted in a study [C. Brauer, 2009]: Mortality from hip fractures in men and women aged 65-74 years is less than 75-84 years by 1.5 times and less than in people older than 85 years. This fact does not allow to explain the exponential growth of fractures and mortality from them only by one mechanism of osteoporosis, which develops gradually, *with* a linear nature of changes in the composition and structure of bone tissue.

In real life, statistical data show a cascading mechanism for increasing the severe consequences of banal domestic injuries [15]. Such a contradiction can be explained by taking into account the influence of the so-called comorbid conditions that accompany the process of osteoporosis in men and women with age. In this case, according to the principles of the theory of stability of complex systems, all concomitant diseases, as indicators of failure or violations of accompanying processes, will mutually potentiate each other, sharply or exponentially increasing the risk of an unfavorable outcome in domestic injuries. The burden of comorbid conditions accumulating with age is growing rapidly, which contradicts the concept of "complete well-being" with age. Thus, in the manual of the Mayo Clinic (USA) on risk factors for hip fractures [16], the following comorbid diseases that aggravate the prognosis are presented:

– Acute myocardial infarction or the presence of a heart attack in the anamnesis;
– Cancer or metastatic cancer;
– Cerebrovascular disorders;
– Chronic lung diseases;
– Chronic renal failure;
– Congestive heart failure;
– Dementia;
– Diabetes with or without complications;
– Liver damage of moderate or severe degree;
– Paralysis;
– Peripheral vascular diseases;
– Rheumatological diseases;
– Peptic ulcer disease;
– Cirrhosis.

Thus, it is quite obvious that the age-related violation of human adaptation to the forces of gravity ends with an inevitable fall, followed by an unfavorable outcome when the bones of the skull, spine or femoral neck are damaged. By itself, the specific cause of the fall may be *accidental (*a person slipped in the bathroom, tripped over a carpet, threshold, etc.) *,* but the fall itself is not accidental.

It is prepared by numerous partial failures of the functioning of different parallel life support systems in a person with osteoporosis (Fig. 3): chronic kidney disease, vitamin D deficiency, alcohol abuse, visual impairment, joint contracture and multiple accompanying chronic conditions ("comorbid cascade").

The comorbid cascade of clinical manifestations is preceded by a cascade of metabolic disorders, which often proceed imperceptibly, "linearly" and do not cause concern among medical workers [15].

The projection of detected violations on the PVC makes it possible to conceptually determine the following kinetics of age-related changes in relation to violations to gravitational forces (Fig. 7).

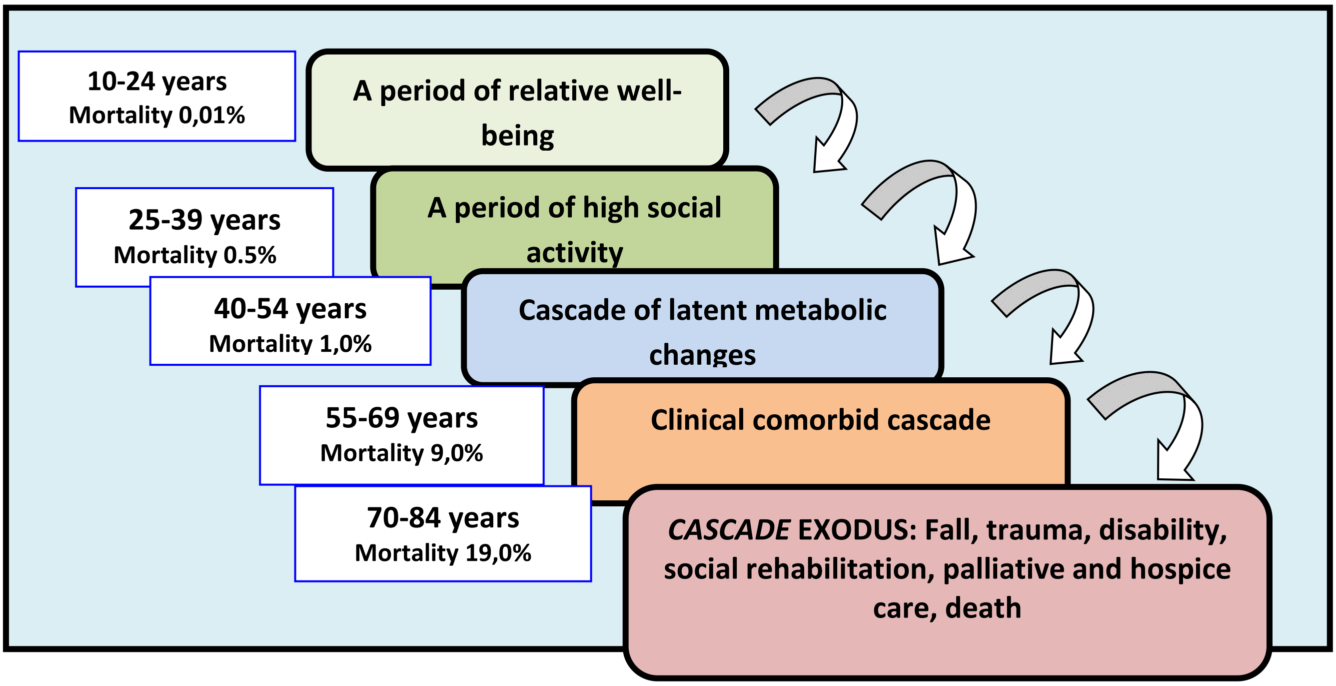


Figure 7. Cascading mechanism of age-related maladjustment to the effects of gravity.

1.4. Medical aspects of health research

One of the important functions of the state is to protect the health of the population, since people's health is one of the resources of prosperity of any country. Mass epidemics, high disability, short life expectancy, a high pool of congenital diseases, poor physical development of men and women in adulthood - all these factors create a heavy "burden of diseases", a lot of intractable social and economic problems.

The health care system (HCS) includes three mandatory blocks or subsystems: the management of HCS services, the prevention sector of the HCS and the HCS medical care sector itself. According to the WHO concept, medical care in each country should be represented at three levels: primary (prehospital), secondary (hospital) and tertiary (highly specialized).

The main function of preserving and assessing the health of the population is assigned to the primary link, represented by general practitioners and family doctors. It is this contingent of medical workers who collects, processes and sends to the management bodies of the HCS information on the number of healthy and sick people in various groups of the population: children, adolescents, men and women, disabled people, the elderly, etc. Secondary and tertiary levels of medical care, as well as recently created disaster medicine, are focused on providing medical care to sick or injured people.

The conclusion of a medical worker on the health of a person is based on the presence or absence of facts of deviation of the studied health parameters from the accepted "norm". Each deviation from the norm is considered to be a symptom of the disease. A healthy person has no symptoms.

If there are no deviations from the "norm", then such a person is considered "practically healthy". If during the examination deviations from the norm are revealed, defined as symptoms, the doctor compares them with the criteria of various diseases and goes to the nosological diagnosis.

We put the term "practically healthy" in quotation marks, implying the relativity of such a conclusion. Among medical workers, with the development of medical diagnostic technologies, there is a common ironic opinion that "a healthy person is not a pre-examined patient."

Indeed, during a total laboratory, genetic and instrumental examination, most people reveal certain deviations from the recognized norms. These "findings" are random against the background of the fact that the examined person does not make any complaints, leads a normal healthy lifestyle and consults a doctor for the purpose of a preventive examination.

Genetic examination poses even more difficult tasks for doctors to assess a person's real health. It is known how many genetic variants of the activity of certain genes exist to control the same function of controlling metabolism. For example, increased blood clotting, leading to the formation of many vascular blood clots

(thrombophilia). Thrombophilia - the most common type of coagulation disorder (blood clotting), characterized by the body's predisposition to the formation of blood clots followed by deep vein thrombosis, heart attack, stroke and other life-threatening conditions, may depend on mutations of different genes:
Leiden mutation (coagulation factor V of the F5 gene)
Mutation prothrombin (coagulant factor II gene F2)
Mutation methylenetetrahydrofolatereductase (MTHFR gene)
Gene methioninesynthasereductase MTRR
Mutation methioninesynthase (MTR gene)
Gene proconvertin – F7
Gene fibrinstabilizing factor – F13
Fibrinogen gene – FBG
Mutation-1 integrin α2 (ITGA2 gene)
Gene platelet integrin ITG B3
Plasminogen activator inhibitor gene PAI1

And breast and ovarian cancer can also be caused by different genes:
Mutation-1 of the VRCA1 gene
Mutation-2 of the BRCA1 gene
Mutation-3 of the BRCA1 gene
Mutation-4 of the BRCA1 gene
Mutation-1 of the BRCA2 gene
Mutation-1 checkpoint kinase
Mutation-2 cell cycle checkpoint kinase (CHEK2 gene) of the cell cycle (CHEK2 gene)

There is a large group of diseases for which the presence of a genetic predisposition has been established. The development of such diseases depends on the interaction of environmental factors and the heredity of the person himself.

The diversity of genes ensures the genetic uniqueness of each person. Variations in genetic material form both differences in physical characteristics (for example: eye color, height) and the body's response to external influences. If a person with a predisposing genotype falls into conditions that provoke the manifestation of genetic characteristics, the corresponding disease develops.

Experts estimate that each person carries up to 2,000 genetic defects that can affect their health, and in some cases can contribute to the development of serious diseases. And in rare cases, such mutations give the personality valuable properties for society. There are a lot of causative factors (mutagens) and a number of them, like natural radiation, accompany a person throughout life.

According to statistics, about 4% of children are born with certain hereditary diseases. Among them are:
Huntington's Chorea; muscular dystrophy; achondroplasia (dwarfism); Hydrocephalus; Phenylketonuria; Down syndrome; type I diabetes mellitus; sickle cell anemia; endocrine disorders; mental disorders.

However, it is not only DNA that determines the signs of our body. In studies on twins, it was shown that even with the complete identity of the genome, twins could differ in many traits. Scientists have long investigated this issue and found that in addition to genetics, there are many other factors that affect the activity of our genes. They were called "epigenetic factors."

There are several levels of epigenetic regulation. The first is chemical modifications of DNA itself (the most common being methylation) or of its surrounding proteins (chromatin). All of these modifications determine how much DNA will be available for interaction. Other mechanisms (RNA interference) regulate the rate of formation of protein molecules (translation). Epigenetics also regulates the rate of maturation of protein molecules (protein folding). In other words, epigenetic mechanisms determine how active those molecules will be. or other genes and proteins.

The mechanisms of epigenetic regulation are an evolutionary acquisition because they allow us to adapt well to changing environmental conditions. Many studies, both in animal models and in humans, have made it possible to establish that the distribution of epigenetic modifications in the genome changes in response to the stress experienced, the intake of various pharmaceuticals and drugs, hormone therapy, changes in environmental conditions, etc.

An important role here is played by the strength of the effect of the factor and its duration. The most negative effects are associated with chronic exposures. For example, prolonged stress can lead to the development of depression. But even short-term experiences of severe stress (trauma, severe emotional turmoil) can also cause the development of post-traumatic stress disorder. Also, epigenetic changes affect metabolism. For example, studies have shown that children who are malnourished in childhood have an increased risk of developing diabetes 2nd. type in adulthood.

The problem is what can be considered a disease, and what is a variant of normal polymorphism, a variety of health options?

The rapidly developing and recognized by the medical community direction of evidence-based medicine (Evidence-based medicine) has developed and adopted the concept of levels of evidence, which helps a medical professional to get rid of subjective assessment of health and rely on objective facts when arguing a medical opinion.

A distinctive feature of research regarding the principles of evidence-based medicine is the presence of the main document that determines the procedure for conducting the study - the research protocol. It formulates the purpose of the study, clearly defines its design, describes in detail the methodology for selecting the contingent of subjects, forming groups, conducting diagnostic and therapeutic procedures, recording results and statistical data processing

So, in particular, a pyramid of design of statistical studies has been built, crowned by the "gold standard" - randomized clinical trials (Figure 8).

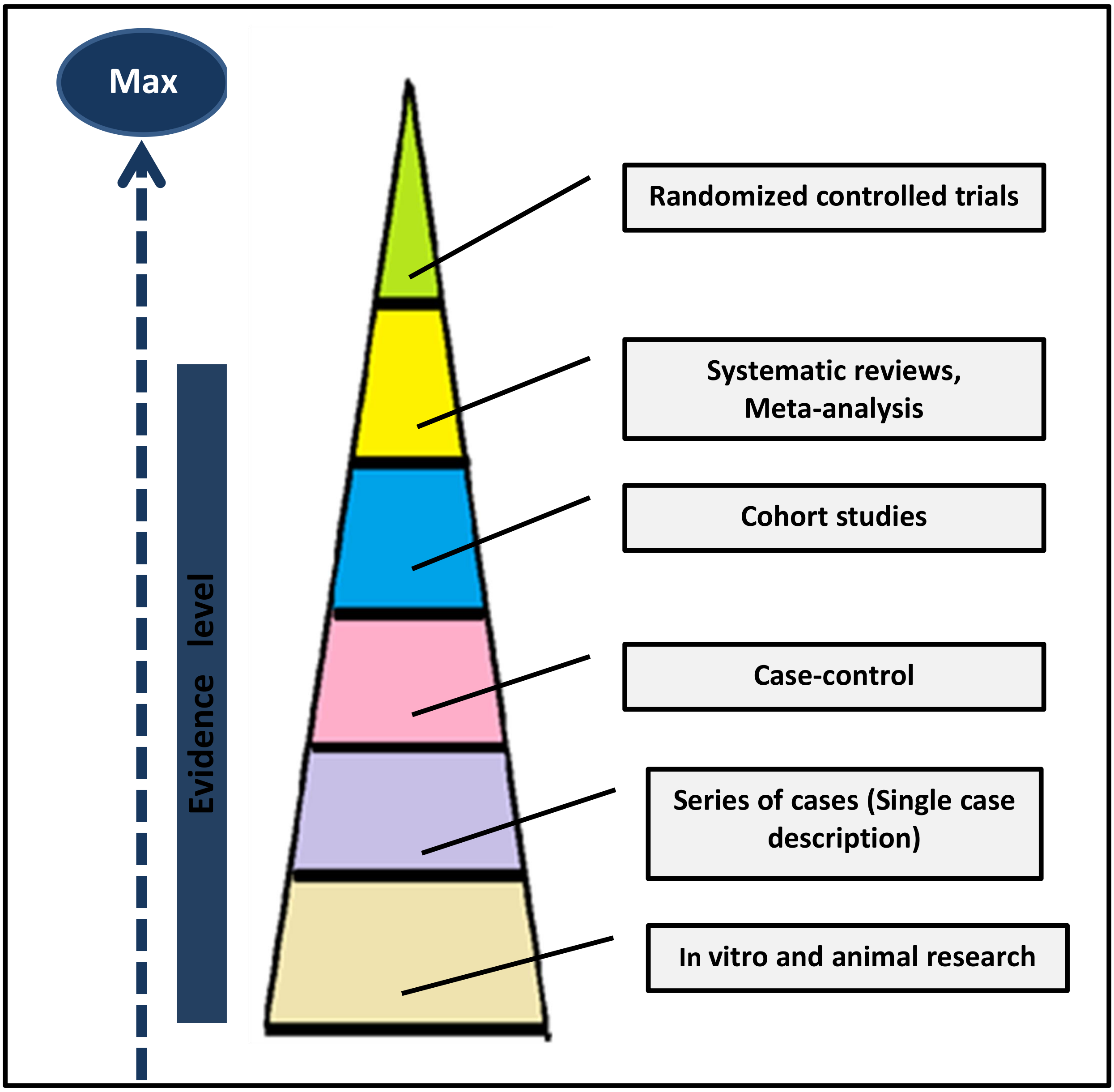


Figure 8. Types of design of statistical studies in medicine.

A randomized controlled trial (RCT) is a type of scientific (often medical) experiment that aims to reduce certain sources of bias (e.g., when testing the effectiveness of new treatments). Clinical trials are called randomized if randomization is used when assigning participants to different treatment groups.

Randomization in RCTs should ensure the comparability of groups on various grounds and, most importantly, on the signs affecting the outcome of the disease. However, this can be achieved only with sufficiently large samples, which are not always possible to form. With a small number of patients, the comparability of groups, as a rule, is disturbed as a result of the fact that some persons, for various reasons, drop out of the experiment, which may prevent the obtaining of reliable conclusions.

The application of the randomization procedure eliminates the biased subjective distribution of the studied persons, provides a more reliable statistical basis for quantifying differences. Therefore, randomized trials are considered more evidence-based and informative than those that lack a randomization procedure, and the gold standard of evidence (Class I) is randomized, double-blind controlled trials [17].

Cohort studies are no less valuable. This is a type of medical research that is used to identify the causes of the disease, establish links between risk factors and their consequences for health. Such studies, as a rule, are predictive, or "promising" – that is, they are planned in advance and conducted over a certain period of future time [17, 18].

With the advent of computer technology for information services of medical requests, interest in the possibilities of accumulating and summarizing numerous bio-medical data has increased dramatically. One of the forms of analysis of medical research, the essence of which is reduced to the thematic selection and study of all available articles on a particular topic, are systematic reviews and meta-analysis.

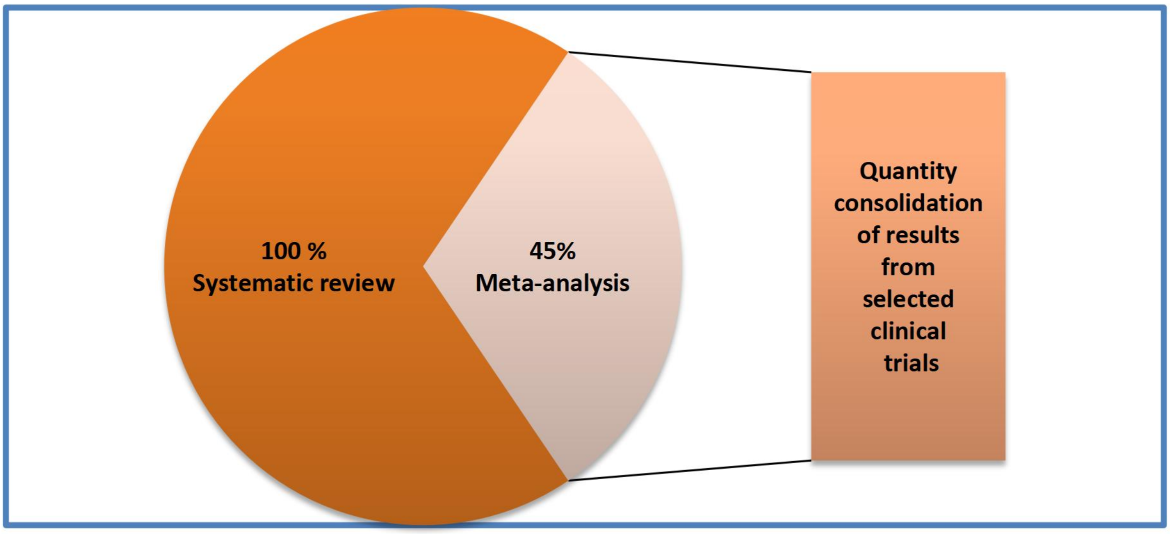


Figure 9. Relationship between systematic reviews in medicine and meta-analysis.

Meta-analysis is a type of systematic review. It combines a numerical analysis of similar studies, and can be carried out both on its own and be part of a systematic review.

Researchers conducting relevant systematic reviews are usually experts, and work according to a well-known research protocol, analyzing medical data.

The findings of systematic reviews are much more valuable than those of a single study, thanks to a better methodology and a larger sample of cases taken into account.

The results of convincing, reliable research are transferred from science to practical medicine. Practical doctors in their activities rely on the data of evidence-based medicine, both when prescribing treatment and when assessing the state of human health. In particular, the routine assessment of weight, height, head and chest circumference of a child and an adult, dynamometry, parameters of functional tests are based on two types of statistical approaches.

In the first case, we are talking about the method *of sigmal deviations*, which involves a graphic representation of the main indicators of physical development (body length, body weight and chest circumference) after preliminary comparison with standard data. The standards, developed taking into account age and sex, present the arithmetic means (M) of each of the above features, as well as the mean square deviation - the permissible deviation from the mean Values up or down (±s).

The values of sigmal deviations are marked with dots on the corresponding horizontal line. All points are connected in straight lines. The resulting graph (profile of physical development) allows you to draw a conclusion about the physical development of the child, the magnitude of deviations from the average indicators and the proportionality of the physique. The deviation of individual indicators from the average standard values within **M±1s** indicates the average physical development of this individual (Figure 10). With development below average, indicators are in the range from **-1s** to **-2s,** with low physical development from **-2s** to **-3s.** With physical development above average, individual indicators range from **+1s** to **+2s,** with high - from **+2s** to **+3s.** At the same time, the decisive indicator for determining the degree of physical development is considered to be height (body length), the least susceptible to external influences.

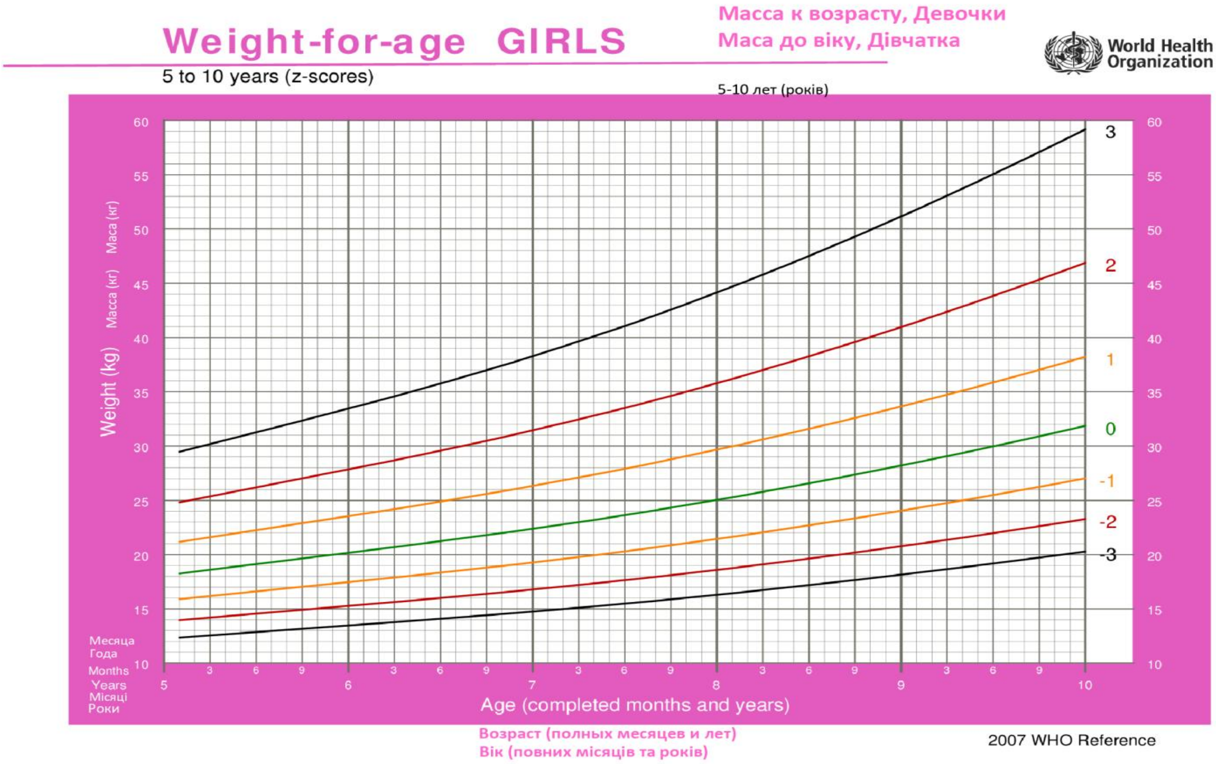


Figure 10. Example of a WHO sigmal deviation nomogram for evaluation physical development of girls aged 5 to 10 years.

In the second case, we are talking about *a centile* method, which involves a graphic or tabular representation (Figure 11) of the main indicators of physical development in relation to the percentage distribution of such indicators in the population. In this case, the indicators of 50% ± 25% correspond to the norm. From 25% to 10% - an indicator below average. From 10% to 3% - a low figure and less than 3% - an extremely low indicator. Accordingly, 75% - 90% - the indicator is higher than normal; 90% - 97% - a high figure, and more than 97% - an extremely high figure.

Рост и вес ребенка до года (девочки)

Возраст	Длина/рост							Масса						
	Центильный интервал 1–8							Центильный интервал 1–8						
	3%	10%	25%	50%	75%	90%	97%	3%	10%	25%	50%	75%	90%	97%
0	45,8	47,5	49,8	50,7	52,0	53,1	53,9	2,6	2,8	3,0	3,3	3,7	3,9	4,1
1 мес	48,5	50,3	52,1	53,5	55,0	56,1	57,3	3,3	3,6	3,8	4,2	4,5	4,7	5,1
2 мес	51,2	53,3	55,2	56,8	58,0	59,3	60,6	3,8	4,2	4,5	4,8	5,2	5,5	5,9
3 мес	54,0	56,2	57,6	59,3	60,7	61,8	63,6	4,4	4,8	5,2	5,5	5,9	6,3	6,7
4 мес	56,7	58,4	60,0	61,2	62,8	64,0	65,7	5,0	5,4	5,8	6,2	6,6	7,0	7,5
5 мес	59,1	60,8	62,0	63,8	65,1	66,0	68,0	5,5	5,9	6,3	6,7	7,2	7,7	8,1
6 мес	60,8	62,5	64,1	65,5	67,1	68,8	70,0	5,9	6,3	6,8	7,3	7,8	8,3	8,7
7 мес	62,7	64,1	65,9	67,5	69,2	70,4	71,9	6,4	6,8	7,3	7,7	8,4	8,9	9,3
8 мес	64,5	66,0	67,5	69,0	70,5	72,5	73,7	6,7	7,2	7,6	8,2	8,8	9,3	9,7
9 мес	66,0	67,5	69,1	70,2	72,0	74,1	75,5	7,1	7,5	8,0	8,6	9,2	9,7	10,1
10 [redacted]	67,5	69,0	70,3	71,9	73,2	75,3	76,8	7,4	7,9	8,4	9,0	9,6	10,1	10,5
1[redacted]	[redacted]8,9	70,1	71,5	73,0	74,7	76,5	78,1	7,7	8,3	8,7	9,3	9,9	10,5	10,9
1[redacted]	[redacted]70,1	71,4	72,8	74,1	75,8	78,0	79,6	8,0	8,5	9,0	9,6	10,2	10,8	11,3

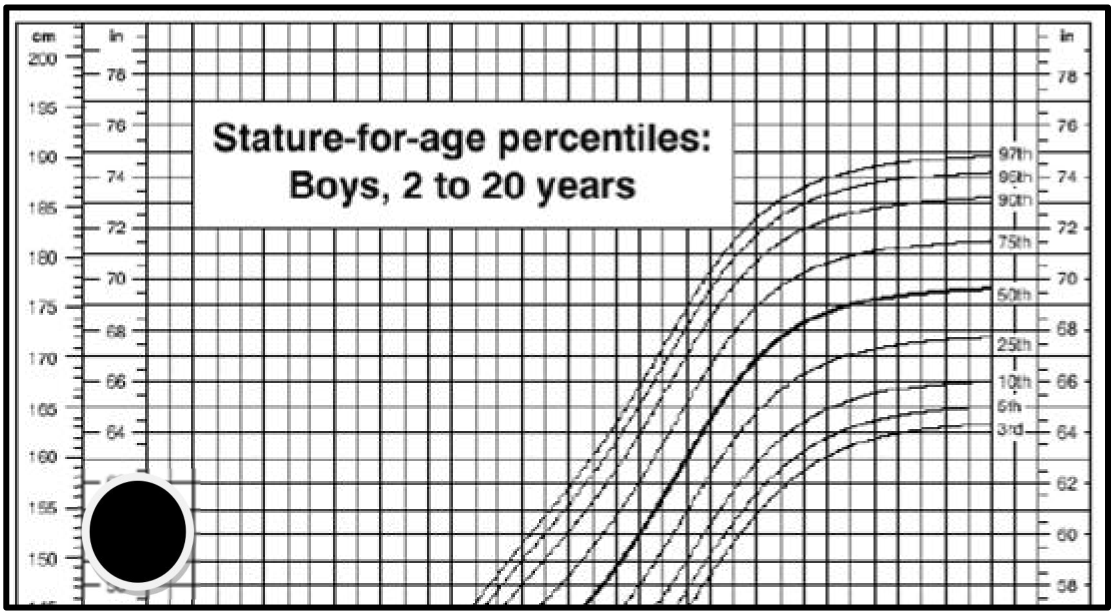


Figure 11. Examples of centile assessment of the physical development: height and weight of girls and boys according to tabular data(A)or nomogram (B).

2. Methods of studying social health

2.1. Statistical methods

The study of health, as an extremely important factor in the social and economic life of society, required a variety of approaches to its assessment. For example, WHO experts consider the percentage of gross national product (GNP) going to health as a criterion for public health; access to primary health care; child mortality rates; average life expectancy, etc. [19].

Such an analysis requires the use of statistical, sociological (questionnaires, interviews, family comprehensive survey), expert, economic and other approaches. These methods make it possible to *quantify* such categories as ***the social health ratio*** **(an indicator of measuring** the quantity, quality and reserves of people's health accumulated by society), or ***the public health index*** **(an indicator** of the ratio of healthy and unhealthy lifestyles of the population).

Such an indicator approach should be recognized as more progressive than qualitative criteria for public health, which are subject to speculative influences. For example, the well-known definition of Academician Yu. P. Lisitsyn is "Public health is a state of society that provides conditions for an active productive lifestyle that is not constrained by physical and mental diseases, that is, this is something without which society cannot create material and spiritual values, this is the wealth of society." With this approach, the categories of "wealth of society", "spiritual values", "unconstrained productive way of life" will have a very different interpretation in countries with a different way of social and political life.

Defining the essence of the category of "health", despite 75 years ago, WHO remains firmly committed to the principles set forth in the preamble to the Charter. In particular, in defining health as "a state of complete physical, mental and social well-being, and not simply the absence of disease or physical defects" [20].

WHO experts recommend using three main blocks to study the health of the population:

- Demographic indicators;
- indicators of physical development;
- Morbidity and disability rates.

Each of these blocks includes many other statistics, the processing of which makes it possible to calculate such a significant indicator of public health as the Global Burden of Disease (GBD). Under the guidance of WHO, a study of GBD was conducted in 2010 with the participation of 488 co-authors from 303 organizations in 50 countries [21]. In this ambitious program, GBD was studied on the basis of analytical processing of 18 components:

1. Covariat database; 2. mortality by age groups; 3. databases on causes of death; 4. assessment of causes of death; 5. bringing individual mortality indicators to a single value of mortality from all causes; 6. databases of epidemiological data on the consequences of diseases; 7. assessment of the prevalence, frequency and duration of the consequences of diseases; 8. cross-checking the levels of ill health; 9. analysis of the nature and external causes of injuries; 10. disability weights; 11. modeling of concomitant diseases; 12. healthy life expectancy; 13. Loss of DALY (disability-adjusted life year) - an indicator that assesses the total "burden of disease" associated with diseases and injuries; 14. databases on exposure to risk factors; 15. Assessing the prevalence of exposure to risk factors; 16. relative risk assessments for risk-disease pairs; 17. theoretical minimum exposure to risks; 18. years of life lost (PGH) associated with each risk factor + disability life loss (HHS) associated with each risk factor + DALY losses (healthy life lost associated with risk factors) [21].

Thus, the GBD study project is the first integrative and multifactorial approach to the study of the health of our world's population based on the quantitative assessment of the magnitude of health loss caused by diseases, injuries and risk factors associated with age, sex and geographical location for certain points in time.

The findings showed a dramatic transformation in the global health and wellness status over the past two decades. Life expectancy around the world has increased significantly. As a result, the average age of the world's population has increased, i.e. the population has "aged". The number of people in the world has increased significantly.

In addition to these demographic shifts, the quality of national health systems has changed significantly. Many countries, for example, have made exceptional progress in preventing child mortality. And if earlier the negative factors associated with premature mortality dominated in health indicators, now demographic indicators largely depend not on mortality, but on the level of disability of the population.

The results of the GBD program showed that "the main causes of death and disability are no longer infectious childhood diseases, but non-communicable diseases of adults." Paradoxically, overeating has surpassed malnutrition as the main risk factor for disease globally, although significant differences remain at the regional and country levels. In sub-Saharan Africa, the contrast is particularly pronounced. It is there that infectious diseases, diseases during pregnancy, nutritional problems and diseases of newborns continue to dominate. All low-income countries have risks associated with childhood morbidity, limited breastfeeding, and underweight in children.

Although infectious diseases are not the main causes of health loss in Europe and Central Asia, other risk factors are present in these regions – excessive diet, high blood pressure, widespread alcohol consumption, smoking, elevated body mass index (BMI) and lack of physical activity.

Google, as a reflection of the structure of the information flow that accompanies the activities of our society, clearly shows the degree of universal interest in health issues. So, in the Google search engine database, as of September 7, 2022, the term "health" had more than 260 million titles of works in Russian language, the term "Health" - more than 13 billion sources and the term "healthy" - more than 42 million works in Ukrainian. "Zhyttya" - more than 54 million sources; "Life" is 425 million." Life" – more than 18.5 billion sources; " disease" - 86.4 million, "disease" - more than 8 million, "Disease" - 6.6 billion sources.

2.2. Socio-economic methods. Social health and its determinants

In recent decades, considerable attention has been paid to the "social determinants of health" as a fundamental concept in population and public health (20). An online search using the term "social determinants of health" allows you to find numerous articles and documents, most of which have been published in recent years.

The work of the World Health Organization's Global Commission on Social Determinants of Health was instrumental in drawing attention to the concept of social determinants of health, as was the landmark World Conference on Social Determinants of Health in Brazil in 2011.

Effective monitoring of the effectiveness of public health activities requires reliable, sensitive and reliable indicators based on a reliable evidence base. Theoretical evidence suggests that interventions targeting the social determinants of health can be used as indicators of action, as it is theoretically assumed that the declared interventions improve these determinants, restore health equity.

Social epidemiological methods have been developed to assess the effects of interventions on social determinants of health, which often rely on natural experiments to substantiate cause-and-effect relationships.

Specific socioeconomic interventions can be used as indicators of impact on the social determinants of health. The social dimension of such social protection interventions can be proven without difficulty. Difficulties in assessment are associated with the use of economic characteristics, such as, for example, *studies on the effectiveness of* management and environmental interventions.

Figure 12 summarizes the process approach to assessing the performance of different health systems (public, insurance and private) proposed by WHO experts. The WHO standard classification of health system performance includes four groups according to functions in the production cycle:

1. resources – the quantity or quality of resources provided by the intervention and the processes of their pooling;

2. results – the quantity or quality of the results achieved through contribution;

3. the results of the policy or programme – coverage of the population by intervention;

4. impact on ultimate goals – well-being and health outcomes affected by the intervention, such as improving the social determinants of health and health equity.

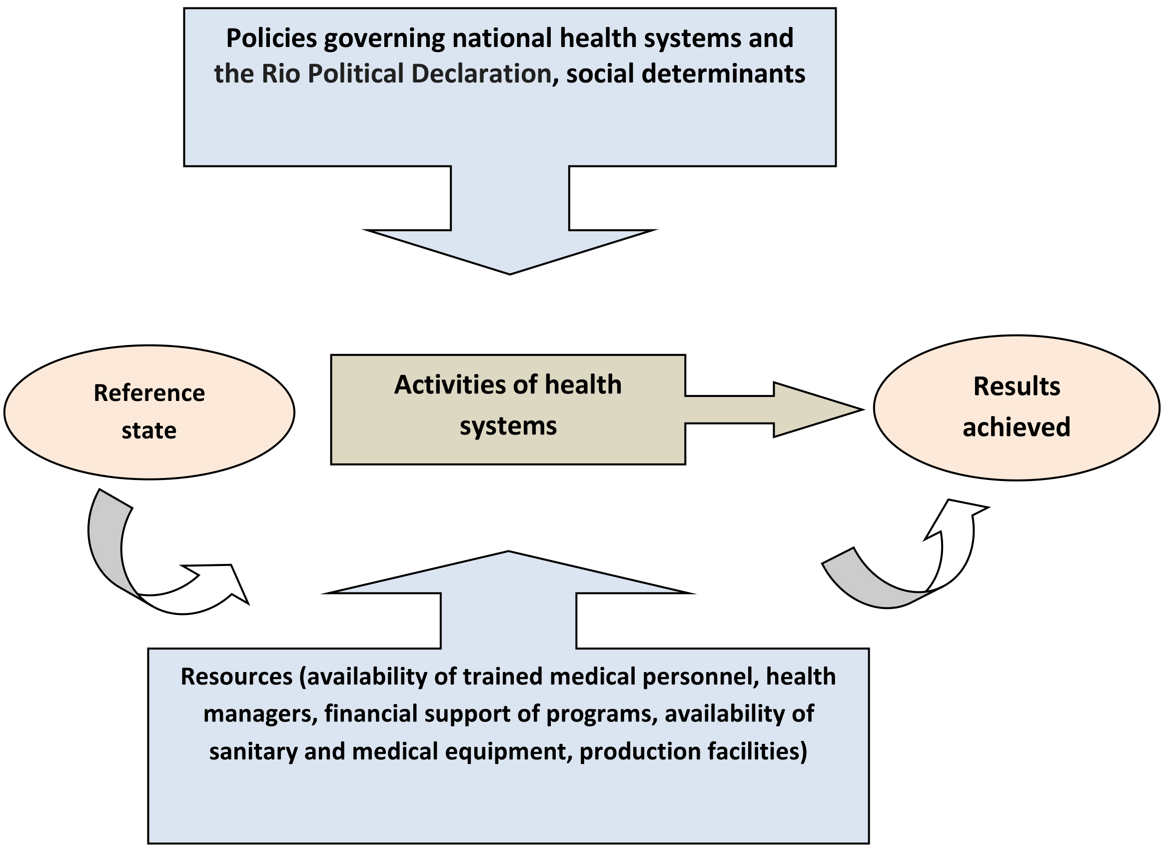


Figure 12. Leading performance indicators of health systems.

Performance indicators should be based on the cost-to-results ratio and not on the number of outputs. An example of such indicators characterizing the effectiveness and efficiency of social determinants can be the following indicators [21].

1. **Indicator of cross-sectoral intervention** in governance (proportion of local administrative units with established and implemented policies and procedures for community participation in water and sanitation management).
2. **Indicator of cross-sectoral socio-economic intervention** (proportion of population covered by minimum levels/social protection systems, disaggregated by sex and disaggregated by children, unemployed, older persons, persons with disabilities, pregnant women/newborns affected by occupational injuries, poor and vulnerable).
3. **Indicator of intersectoral environmental intervention** (proportion of municipal solid waste collected regularly and with adequate final discharge in relation to the total amount of waste generated in the city).

The purpose of developing and implementing such international indicators is to improve the quality of the built or natural environment that increases health equity.

An important element of the WHO Sustainable Development Goals programme is the shift of responsibility for public health, for the burden of disease, from health authorities to municipal and national administrations.

This practice of intersectoral intervention is welcomed by WHO experts [21]. However, due to the conflict of interest between participants encountered, it sometimes takes a long time to achieve the expected effect, and positive evolutionary changes in health inequalities or in social determinants of health cannot necessarily be attributed to the intervention.

Hence, systems are needed to monitor intersectoral action on the social determinants of health. WHO is already developing such international monitoring systems, and Canada has begun to report on national and subnational actions taken to implement the Rio Political Declaration.

Social determinants of health (CLE) are numerous indicators of the sphere in which people are born, grow, live, work and age, and that shape health.

The following is a current WHO review of the social determinants of health:

- socio-economic status,
- education
- environment and physical environment,
- employment and social support networks, and
- access to health care.

Exposure to CLE is essential to improve health and reduce long-standing disparities in health and health care.

Influencing the social determinants of health is important not only for improving overall health, but also for reducing health inequalities, which are often associated with social and economic disadvantages.

There are a growing number of initiatives to address the social determinants of health. Some of these initiatives aim to increase the focus on health in non-health sectors, while others aim to ensure that the health system takes into account the broader social and environmental factors that affect health.

Although medical care is necessary for health, it is not the leading determinant of health (Figure 13).

Nutrition programmes and policies can also promote health, such as farm-to-school and community and school gardens.

Social determinants also include socioeconomic status, education, neighborhood and physical environment, employment, and social networks.

support, as well as accessibility (financial, territorial, organizational) to medical care.

Policies and practices in sectors other than health can have a significant impact on health and health equity.

For example, the availability and accessibility of public transport affects access to employment, affordable healthy food, health care, and other important factors of health and wellness.

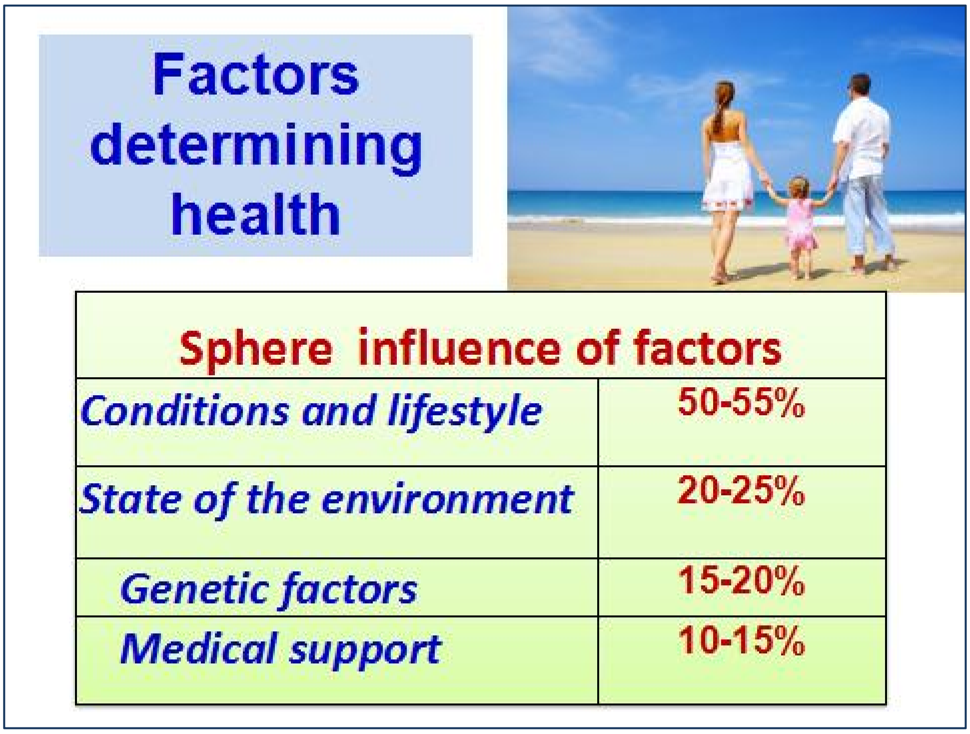


Figure 13. Factors determining human health (http://www.minsksanepid.by/node/25032)

According to WHO experts, although there is currently no consensus in studies on the magnitude of the relative contribution of each of these factors to health, studies show that health behaviours such as smoking, diet and exercise, as well as social and economic factors, are the main drivers of health.

For example, children born to parents who have not completed high school are more likely to live in an environment that creates barriers to health, such as insecurity, open garbage, and substandard housing. They are also less likely to have access to parks or playgrounds, recreation centers or a library. In addition, evidence shows that stress negatively affects health throughout life and that environmental factors can affect multiple generations [21].

Exposure to CLE is important not only for improving overall health, but also for reducing health inequalities, which are often associated with social and economic disadvantages.

3. Mental health and its determinants

Based on the WHO definition of the essence of health, mental health is a state of well-being in which a person realizes his abilities, can withstand the usual stresses of life, work productively and contribute to his community. In this positive sense, mental health is the foundation of human well-being and the effective functioning of the community [22].

Mental health is essential to our collective and individual ability, as sentient beings, to think, to show emotions, to communicate with each other, to earn ourselves the necessities of life, and to enjoy life. From this point of view, the strengthening, protection and restoration of mental health is unequivocally perceived by individuals as actions of indisputable vital importance.

There are a number of determinants that affect mental health. They are intertwined with numerous social, psychological and biological factors, such as: violence, sustained socio-economic pressure, sexual violence, child abuse. There are also numerous special psychological and personal factors that make people vulnerable to social and domestic problems. Poor mental health can be attributed to:

- rapid social change,
- stressful conditions at work,
- gender discrimination,
- social exclusion,
- unhealthy lifestyle,
- physical ill-health, and
- human rights violations.

Specific ways suggested by WHO experts to promote mental health include the following actions [23]:

- early childhood interventions (e.g., creating a stable environment that responds to children's health and nutritional needs, provides protection from hazards, and provides opportunities for early learning and communication with others in a responsive, emotional and developmental way);

- child support (e.g. skills acquisition programmes, child and young people development programmes);
- socio-economic opportunities for women (e.g. improved access to education and microcredit schemes);
- social support for older persons (e.g. dating initiative, local day centres for the elderly);
- programmes targeting vulnerable people, including minorities, indigenous peoples, migrants and people affected by conflict and natural disasters (e.g., psychosocial interventions in the aftermath of natural disasters);
- mental health promotion activities in schools (e.g. programmes supporting environmental change in schools);
- mental health promotion activities in the workplace (e.g. stress prevention programmes);
- housing policies (e.g. improvement of housing conditions);
- violence prevention programmes (e.g. restricting access to alcohol and weapons);
- community development programmes (e.g. Communities That Care initiatives, integrated rural development);
- poverty reduction and social protection for the poor;
- anti-discrimination laws and campaigns;
- empowering and caring for persons with mental disabilities.

Over the past decade, there has been a significant improvement in understanding of what needs to be done about the growing burden of mental disorders. There is a growing body of information on the impact and effectiveness (from an economic point of view) of critical interventions for the treatment and prevention of priority mental disorders in countries at different levels of economic development. Examples of such actions that are cost-effective, feasible and affordable include:

- treatment of depression with psychotherapy and, in the case of moderate or severe depression, antidepressants;
- treatment of psychosis with antipsychotics in combination with psychosocial support;
- taxation of alcoholic beverages and restriction of their sale and advertising.

In addition, there are a number of effective measures to prevent suicide, prevent and treat mental disorders in children, prevent and treat dementia, and treat substance use disorders. The WHO Programme of Action to Address Mental Health Gaps has developed evidence-based guidelines for non-specialists to identify and manage a range of priority mental health disorders.

In 2013, the World Health Assembly approved the Comprehensive Mental Health Action Plan 2013-2020. The plan reflects the determination of all WHO Member States to take concrete action to promote mental health and to contribute to the achievement of global goals.

The overarching objective of the Plan of Action is to promote mental well-being, prevent mental disorders, provide health care, accelerate recovery, strengthen human rights and reduce the mortality, morbidity and disability of persons with mental disorders. The plan aims to achieve 4 objectives:

- strengthen effective leadership and leadership in mental health;
- provide comprehensive, integrated and responsive health and social care at the primary level;
- implement mental health promotion and prevention strategies in the area of mental health; and
- strengthen mental health information systems, evidence and research.

The plan of action focuses on the protection and promotion of human rights, the strengthening and empowerment of civil society, and the central focus of health care at the primary level.

4. Criticism of existing views on health.

Since the concept of "social determinants of health" requires a multifaceted view of health care, this has led to the rapid emergence of theoretical models and structures, as well as an increase in the volume of literature in a relatively short period. This process has created significant ambiguities and ambiguities around the concept, which will prevent key information about the "social determinants of health" from reaching key stakeholders, such as health care providers, health care providers, policy makers, researchers, the public, or students.

Given that the social determinants of health (CLE) are vital to the overall achievement of public health, a clear understanding of the concept is crucial.

The World Health Organization defines CLE as the conditions or circumstances in which people are born, grow, live, work and age. These conditions are shaped by political, social and economic forces. A toxic combination of bad policies and programs, unfair economic arrangements, and poor governance can lead to adverse consequences. Ideally, the socio-political-economic conditions in a society should be such that its citizens benefit from a favourable set of social resources and that these resources are distributed equitably.

The quality, quantity and distribution of these resources together largely determine the health and well-being of a citizen. Educational opportunities, a healthy living environment, nutrition, healthcare, and employment are some of these classic resources.

It is easy to see that all these social resources, known as SDZ, are shaped by government policy. For example, the structure and quality of health care is significantly influenced by government policies. Thus, public policy is a more fundamental determinant than the oft-discussed CLE. If we apply the hierarchy of competencies, we will see that most of our well-known GTS, such as education, employment, and habitat, are in the middle of the rankings, and public policy is in a dominant position.

Using Jeffrey Rose's famous method of finding "cause causes (also called root causes)," we may find that these intermediate resources and their quality are largely determined (or invoked) by government policy.

However, in most academic textbooks and journal articles dealing with the social determinants of health, public policy is rarely covered, and mid-level factors are often emphasized.

American researchers note that the concept of CLE has acquired a double meaning, referring both to social factors that contribute to or undermine the health of individuals and populations, and to the social processes underlying the unequal distribution of these factors between groups occupying an unequal position in society. Thus, the central concept of CLE refers to both the determinants of health and the determinants of health inequality.

In other words, this concept has two dimensions: one is the improvement of social factors that determine health, and the other is the equal distribution of these factors. As a result, the term "social determinants of health" can be confusing and can mean that it's all about the determining factors. For example, in the city A, the water is cleaner than in the city B. The incidence of the population of the city B with gastrointestinal disorders is higher than that of the population of the city A. In this case, the food determinant of health is water. And the difference in the incidence of the population, this is an estimate of the statistical difference in the incidence rates per 1000 population in different cities. The difference in indicators itself can in no way be a determinant, it is an abstract quantity. But, the confusion arising from an overly broad interpretation of the term CLE may fuel policy assumptions that health inequalities can be reduced through policies and a focus only on the social determinants of health. In this case, the responsibility for this inequality can be fully attributed to the health services.

There is now evidence of significant improvements in the determinants of health, and therefore parallel improvements in health can simultaneously increase inequalities in health determinants and outcomes. It can be assumed that the overall improvement may mask persistent or even growing inequality in the distribution of social determinants.

The Australian researcher M. Mofifizul Islam (2019) proposed revising the term, for example, "social determinants of health and associated inequalities", to cover both the determinants of health and the determinants of health inequalities.

Another source of uncertainty for CLE is the long and growing list of their types or species. Although initially a limited set of factors was often emphasized, such as nutrition, education, employment, living conditions, recently this list has expanded significantly – both in peer-reviewed literature and in academic textbooks. In fact, it has grown so large that if someone wants to have a complete list of social determinants of health, his/her enthusiasm can quickly fade when they realize how long the list is.

Some of the most important social determinants of health that dominate the literature are education, housing and/or habitat, income and its distribution, stress, youth, social isolation, work, unemployment, social support, dependence, nutrition, transportation. In later literature, health care, gender, sexual orientation, social safety net, culture or social norms, the media, stigma and discrimination, social capital, conflict, the rule of law, racism, racial legal status, immigration, family, religion, colonialism and marginalization have also been identified as social determinants of health.

Strazdins et al. (2016) defines "time" as the social determinant of health, as healthy behavior, access to health services, rest, and care take time. In addition, the amount of time a person can use for health-related activities is determined by social norms and therefore can be a source of health inequality.

In an article published in Iran, economic sanctions are also defined as SDRs. Access to broadband Internet was also included in the list of CLE compiled by the American Association of Medical Informatics. A subset of literature that examines the social determinants of specific conditions, such as depression, contraceptive use, and oral health, is growing rapidly.

The growth of the CLE list has been accompanied by "considerable ambiguity and confusion". For example, in an interview with NEJM Catalyst (2016), the chief medical officer of Health Leads stated, "In many ways, we fail to work better with the social determinants of health because while we are aware of their importance, we don't really understand them."

Indicative in this regard is the experience of teaching at Melbourne's Australian University La Trobe University the subject "Social Determinants of Health", for which about 2,000 students are enrolled annually. According to the teacher, he receives questions from his students about whether it is possible to compile a complete list of SLZs. Some students believe that this list is too long, and suggest classifying food, housing, education, employment, health and early development as "elementary" social determinants of health and give priority to policy interventions, as these determinants are likely to be important in most programmes being developed.

Although the WHO publication Social Determinants of Health: The Solid Facts contains a short list, academic textbooks rarely follow this view of CLE.

WHO experts acknowledge: "We must also remember that the interaction between different determinants is equally important. While there are reasons to change the list of social determinants of health, a long and varied list can have negative consequences for our efforts to address them."[23]

According to THE DIRECTOR-General of WHO, Dr T.A. Ghebreyesus: "The most important social determinant of health is the human work itself, which can have "disastrous consequences" for a person. CLE, such as excessive workloads, negative behaviours and other stressors of the work environment, result in the loss of 12 billion working days each year and cost the global economy almost US$ 1 trillion. these figures are noted in a recent (28 September 2022) joint press release from WHO and the ILO [24]

The JUNE 2022 WHO report on mental health in the world [25] noted that social phenomena harmful to mental health, such as discrimination and inequality, are exacerbated in the course of work, and that mental disorders affect 1 billion people worldwide, including 15% of adults of working age. workers most often call bullying and psychological violence.

In the literature, the subjective assessment of whether social factors affecting health can be avoided through structural changes in policy and practice appears to be the dominant way to determine the social determinant of health. In addition, the term "social" remains ambiguous and difficult to define within the clear boundaries of health care.

There are already concerns about the requirements and approaches to their screening, as well as their benefits and unintended harm. A long list of CLE can prevent doctors from prioritizing screening for social determinants and referring patients to support services. Politicians may also be less inclined to continue working with such a long and growing list. In most government agencies, there are inherent barriers to adopting a social determinant approach in policymaking.

A long list can add additional restrictions on adoption. A clear understanding of the "social determinants of health" is critical for all key stakeholders, including the public.

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