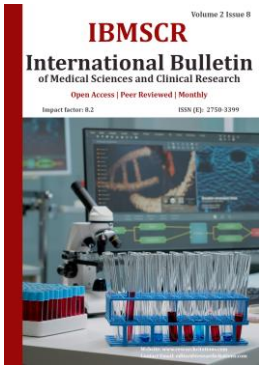

ASSESSMENT OF THE CARDIORESPIRATORY SYSTEM OF CHILDREN 11-13 YEARS OLD LIVING IN DIFFERENT DISTRICTS OF KARAKALPAKSTAN

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Abstract. The functional state of the cardio-respiratory system in children living in the Republic of Karakalpakstan is evaluated in this article. The research work was carried out on pupils of schools of Muynak district and Nukus city of the Republic of Karakalpakstan. 264 children (122 boys and 142 girls) aged 11-13 took part in the study. When comparing the indices of the external respiratory system (Lung Vital Capacity (LVC), vital capacity index) of boys living in Muynak district and Nukus city the statistically higher results were revealed for the representatives of Nukus city, which were relatively well assessed from the ecological point of view ($p<0.05$). From cardiovascular system indices it was found that the levels of systolic blood pressure (SBP) and diastolic blood pressure (DBP) as well as heart rate (HR) were higher in boys living in unfavorable environmental conditions ($p<0.005$). It was noticed that girls from Nukus had lower vital capacity index and LVC than girls from Nukus ($p<0.05$). Comparison of cardiovascular system indicators of schoolchildren in Muynak and Nukus in terms of values of SBP, DBP, pulse pressure (PP), systolic blood volume, minute blood volume, no statistically significant differences were found in them. However, it was found that girls living in unfavorable environmental conditions had a higher HR than girls from Nukus ($p<0.001$).
Keywords: Karakalpakstan, environment, cardiorespiratory system, blood pressure, children

Introduction

Breathing is a biological process that provides the body with energy. The respiratory physiological system-consists of the respiratory system, which carries out breathing through the lungs (external), blood circulation, blood and tissues. The external respiratory system can be called the gas transport system, which carries gases between the atmosphere and blood in the pulmonary capillaries [9]. Knowledge of regularities of influence of environmental factors on a young organism, knowledge of possibility of occurrence of functional changes by a particular organ in the system of an organism - gives an opportunity to predict detrimental consequences of influence of these factors [2].

In order for the organism's vital physiology to proceed normally, a necessary condition is the maintenance of its cardiorespiratory system in a relatively constant form. However, changes in the parameters of the organism's cardiorespiratory system are greatly influenced by environmental factors and changes occurring in the organism's internal environment. The study of the characteristics of the cardiorespiratory system of people of different ages means that at different stages of the organism's ontogenesis, the external environment is of great importance for understanding the mechanisms and regularities of adaptation [1].

Recently, the pollution of the atmospheric air in the Southern Priaralie by various dust and salt chemical compounds increases every day [15]. This affects the respiratory system of

people living here, causing various respiratory diseases. In addition, a number of scientific studies of disorders in the physical development of children [12, 13], adolescents [16] and young men [4, 19], girls [18], athletes [20], adverse changes in the cardiorespiratory system [5, 10, 11, 17]. Especially sensitive to adverse environmental factors is the growing children's body.

Materials and methods

The research work was conducted on school students of Muynak District and Nukus City of the Republic of Karakalpakstan (Fig. 1). A total of 264 children (122 boys and 142 girls) aged 11-13 years old participated in the study.

Figure 1. Areas where research was conducted

Lung Vital Capacity (LVC): measured with the Electronic vital capacity tester, FCS-10000, Grows Instrument (China, 2018). Lung Vital Capacity - removed by blowing in all air after filling the lungs with air. At the same time, it is important that the air does not come out of the nose. The number of attempts can be several. In whichever attempt the maximum capacity is achieved is taken into account.

And in volunteers, blood pressure (systolic blood pressure (SBP), diastolic blood pressure (DBP)) and heart rate (HR) were measured by shoulder using an OMRON 711 electronic tonometer (HEM-8712-CM2) (China, 2017). Measurements were taken in the afternoon, in an environment with no psycho-emotional effects.

Systolic and minute blood volume were calculated on the basis of the measurements performed. Systolic and minute blood volume were calculated according to the formula:

1. Systolic blood volume = 40+0.5*PB-0.6*DAB+3.2*A

Where PP-pulse pressure, DBP-diastolic blood pressure, A-age.

2. Minute blood volume = SBV*HR

Where SBV-systolic blood volume, HR-heart rate

All results were carried out using the functions of the Excel program installed in the application package Microsoft Office 2010; using the statistical data processing program MicroCAL OriginPro 8.5.0. Arithmetic mean values (M) and standard deviation (SD), values of physiological indices were calculated from the obtained results.

The results obtained and their discussion

When comparing the indicators of the external respiratory system (Lung Vital Capacity, vital capacity index) in boys living in Muynak district and Nukus city, statistically higher results were found in representatives of Nukus city, which were relatively well evaluated ecologically (Table 1).

Table 1. Comparison of external respiration and cardiovascular system indices in boys aged 11-13

District / Indicators	Muynak district	Nukus city	p value
Respiratory system indicators			
Lung Vital Capacity, ml	2567,6±64,28	2806,09±59,72	0,00301
Vital Capacity Index, ml/kg	66,94±1,51	69,74±1,40	0,04522
Cardiovascular system indicators			
Systolic Blood Pressure, mm Hg	111,54±1,65	105,12±1,37	0,00316
Diastolic Blood Pressure, mm Hg	75,21±1,06	69,81±0,94	$2,177x10^{-4}$
Pulse Pressure, c.u.	36,33±1,26	35,31±1,19	0,55651
Heart Rate, bpm	90,49±1,67	80,0±1,61	$6,08501x10^{-5}$
Systolic Blood Volume, ml	52,00±0,98	55,89±0,98	0,00623
Minute Blood Volume, ml	4704,65±129,50	4507,43±109,23	0,24344

When comparing the indicators of the external respiratory system (LVC, vital capacity index) in boys living in Muynak district and Nukus city, statistically higher results were found in representatives of Nukus city, which were relatively well evaluated from the environmental point of view. According to the indices of the cardiovascular system, it was found that the levels of SBP and DBP, as well as HR were higher in children living in adverse environmental conditions. No statistically significant differences in PP were found. It was observed that systolic blood volume was statistically higher in boys with Nukus compared to their peers with Nukus. However, no significant differences in minute blood volume were found in children of both districts.

It was observed that girls from Muynak had lower LVC and vital capacity index than girls living in Nukus (Table 2).

Table 2. Comparison of external respiration and cardiovascular system indices in girls aged 11-13

District / Indicators	Muynak district	Nukus city	p value
Respiratory system indicators			
Lung Vital Capacity, ml	2591,23±54,61	2802,81±55,25	0,00793
Vital Capacity Index, ml/kg	65,31±1,69	69,92±1,43	0,0378
Cardiovascular system indicators			

Systolic Blood Pressure, mm Hg	110,87±1,45	106,63±1,13	0,04532
Diastolic Blood Pressure, mm Hg	75,25±1,59	73,13±1,66	0,36567
Pulse Pressure, c.u.	35,62±1,50	34,5±1,33	0,57685
Heart Rate, bpm	90,40±1,83	83,07±1,31	$2,30389x10^{-4}$
Systolic Blood Volume, ml	52,06±1,58	52,51±1,61	0,84469
Minute Blood Volume, ml	4524,09±152,37	4414,07±163,16	0,62861

Comparison of the cardiovascular system indicators of schoolchildren in Muinak and Nukus in terms of the values of SBP, DBP, PP, systolic blood volume, minute blood volume did not reveal statistically significant differences in them. However, it was found that schoolchildren living in unfavorable environmental conditions had higher HR levels than girls from Nukus.

Analyzing the results of the experiments, we can conclude that changes in these indicators in the respiratory system of children may be due to aggravated environmental factors in this region, that is, in the vicinity of the Southern Priaralie, air pollution by various chemicals and air aridity, as well as socio-economic conditions of the population.

The conducted experiment shows that functional change and deviation from the norm of the indicator of the respiratory system in children living in an area with unfavorable environmental conditions due to a number of environmental factors was observed among adolescents, especially boys, stably living in rural areas, which is explained by high levels of air pollution by chemical pollutants, dust on this land and the additional impact on the body of environmental factors.

Dynamics showing functional conditions of children's respiratory system reflects the influence of various anthropogenic factors on the organism of a child living in a given territory. Study of patterns of exposure to negative factors in the environment - makes it possible to assess the emergence of changes in child health and to correct this change in the early periods of development of the organism.

It has been established in researches that there are two necessary periods of external respiratory system development in younger schoolchildren of the Republic of Karakalpakstan: in 6-7 years there is a significant decrease of bronchial asthma, which leads to an increase of inhalation and exhalation volume, and in 10-11 years - intensive increase of lung volume [7].

The study involved 45 healthy boys and girls of the 1st grade with an average level of physical development, who studied in a secondary school in Kazan [6]. Thus, the adaptation of the cardiorespiratory system of boys and girls in the first grade to the learning load differed significantly. At the beginning of the school year in boys there was tension of the external respiratory system, as evidenced by the increase in its frequency component. In the middle of the school year, the flexible capabilities of the cardiorespiratory system of 8-year-old children were in optimal condition. The fatigability of the organism by the end of the school year in girls was manifested by a negative response of the cardiovascular system and the external respiratory system in response to dynamic and static loads, which can be considered as a general tension of the cardiorespiratory system of girls [6].

The external respiratory system was studied in 349 boys and girls 7-11 years old living in areas of northern Siberia with different environmental conditions. According to him, during the second childhood, regardless of environmental conditions, ventilation demonstrates increased efficiency and cost-effectiveness. Children living in environmentally unfavorable

Industrial area have disorders of the external respiratory system, and its work is less cost-effective, which is manifested in higher rates of minute volume of breathing, provided by an increase in respiratory frequency and strengthening respiratory muscles [8].

Cardiovascular system and physical performance were evaluated by standard methods in 1049 children 7-8 years old in Kirov. It was found that aerotechnical pollution affects the cardiovascular system of children 7-8 years old, manifesting itself in the main mass of children by increased diastolic and mean ad [14].

The main indices of physical development were checked in 16-17-year-old schoolchildren living in Vakhitovsky district of Kazan [3]. To assess the state of the cardiovascular system the heart rate, diastolic and systolic blood pressure, systolic blood volume and minute blood volume were determined. The amount of trace elements in the hair was determined by spectral analysis. It was found that the height and body weight indices of the students living in an environmentally clean area were higher than those of the students from the experimental group. The chest circumference score was higher in girls living in unfavorable environmental conditions compared to the control group. The number of HR was 3% higher in the representatives of the control group. No corresponding differences in blood pressure value were found in the representatives of both groups. Systolic blood volume was higher in the girls (45.1±3.0 ml) living under unfavorable environmental conditions compared to the control group (40.78±3.63 ml). A similar situation was observed in the level of minute blood volume, it was found that girls in environmentally clean areas had a minute blood volume of 2.98±0.29 l/min, while girls in environmentally polluted areas had a minute blood volume of 2.73±0.21 l/min, that is 8% less. This condition indicates a sharp violation of the cardiovascular system in girls living in environmentally polluted areas [3].

Conclusion. Research of functional state of cardio-respiratory system of children and teenagers in conditions of South Priaralie is one of the actual problems of our time. Now to solve this problem it is necessary to organize preventive work on timely and constant obtaining of information about functional state of children and teenagers organism.

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