

The Physiological Mechanisms of Adaptation to the Environment Factors

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Abstract

Of particular concern at present is air pollution which is one of the most important components of the natural environment. Studies of the relationship between the state of public health and the impact of various factors, find that environmental pollution has a significant adverse effect on public health. Under the influence of environmental factors, adverse effects develop in the state of public health, this is manifested in an increase in mortality, morbidity and deterioration of physical development. Environmental factors play a major role in the health status of the population in whole and especially of individual age groups, as individual groups and categories of the population have different sensitivity to the influence of adverse factors and the role of the same factors is significantly different.

Environmental pollution (air, water, food) causes the body's constant efforts to adapt to damaging effects. A deep violation of adaptation can lead to the occurrence of diseases, disruptions in educational and professional activities, antisocial actions.

INTRODUCTION

The problem of human adaptation is an important direction in the study of human ecology. In this case, the significant environmental factors affecting the adaptation of a person are the processes of training and education.

Environmental factors when acting on the functional systems of the body can cause their qualitative and quantitative changes, and this, in turn, affects the health status of the entire younger generation. The problem of adaptation of an organism to various environmental factors is one of the most important in biology and medicine. In the process. [1]

Adaptation involves a complex restructuring of bioregulation, aimed at restoring and maintaining homeostasis, as well as maintaining body functions. An important link in various adaptation reactions is stress, which is based on nonspecific reactions of the body, which reflect the state of tension of the functions of organs and systems and provide the mobilization of its reserve capabilities.

Factors affecting the state of the functional reserves of the central nervous system and the body's adaptability level include: general health, social environment, and climatic and environmental conditions.

In the student years, when the physiological systems of the emotional-vegetative response experience significant stress and are especially susceptible to adverse environmental influences, the study load and the influence of socio-psychological factors are intensified.

Recently, strong changes have occurred in the system of Russian education, new educational institutions of various kinds are being created. With all this, the workload is noticeably increased, the regimen is violated, and as a result, children's health deteriorates.[2]

The beginning of study at the university is associated with a change in place of residence, social environment and the usual rhythm of life. This causes psychophysiological stress, and also leads to efforts to adapt the body to environmental conditions.

In available sources of literature, data on the characteristics of adaptive reactions in girls living in different ecological environments (city, village) who have started studying at a university are not found. However, the study of this problems become relevant in connection with the change in girls aged 16-23 years old place of residence and the ecological and social environment.

METHODS AND RESULTS

Purpose of the study is to establish the features of the formation of compensatory-adaptive reactions of the body of girls living in various environmental media before entering a university and the influence of the urban environment during their education at a higher educational institution. Based on the goal, the following tasks were put forward:

- 1) to evaluate the anthropometric and constitutional indicators of the body of girls living in various environmental environments;
- 2) to study the features of the adaptive response of the cardiorespiratory system in rural and urban residents during their study at the university;
- 3) determine the specificity of psychophysiological reactions in girls who live before entering university in different environmental environments.

The scientific novelty of the study is for the first time on the basis of a comprehensive study of adaptive reactions of the body of girls the psycho-functional differences were found in students of all the studied groups.

When comparing functional indicators, the following priority data were obtained: girls from rural areas showed higher values of indicators of the functional state of both the cardiovascular and respiratory systems, and muscle development indicators than urban girls. A consequence of differences in the values of functional indicators is the level of adaptive capabilities of the body. Objective differences in the correlation of types of temperament among girls living in various ecological environments were first revealed. People from rural areas have a type of temperament that corresponds to the best opportunity to adapt to study at a university.

The research results were included in the methodological recommendations "Preventive measures for the adaptation of students to study at the university."

The authors participated in the study of morpho-functional and psychophysiological indicators of the body condition of girls in the city and the south of the region, carried out mathematical processing of survey results. The study was carried out in dynamics for 5 years and allowed us to consider the process of adaptation in dynamics. All studied material was obtained, processed, and personally analyzed by the authors.

DISCUSSION

The body's adaptability to various environmental factors acts as a long historical process, which is aimed at creating an adaptive type that ensures the integrity and optimal conditions of its life.

Consider the term "adaptation" as applied to a person. In the beginning, the term had a physiological meaning, and was used to denote the adaptation of the sensory organs to changes in the intensity of the corresponding stimuli in the environment. This view is one-sided, because on its basis it can be concluded that the contents of the concepts of "adaptation" and "adaptation" are identical, since adaptation in this sense means only passive changes in the body under the influence of environmental factors. Adaptation processes to one degree or another fit into any act of life, the meaning of the term has gradually changed. In the literature there are a fairly large number of different understandings of the term "adaptation".[3]

In biology, adaptation means the process of adapting the structure and functions of an organism to environmental conditions. Adaptation is a dynamic process on the basis of which the mobile systems of living organisms maintain the stability that is necessary for the existence, development, and procreation, despite the variability of conditions. The adaptation process will be carried out whenever significant changes occur in the body-environment system and the formation of another homeostatic state is ensured, due to which the maximum effectiveness of physiological functions and behavioral reactions can be achieved. Since the organism and the environment are located not in static, but in dynamic equilibrium, their relationships change all the time, therefore, the adaptation process must also constantly take place. Thus, adaptation in biology is considered as a combination of morphophysiological, population, behavioral and other features of a biological species, which provides the probability of a specific lifestyle of individuals in certain environmental conditions.

"Adaptation" (from Latin *adaptado* - adaptation, adaptability) is part of the adaptive reactions of the biological system to changes in environmental conditions. This is expressed in the fact that a system that responds to changes in the parameters and environmental factors that are significant for it modifies its structural relationships to preserve the functions that ensure its existence as a whole in a changing environment. The adaptation mechanism may contain morphophysiological and behavioral reactions, depending on the degree of organization of the system. The main content of adaptation is the internal processes in the system, which ensure the safety of its external functions in relation to the environment. Thus, the result of adaptation is the preservation of homeostasis, in which the structural connections of the system are brought into line with the structure of the changing environment so that the system can continue to operate.[4]

Adaptation is a complex of morpho-functional, behavioral and other characteristics of individuals, populations or species, which ensures success in competition with other individuals, populations or species, as well as resistance to environmental factors. The meaning of adaptation is to maintain a stable state of the organism, population, species in these conditions. Adaptation is the emergence and development of morphophysiological properties, their significance depends on certain environmental conditions, that is, adaptation is always adaptation to the environment. This process is aimed at ensuring normal life and work in the environment.

There are two types of adaptation to external factors: 1) adaptation according to the type of tolerance (endurance) - a passive way of adaptation; 2) adaptation by type of resistance (resistance) is an active way of adaptation, in which, using specific

mechanisms, the body compensates for the influence of the acting factor, and the internal environment remains relatively constant.

Significant contribution to understanding the problem of active adaptation was made by Canadian scientist Hans Selye, who developed the theory of general adaptation syndrome. G. Selye established that the response of the body, regardless of the nature of the effect, is characterized by active mobilization of the hypothalamus – pituitary – adrenal cortex system. The author identified three phases of the body's adaptive response to the action of the stressor.[5]

The first phase (“emergency”) is formed at the very beginning of the action of both physiological and pathogenic factors or changes in environmental conditions. The main burden falls on the visceral system: blood circulation, respiration. Regulation is carried out by the central nervous system with a wide involvement of hormonal reactions, in particular hormones of the brain substance of the adrenal catecholamines), this also leads to an increase in the tone of the sympathetic nervous system. Activation of the sympathoadrenal system results in shifts in the autonomic functions of a catabolic nature. They are aimed at providing the body with the necessary energy.

The emergency phase of adaptation often occurs against a background of increased emotionality.

The second phase is a transition to sustainable adaptation. It can be characterized by a decrease in CNS excitability and the development of functional systems that provide adaptation control. The frequency of hormonal changes decreases, over time, a number of systems and organs that are initially involved in the reaction are excluded. In this phase, the adaptive reactions of the body gradually move to a deeper tissue level. The hormonal background is modified, hormones of the adrenal cortex, “adaptation hormones,” increase their effect.[6]

The third phase is the phase of sustainable adaptation, or resistance. It is adaptation itself, and is determined by the new level of activity of tissue cell membrane elements that have changed due to the temporary activation of auxiliary systems, which will work almost in the initial mode, while tissue processes are enhanced, providing homeostasis that is adequate to the new conditions of existence. The main features of this phase are: mobilization of energy resources, increased synthesis of structural and enzymatic proteins and activation of immune systems. In the third phase, the body receives non-specific and specific resistance - the resistance of the body.

The initial stage of the adaptive reaction begins immediately after the beginning of the influence of the stimulus and can be carried out only on the basis of previously formed physiological mechanisms.

The most important feature of this stage is that the activity of the body passes to the limit of its physiological potentials, with an almost perfect mobilization of the reserve and does not fully provide the necessary adaptive effect.[7]

The "long-term" stage of adaptation does not appear immediately, but gradually, in the result of repeated influence on the body of environmental factors. It is formed on the basis of repeated implementation of "urgent" adaptation.

As a result of the gradual accumulation of changes, the body gains a new quality - it turns from an unadapted into an adapted one. An adapted person is a person who receives certain properties or qualities under the influence of this process. In humans, the ability to adapt to environmental conditions that change during the course of his life within the limits of the reaction norm is sequentially fixed. In addition, the adaptation of a person to environmental conditions may be intermittent and not accompanied by profound changes - incomplete adaptation. Acclimatization refers to this type of adaptation - non-genetic biosocial adaptation, in which the climatic factor is central. In the works of Schwartz S.S. acclimatization refers to direct reactions to a new environment, which are expressed in phenotypic shifts and compensatory physiological changes that allow maintaining the body's balance with this environment. In the transition to the previous conditions, the usual state of the phenotype is established, compensatory physiological reactions disappear. Such acclimatization does not go beyond the potential ecological individuals of a given species and genotype and occurs without genotypic changes. In addition, Schwartz S.S. notes a type of acclimatization in which hereditary genotypic adaptive properties are developed in a number of generations in relation to new conditions of existence.[8]

Thus, the term “adaptation” in biology means a completely different way of adaptation to the environment. In this case, we are talking about much deeper shifts in morphology and physiology - their transmission by inheritance, the transition of phenotypic changes under the influence of selection into the genotype and their fixing as new hereditary characteristics of the population, geographical races and species, for its implementation several generations.

The system of biological adaptations to the external environment contains morphological, physiological, and behavioral adaptations. Morphological adaptation is located on the surface of the body. Physiological adaptation can be divided into two groups: static and dynamic. The mechanism of static adaptation is based on the maintenance of physiological constants. The mechanism of dynamic adaptations consists in changing metabolic processes in order to minimize the impact of harmful factors. Behavioral adaptation contains all the variety of behaviors aimed at the survival of individual organisms and the species as a whole.[9]

For a person, social adaptation is also of great importance. The main social factor is the socio-economic level of income and occupation. The ratio of biological and social factors is different at the stages of the history of mankind. Social adaptation

presents a more complex, self-developing system of material and spiritual ways of adaptation. It is not identical in its essence, means and direction of human biological adaptation. Social at all levels "sets" the boundaries and determines the requirements for the biological manifestations of the vitality of the organism. People have formed genetically unchanged mechanisms of adaptation to a specific set of factors, and now each person has an optimal ecological environment, which is characterized by climatic, geochemical and social conditions under which it shows normal biological and labor activity.

CONCLUSION

Predicting the effectiveness of activities under certain conditions and assessing the effects of various factors on a person must be performed based on the basic principles of the theory of adaptation and the concept of a functional state. Adaptation as a dynamic process is connected with the functional state of the body, and becomes a characteristic of the level of functioning of body systems in a certain moment of time. In terms of quality, the composition of functional states in all people is approximately the same, since it is set genetically. However, there are important individual differences in the severity and dynamics of identical states, which is a feature of the activity of regulatory mechanisms, and most importantly, the individual psychological characteristics of the individual. Based on this, the following assumptions can be made:

1. The adaptive abilities of an organism in many respects depend on its psychophysiological features, which establish the possibility of adequate regulation of the functional state of the organism in various conditions of life.[10]
2. Assessment of the adaptive capabilities of the individual is permissible through an assessment of the level of development of psychological characteristics that are most significant for the regulation of mental activity and the adaptation process. Thus, people with adaptive potential have a lower level of anxiety, a higher level of neuropsychic resistance, there are no problems in social adaptation and somato-neurotic symptoms.

Qualitative changes in the biological, psychophysiological indicators of the modern population are characterized by the development of new biological laws, their specific orientation in various climate-geographic, socio-production conditions.

Modern populations of people can no longer be defined as conservatively stable groups, constantly isolated for generations in the space they have mastered. Most likely, these are continuous flows of people who move through geographic space in the complex interweaving of social, industrial and natural conditions. High migration mobility of the population is a constant phenomenon that characterizes the most important aspect of the socially conditioned adaptation of modern populations. Special

large-scale this feature appears today in Siberia, where the share of the zone of human development is growing rapidly.

Using the terminology of E. Bauer, we can say that today the relationship of a person with the environment is characterized by an ever-increasing degree of stable disequilibrium, which is supported by the constant tension of the adaptation process.

Adaptation is inherent in all known forms of life and is so comprehensive that it is often compared with the very concept of life. This is not accidental, since the processes of the emergence of living matter, wherever they take place, and its evolution carried adaptive properties. And they, being an obligatory attribute of life, become more complicated and progress in the process of its development, becoming more and more active. And if the evolutionary process is considered as a progressive development of the property of adaptation to the environment and the property of adaptation of this environment in the interests of the living, then, indeed, the concept of life and the concept of adaptation substantially overlap.[11]

Just as the properties of individual development are embedded in the genetic apparatus, and the manifestation of the qualities that genetic structures carry is possible only if they are realized in individual life (ontogenesis), so the properties of fitness and adaptation, that is, quality, an individual "health norm" can be deep research only when they manifest themselves in real life conditions. To do this, one or another organism must be in such natural or artificial conditions, when for the survival and preservation of offspring requires maximum mobilization and stress of its potential adaptive capabilities. Thus, the adaptation property of a living system is a measure of individual health.

Theoretical and practical significance of the work concludes in the obtained data on the functional and psychological state of girls studying at the university, as well as their adaptive capabilities, can be used to increase the effectiveness of the educational process at the university and provide conditions for sparing adaptation of first-year students to new social conditions, as well as when planning measures to maintain health in the process studying at a university. Data on psychophysiological features and functional capabilities 1st year students are used to develop recommendations for physical education classes, as well as disciplines of the natural science cycle. The established age-gender characteristics of girls in the city and the south of the region complement knowledge of environmental physiology, the results of the study are introduced into the educational process at various departments (biology, ecology, physiology, etc.).[12]

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