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THE INFLUENCE OF PHYSICAL ACTIVITY ON THE PARAMETERS OF EXTERNAL RESPIRATION OF SEVEN-YEAR-OLD GIRLS, LIVING IN DIFFERENT ENVIRONMENTAL CONDITIONS

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Abstract:
Different social and environmental factors over the past few years have had a negative impact on the health of the population and its adaptive capacity. Among the studied issues, constituting a social procurement, a special place is occupied by the problem of preserving the health of children, living in conditions of technogenic pollution of the environment. Growing organism under modern conditions is forced to stand against various factors, causing functional mismatch, among which there are certain ecological living conditions. Therefore, the relevance of investigation the physiological systems, which provide the adaptation of the organism to changing environmental conditions, is quite obvious.
We conducted the investigation of functions of the external respiration system and its response to the controlled physical activity in seven-year old girls, studying in the first grade of comprehensive school, living in different environmental conditions. Comparative analysis of the physical activity influence on the parameters of external respiration in 7-year-old girls, living in different environmental conditions, was carried out.
In the process of the study it was found, that environmental pollution was one of the causative factors of reducing the parameters and adaptive capabilities of the external respiration system, in response to the controlled physical load, and the period of recovery of the studied parameters was lingering and uneven.
Keywords: *children, external respiration, environmental conditions, physical activity.*

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INTRODUCTION:

Among the most important medical and biological problems, the priority is given to the assessment of the influence of environmental factors on the population health state [1-3]. The main contribution to the pollution of the air basin from stationary sources makes the enterprises of the thermal power complex, the fuel industry, machine manufacturing, chemistry and petrochemistry industries [4-8]. Chemicals, coming from the external environment, cumulate in the human body and have the effect of damaging factor in the functioning of the physiological systems in the organism [9-12].

Based on the numerous observations, it can be said, that children are particularly sensitive to the influence of negative environmental factors [13-15].

The child's organism is characterized by incompleteness of anatomical and physical development, low level of functioning of biochemical systems. So, in particular, the activity of processes, that provide biotransformation of xenobiotics, is lower in children, than in the adults. All of this causes the high vulnerability of the child's organism to the effect of unfavorable environmental conditions [16,17]. Growing organism is forced to stand against aggressive environmental factors, which can cause functional mismatch [18]. The starting point of pathology development in children is the need to increase energy production in the cells of adaptive systems, responsible for compensation of anthropogenic impact.

To date, a significant number of studies have been carried out, to identify the impact of environmental pollution on the physical development and morbidity of children, but insufficient attention has been paid to compensatory adaptation and the development of nonspecific resistance of the children's organism, in response to chronic exposure of atmospheric air admixtures, exceeding the maximum allowable concentrations [4]. The respiratory system plays an important role in maintaining the body's homeostasis. The external respiration system is one of the first, which reacts to the influence of environmental factors, and the changing of its functions can lead to a violation of the oxygen supply of the whole organism [19,20].

Any changes in the activity of control or homeostatic systems, connected with various effects, including muscular activity, are reflected in the level of functioning of the respiratory system, which can be mobilized to varying degrees, reflecting the complex mechanism of regulation and mutual compensation of these systems and external factors.

Thus, by examining the functions of respiration, it can be said about the tension of regulatory processes and the functional reserves of the whole organism.

The purpose of the work was a comparative analysis of the functional state and adaptive capabilities of the external respiration system parameters, as well as their response to the controlled physical activity in 7-year-old girls, living in different environmental conditions.

MATERIALS AND METHODS:

The method of directional selection of contingent, physiological and statistical methods, the method of determining physical working capacity, the method of physical exercises were used in the work.

The study was conducted in the secondary school №130 in the area of the location the petrochemical enterprise, which was selected as a relatively environmentally unfavorable region (REUR), and in the secondary school №40, located in a relatively environmentally favorable region (REFR) in Kazan. 30 first-grade girls (в русском варианте «мальчики», в англ заменила на «девочки», так как речь в исследовании идет именно о девочках), practically healthy, with an average level of physical development, took part in the studies. The examinations were conducted in the morning hours, during the whole week. For the investigation, qualitatively homogeneous groups of children were formed in the REUR and REFR, by the method of directional selection of the contingent.

For experimental study of the external respiration parameters, the assessment of airway conductance was made, with the help of the program "AD-102M Respiratory Analyzer". The method of physical exercises was used for determining the physical working capacity.

The cycloergometric method was used in the process of physical activity. The advantage of cycloergometric method is the relative immobility of the upper body, which contributes to the most accessible and accurate receipt of physiological information. Ergometer ERG-3 of Kazan "Medfizpribor" was used in the process of physical activity. Children were asked to perform an exercise test PWC_{170}. Exercise load was selected individually at a rate of 1.50 W/kg.

Children performed the proposed exercise at a constant pedaling frequency of 60 rpm. Exercise time was 3 minutes. The parameters of external respiration were recorded before the exercise test (at rest) and during the recovery period.

The degree of atmospheric air pollution was estimated according to the conditional indicator (P) and the total multiplicity of excess of maximum allowable concentration of harmful substances (K_{total}). The results of the samples were generalized according to the data of the Sanitary and Epidemiological Supervision Center of Kazan. The standard values of the Student's test were used to determine the reliability of the research.

RESULTS AND DISCUSSIONS:

The physical load of seven-year-old girls, living in the REUR, at the 1st minute of the recovery period, caused a slight decrease in the studied parameter of the vital lung capacity (VLC) from 1.65±0.05 liters to 1.62±0.05 liters. During the next 10 minutes of the recovery period after physical activity, a gradual decrease in the investigated parameter has been observing, reaching a maximum (P <0.05) decrease in the 5th minute of the recovery period. Thus, in the 3rd minute the value of the studied parameter was 1.58±0.03 liters, in the 5th minute it was 1.5±0.04 liters (P <0.05), remaining significantly lower than the initial value. And in the 10th minute the VLC value was 1.53±0.04 liters, practically not reaching the initial level. Thus, there was no complete restoration of the values of vital lung capacity.

In 7-year-old girls, living in the REFR, at the 1st minute of the recovery period, the physical load caused a decrease in the value of the investigated parameter, from 1.76±0.04 liters to 1.69±0.06 liters. During the next 10 minutes of the recovery period, there has been a slight fluctuation in the studied parameter of VLC. Thus, in the 3rd minutes this value was 1.74±0.07 liters. It has been remaining practically unchanged up to the 10th minute of the recovery period – 1.74±0.06 liters. Thus, the restoration of the investigated parameter to the initial level was observed almost in the 3rd minute of the recovery period.

In 7-year-old girls, living in the REUR, a significant (P <0.01) increase in the respiratory volume (RV) from 0.52±0.01 liters to 0.65±0.03 liters was observed at the 1st minute of the recovery period. In the 3rd minute of the recovery period, the observed parameter was reduced practically to the initial value of 0.53±0.01 liters. It has been remaining unchanged until the end of the 5th minute of recovery period. By the 10th minute of the recovery period, an increase in the respiratory volume to 0.56±0.02 liters has been observed, remaining a shade higher than the initial level.

The physical load of seven-year-old girls, living in the REFR, caused a significant (P <0.01) increase in the value of the investigated parameter of respiratory volume at the 1st minute of the recovery period from 0.58±0.03 liters to 0.73±0.03 liters. Then, during 10 minutes of the recovery period, there has been a gradual decrease in the values of the investigated parameter, reaching the initial level by the end of the 10-minute recovery period. In the 3rd minute, the respiratory volume was 0.65±0.04 liters. By the end of the 5th minute, it was 0.56±0.02 liters, and by the end of the 10th minute, RV practically reached the initial level of 0.58±0.02 liters.

In 7-year-old girls, living in the REUR, a significant (P <0.001) increase in the respiratory rate (RR) from 12.5±1.06 br/min was observed at the 1st minute of the recovery period up to 20,2±0,97 br/min. In the 3rd minute of the recovery period, the values of the investigated parameter decreased to 14.2±1.15 br/min. By the 5th minute there was a gradual decrease in RR to 12.09±1.19 br/min, that corresponded to almost complete recovery. By the 10th minute of observations a slight increase in the value of the investigated parameter was observed up to 14.5±0.84 br/min.

RR of 7-year-old girls, living in the REFR, significantly (P <0.001) increased from 18.6±1.27 br/min to 27.4±1.83 br/min in response to physical activity at the 1st minute. Then there was a decrease in the studied parameter and its recovery by the end of the 3rd minute to the initial level of 18.9±0.97 br/min. Further, there was a smooth decrease in RR without complete restoration. In the 5th minute, the respiratory rate was 17.2±0.95 br/min, and by the 10th minute there was a significant (P <0.05) decrease in RR to 15.77±1.01 br/min.

The respiratory minute volume (RMV) in 7-year-old girls, living in the REUR, has been significantly (P <0.001) increasing from 6.49±0.47 l/min up to 13.1±0.88 l/min at the 1st minute of the recovery period. By the 3rd minute of the recovery period, a decrease in the RMV to 7.69±0.68 l/min was observed. Then, a smooth recovery of the investigated parameter was noted practically up to the initial level, and by the end of the 5th minute the RMV was 6.97±0.78 l/min. By the 10th minute of observation, a significant (P <0.01) increase in the respiratory minute volume was recorded up to 7.93±0.33 l/min.

The parameters of RMV in 7-year-old girls, living in the REFR, have been significantly (P <0.001) increasing at the 1st minute of the recovery period from 10.7±1.03 l/min to 19.7±1.36 l/min. Then, during 3 minutes, a decrease in the RMV to 12.2±0.88 l/min has been observed. During the next 10 minutes of the recovery period, the values of the

parameter under study have been gradually decreasing. In the 5th minute, the RMV was 9.83±0.77 l/min, and in the 10th minute it was 9.38±0.8 l/min, *i.e.* the complete recovery of the investigated parameter was not observed.

CONCLUSION:

1. Changes in the values of external respiration parameters (vital lung capacity, respiratory volume, respiratory rate, and respiratory minute volume) in children, living in the REUR, indicates the tension of functional reserves of the body and the decrease in the adaptation degree of 7-year-old children, living in different environmental conditions.
2. Pollution of the environment is one of the causal factors of decrease in the parameters and adaptive capabilities of the external respiration system.

SUMMARY:

The results of our research broaden the notion of the features and functional state of the respiratory system of 7-year-old children, living in different environmental conditions. Assessment and prognostication of adaptive mechanisms when doing physical exercises can be carried out by comparing the external respiration rates of girls (в русском варианте «мальчики», в англ заменила на «девочки», так как речь в исследовании идет именно о девочках), living in the conditions of different anthropogenic loads.

As a result of our studies, the parameter of vital lung capacity, indicating the degree of development of pulmonary structures in 7-year-old children, living in the REUR, was slightly lower, than that of children, living in the REFR. When doing physical exercises, the recovery period of 7-year-old children, living in the REUR, was uneven and wavy in comparison with children, living in the REFR.

Other investigated parameters (respiratory volume, respiratory rate, and respiratory minute volume) had similar recovery dynamics after controlled physical activity, in 7-year-old children, living in the REUR and REFR.

Studies of recent decades within the framework of ecological physiology show a high sensitivity of the external respiration system to anthropogenic impact. Thus, children, living in the REUR had lower values of the investigated parameters (vital lung capacity, respiratory volume, respiratory rate, and respiratory minute volume) compared to the children, living in the REFR, and their recovery period was lingering and uneven. The changes in the parameters of the external respiration system, in children of primary school age, identified by us, reflect complex vegetative rearrangements of the organism in the period of adaptation to ecological living conditions, and allow us to judge the mutual influence of these processes, taking into account the dynamics of the functional state of the studied systems.

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