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The dependence of the adaptation of the cardiovascular system in adolescents on the state of some environmental factors

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Abstract. This article presents the experimental data related to the ecological factors that have an impact on the adaptation of children and adolescents. The selected ecological factors are the air and water quality in the areas surrounding the investigated educational institutions. It was established that there is a correlation between the degree of pollution of the external environment and the cardiovascular indices of adolescents. Thus, for the students from the academic institutions located in the more polluted areas, the indices of heart economy and the restoration of the frequency of heart contractions after physical effort are lower compared to those of students located in the educational institutions from the less polluted areas.

Keywords: adolescents, ecological factors, health, adaptation, cardiovascular system.

Dependența adaptării sistemului cardiovascular la adolescenți de starea unor factori de mediu

Rezumat. Sunt prezentate datele experimentale legate de factorii ecologici care au impact asupra adaptării copiilor și adolescenților. Ca factori ecologici au fost selectați starea aerului și a apei din zonele instituțiilor de învățământ. S-a stabilit prezența corelației dintre gradul de poluare a mediului extern și indicii cardiovasculari ai adolescenților. Astfel, pentru elevii din instituțiile situate în zonele mai poluate, indicii de economie a inimii și de restabilire a frecvenței contracțiilor cardiace după efort fizic sunt mai mici față de valorile elevilor din liceele din zonele mai puțin poluate.

Cuvinte-cheie: adolescenți, factori ecologici, sănătate, adaptare, sistem cardiovascular.

1. Introduction

The incidence of neurosis of children increases as the learning period extends [4]. Neurotic disorders are more common in boys, most of who are in their crisis age. School inadequacy also contributes to neurosis [1,5]. The incidence of neurosis of adolescents is higher, especially with a predominance of anxiety and depression, which are more common in girls.

One of the strategies employed by psychologists is monitoring and intervening during the pupils' adaptation to school. According to research by Furdui T. et al. [6], the process of adapting by education includes several stages:

- First stage - characteristic to the first stage are stormy reactions and significant tension of all organ systems. This lasts 2-3 weeks.
- Second stage – adaptation is unstable when the organism searches the optimal body side of impact factors. Energy costs are decreased.
- Third stage - the adaptation is unstable when the body finds optimal variants of reactions, with minimal costs, but the possibilities of a child's body are limited, and long-term effects can influence their health.

Children are classified as children with easy, moderate and difficult adaptation. In easy adaptation, the organism's tension is compensated during the first half of the year. In moderate adaptation, functional disorders may be present also in the first half of the year. In difficult adaptation, health disorders increase towards the end of the school year, which shows that the educational system and information put pressure on children. The proposed criterion of easy adaptation is the level of work capacity during the first half of the year, the absence of adverse changes in health and better assimilation of the curriculum. The indicator of difficult adaptation are the changes in the child's behavior [2].

The factors that that cause inadequacy are:

- School factor - lack of individual approach towards the child, inadequate educational measures, signs of disrespect.
- Family factor - unfavorable emotional and material situation in the family, parents' alcoholism, lack of attention or the contrary, hyperattention.
- Microsocial factor - negative influence, access to money and alcohol.
- Macrosocial factor - deformation of social and moral ideals, propaganda of violence.
- Somatic factor - severe chronic somatic diseases, disorders of locomotion, hearing, vision, speech.

2. Purpose of the Work

Adaptation is an important factor in the educational process, which itself is influenced by many factors. This article analyzes the influence of ecological factors on the physiological parameters of children in order to determine their level of adaptation.

3. Materials and Methods

The study was conducted in two high schools, located in different zones of the anthropic factor. All children (90 people, aged 16-17) participating in the studies were practically healthy. The degree of environmental pollution was proved by the number of factories in the zone, as well as by objective indicators of the air and water quality. To assess the functional state of the cardiovascular system, the heart rate (HR), systolic and diastolic blood pressure (PS and PD) were measured. In order to study the degree of functional recovery of the cardiovascular system, measurements were taken before the load, immediately after it, after 2 minutes and after 10 minutes. Calculation of the coefficient of efficiency of blood circulation (KEK) was carried out according to the formula: KEK = (PS - PD) * Heart rate (HR)

The assessment of the vegetative status of the child included the calculation of the Kerdo index: IK = PS / HR [4].

4. Results and Discussions

The 21st century is characterized not only by the rapid development of the scientific and technological revolution, but also by the emergence of universally recognized dangers for the continued existence of civilization – ecology, nutrition, energy, and demography. Most countries of the European continent are facing demographic problems. Therefore, it is all the more crucial to ensure the younger generation's health. At present, heart diseases occupy the leading place in the structure of the causes of death in the economically developed countries. In different countries, the share of these diseases in total mortality ranges from 30% to 60%. Among other causes of cardiovascular diseases, the effect of air pollution has been noted [3].

The studies of the economy of blood circulation showed that in the studied schools, the KEK increased in most student, which indicates the stress of the state of the cardiovascular system. KEK was increased in 68.75% of students living in a less polluted zone (Fig. 1), and 50% of teenagers from a more polluted area.

The increase in the coefficient indicated a reorganization of the central circulation, which is associated with an increased costs of body reserves. At the same time, there was no student found in the polluted zone who has a normal coefficient of efficiency of blood circulation (KEK) [5]. On the other hand, in an ecologically more favorable zone, a normal KEK was observed in 12.5% of the children.

Thus, a greater number of children in the ecologically favorable area (87.5%) have the HR index within normal range over one minute after exercise. However, this index is

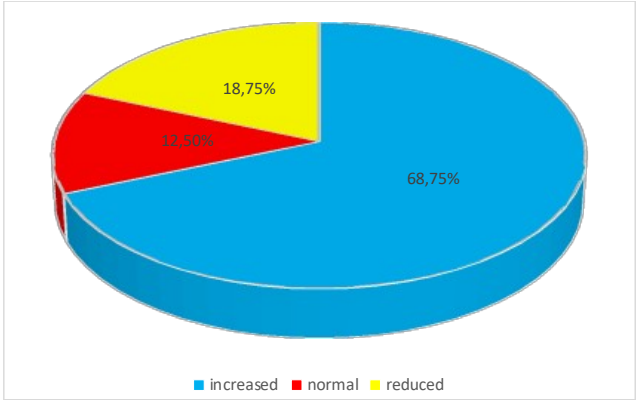

Figure 1. Coefficient of efficiency of blood circulation in the less polluted area.

smaller in value for the children in the polluted area (only 70%). HR over five minutes after exercise is not restored to normal in 60% of children in the polluted area and 37.5% of children in the ecologically favorable area (the difference between the results is statistically significant) [7]. Thus, cardiovascular parameters are influenced by ecological factors – particularly by the composition of the air.

The assessment of the vegetative status of the child are demonstrate in Fig. 1. Research on the functions of the endocrine system (Kerdo Index) has shown that most students have hormonal disorders - 60% in less polluted areas, and 70% in polluted areas.

It is concerning that endocrine disorders are present in most children, regardless of the degree of pollution of the area (Fig. 2).

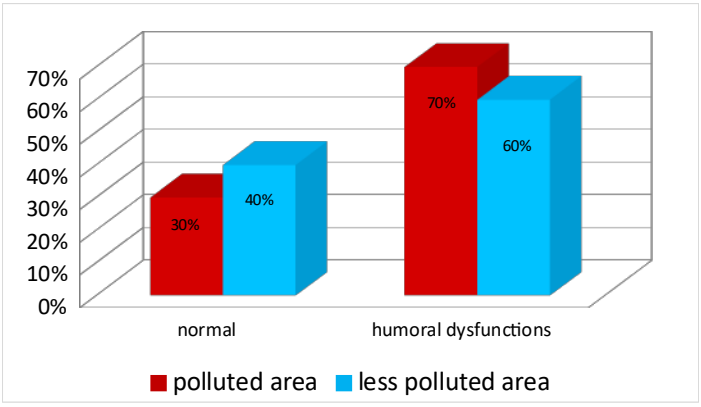

Figure 2. Kerdo index for students in areas with different levels of pollution.

5. Conclusions

The cardiovascular parameters of children are influenced by ecological factors, particularly by the composition of air.

Students from both ecological areas showed disturbances in the activity of the cardiovascular and endocrine systems. For the students from the academic institutions located in the more polluted areas, the indices of heart economy and the restoration of the frequency of heart contractions after physical effort are lower compared to the values displayed by the students in the academic institutions from the less polluted areas

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