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COMPARATIVE CHARACTERISTICS OF THE FUNCTIONAL ACTIVITY OF THE CARDIORESPIRATORY SYSTEM IN PRIMARY SCHOOLCHILDREN (ON THE EXAMPLE OF SOME DISTRICTS OF ANDIJAN REGION)

Abstract: *The purpose of this research is a comparative study of the functional activity of the cardiorespiratory system in primary schoolchildren (7–11 years old) located in different climatic and geographical zones of Andijan region of the Republic of Uzbekistan. The studies revealed that the vital capacity of lungs (l) in primary schoolchildren (7–11 years old) increases linearly in school sequences of desert, pre hilly, hilly and foothill climatic–geographical regions. The obvious difference in the values of this indicator was registered between schools #17 and #5, which are located in the desert and foothill zones, respectively, while in these schools, boys and girls have minimum–maximum values of lungs capacity (l) increased by 1.15–1.28 (1.26) va 1.2–1.39 (1.36). In studies at schools #17–, #26–, #30–, #4 and #5 for primary schoolchildren, the range of heart rate (times/min) for boys was 95–79; 93–79; 94–78; 93–80 and 94–82, respectively, and for girls – 93–82; 95–85; 94–86; 93–85 and 87–85, respectively, while in both sexes in the range of 7–11 years, the heart rate decreases in a linear fashion. Also, for primary schoolchildren (7–11 years old) of secondary schools #17 and #5, in the desert and foothill climatic–geographical zones, the values of blood pressure indicators (systolic/diastolic), respectively, have a high value of 1.03/1.12 and 1.02/1.08.*

Key words: *climatic–geographical zones, primary schoolchildren (7–11 years old), lung capacity, heart rate, blood pressure.*

Language: *English*

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1. INTRODUCTION

Assessment of the functional state of the cardiovascular/respiratory systems is of current importance in terms of clarifying the health and growth trends of the younger generation and the influence of environmental factors on them [1, 3–18].

Morphological and functional regulatory mechanisms expressing the state of the process of adaptation to the influence of various factors are not sufficiently developed and in turn this state leads to the appearance of a kind of response of the cardiorespiratory system in relation to the influence of the "stress" factor characteristic of the school educational process. In particular, some researchers registered the appearance of changes in the rhythm of heart contraction under the influence of tension in the learning process of primary schoolchildren aged 8–10 years [2, 5].

In the studies carried out by A.A. Safronov and I.T. Aryslanov (2013) on the study of physical development and training of schoolchildren (grades 5–6) in urban conditions (Tashkent) using anthropometric research methods revealed a noticeable decline in the physical development of schoolchildren in general terms and the relevance of scientific/practical research was proved direction [4, 455–458].

Environmental anthropology is a branch of science that studies the influence of environmental factors on the human body [5, 818–825] And one of the main areas of science, more precisely in the study of the influence of environmental factors on the human population, is the analysis of indicators of the physical development of children [6, 65].

The response of the morphophysiological systems of the human body to various endogenous/exogenous factors is directly determined by the somatic–typological characteristics of the organism. At the same time, the indicators of the physical development of the body of children are important as a reliable marker of the successful implementation of adaptive capacities under the influence of various factors. [2, 3]. Especially, the period of schooling is of fundamental importance in the physical/spiritual improvement in the personal development and future life of the human ontogenesis [3, 3–20].

Similarly, a high level of health, physical development and training as part of a system of universal values is essential in the full realization of the individual's potential [3, 3–20].

Based on the above data, the purpose of this research is a comparative study of the functional activity of the cardiorespiratory system in primary school children (7–11 years old) located in different climatic and geographical zones of Andijan region of the Republic of Uzbekistan.

2. MATERIAL AND METHODS

2.1. Object and study conditions

Studies were conducted during 2013–2018 at secondary school #17 of the Ulugnor district (desert zone), secondary school #26 of Pakhtabod district (before the hilly zone), secondary school #4 of the Markhamat district (pre–hilly zone), secondary school #30 of the city of Andijan (pre–hilly zone), secondary school #5 cities of Khanabad (foothill zone) of Andijan region.

Experiments in our studies were carried out in full compliance with principles of the Declaration of the Helsinki International Medical Association (World Medical Association, WMA) for determining the functional parameters of primary school pupils. The experiments were conducted with the written consent of the parents of schoolchildren and school administrations and the oral agreement of the schoolchildren themselves.

2.2. Research methods

In the studies, standard anthropometric research methods were used [7, 76–79].

Measurement of the vital capacity of the lungs (ml). In experiments, the vital capacity of the lungs was measured by the standard method [4, 455–458; 8, 10–336; 9, 30] using an air spirometer. In this case, the subject after a deep breath carries out the movement of the maximum expiration into the spirometer hose. The measurement is performed in triplicate and the highest indicator is recorded (Fig. 1A).

Measurement of arterial blood pressure (mm Hg) is carried out by a tonometer using Korotkov method.

The blood pressure of schoolchildren was measured using a standardized medical tonometer, in a sitting position on a chair, in the wrist area, based on the measurement of systolic blood pressure and diastolic blood pressure (mm mercury column) [10, 7–14; 11, 3–24].

Measurements of heart rate are based on measurements of the number of pulses using the tonometric method [10, 7–14; 12, 3–42].

2.4. Data analysis

The results were statistically processed by a special software package OriginPro v. 8.5 SR1 (EULA, USA). The results of experiments processed mathematically–statistically using standard biometric methods [4, 455–458; 13, 5–312; 14, 7–127]. The results are given in the *M*±*m* form of the values of the experiments carried out in n replicates, *M* is the arithmetic average value and *m* is the standard error value. In addition, the results of the experiments, a statistically significant level of values between the groups were calculated using the Student's *t*–test and were evaluated as statistically reliable at *p* values <0.05, *p*<0.01 [15, 675–678].

3. RESULT AND DISCUSSION

In the study, vital capacity of the lungs (1) for primary schoolchildren (7–11 years old) is shown in the following table (Table 1).

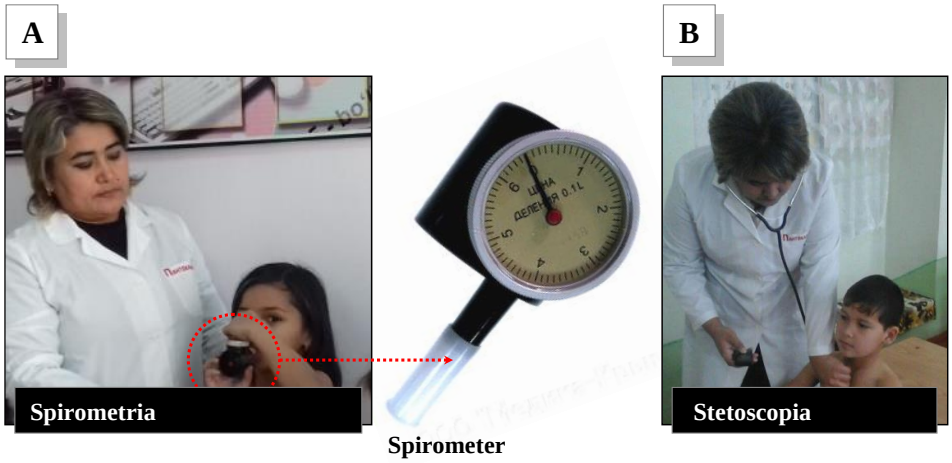

Figure 1. Methods for measuring the vital capacity of the lungs (*l*) (spirometry) and heart rate (times/min) used in the studies (stetoscopia) (Andijan region, 21/04/2017).

Table 1. The values of the vital capacity of the lungs (*l*) in primary school students in some schools of the Andijan region of the Republic of Uzbekistan (*M*±*m*)

Secondary school number 17 in Ulugnor district										
Vital capacity of the lungs (l)	**Boys** (*n*=85)					**Girls** (*n*=79)				
	7 years old (*n*=19)	8 years old (*n*=21)	9 years old (*n*=16)	10 years old (*n*=17)	11 years old (*n*=12)	7 years old (*n*=16)	8 years old (*n*=12)	9 years old (*n*=19)	10 years old (*n*=18)	11 years old (*n*=14)
	1.15±0.03	1.18±0.04	1.22±0.04*	1.51±0.06**	1.60±0.07**	1.10±0.06	1.14±0.05*	1.19±0.08**	1.23±0.09**	1.32±0.06**
	Secondary school number 26 in Pakhtaobod district									
	Boys (*n*=90)					**Girls** (*n*=82)				
	7 years old (*n*=16)	8 years old (*n*=19)	9 years old (*n*=11)	10 years old (*n*=21)	11 years old (*n*=23)	7 years old (*n*=17)	8 years old (*n*=16)	9 years old (*n*=12)	10 years old (*n*=24)	11 years old (*n*=13)
	1.24±0.04	1.41±0.03	1.46±0.06*	1.54±0.04**	1.63±0.05**	1.18±0.05	1.20±0.07*	1.28±0.04**	1.39±0.07**	1.41±0.06**
	Secondary school number 30 in Markhamat district									
	Boys (*n*=76)					**Girls** (*n*=88)				
	7 years old (*n*=14)	8 years old (*n*=18)	9 years old (*n*=12)	10 years old (*n*=13)	11 years old (*n*=19)	7 years old (*n*=11)	8 years old (*n*=22)	9 years old (*n*=17)	10 years old (*n*=23)	11 years old (*n*=15)
	1.25±0.05	1.34±0.05	1.36±0.05*	1.44±0.07**	1.65±0.06**	1.12±0.04	1.18±0.03*	1.21±0.03**	1.32±0.04**	1.38±0.05**
	Secondary school number 4 in Andijan city									
	Boys (*n*=82)					**Girls** (*n*=78)				
	7 years old (*n*=14)	8 years old (*n*=12)	9 years old (*n*=18)	10 years old (*n*=20)	11 years old (*n*=18)	7 years old (*n*=16)	8 years old (*n*=11)	9 years old (*n*=17)	10 years old (*n*=22)	11 years old (*n*=12)
	1.37±0.05	1.55±0.04	1.68±0.08*	1.70±0.08**	1.73±0.07**	1.23±0.06	1.45±0.08*	1.64±0.04**	1.68±0.05**	1.71±0.08**
	Secondary school number 5 in Khonodod city									

	Boys (*n*=87)					**Girls** (*n*=84)				
	7 years old (*n*=19)	8 years old (*n*=14)	9 years old (*n*=24)	10 years old (*n*=13)	11 years old (*n*=17)	7 years old (*n*=14)	8 years old (*n*=17)	9 years old (*n*=18)	10 years old (*n*=16)	11 years old (*n*=19)
	1.37±0.04	1.44±0.04	1.76±0.07*	1.84±0.08**	1.87±0.04**	1.26±0.06	1.34±0.04*	1.58±0.05**	1.70±0.06**	1.76±0.08**

Note: *, ** – express the statistical significance of the difference between the experimental groups (II, III, IV and V) compared with other groups (7 years) (* – $p<0.05$; ** – $p<0, 01$).

Based on the results of the experiments, primary schoolchildren in the surveyed secondary schools found that the vital capacity of the lungs (*l*) increased in accordance with the age range of 7–11 (Figure 2A, B).

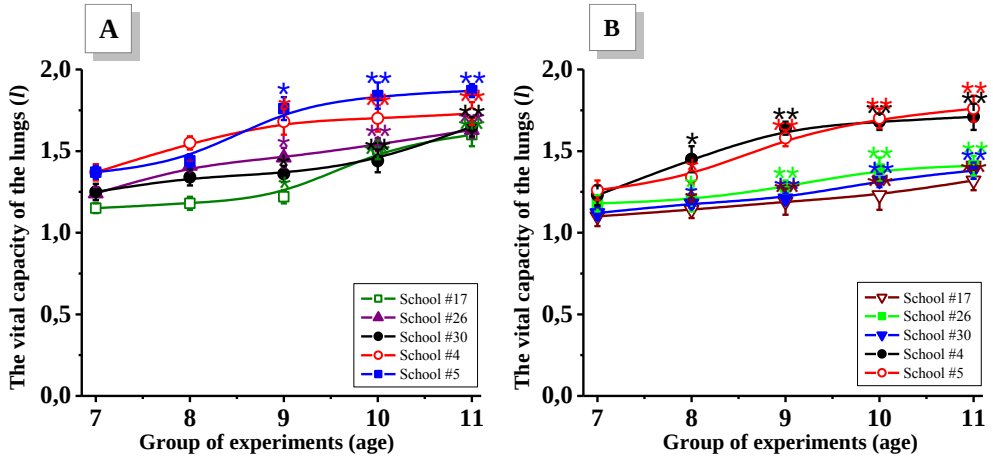

Figure 2. The dynamics of changes in the values of the indicators in the vital capacity of the lungs (*l*) of schoolchildren in the range of 7–11 years of primary classes of secondary schools where the studies were conducted. A. Boys. B. Girls. * – $p<0.05$, ** – $p<0.01$ relative to the control.

In particular, the vital capacity of the lungs (l) among primary school students (7–11 years old) at schools #17, #26, #30, #4 and #5 in the minimum–maximum values for boys is 1, 15–1.07 (average 1.28); 1.18–1.55 (average 1.38); 1.22–1.76 (mean 1.49); 1.51–1.84 (average 1.61) and 1.60–1.87 (average 1.69), respectively, and 1.1–1.26 for girls, respectively (average 1.19); 1.14–1.45 (average value 1.26); 1.19–1.64 (mean 1.38); 1.23–1.68 (mean 1.46); It was found that fluctuations of 1.32–1.76 were observed (mean 1.62).

It was found that the vital capacity of the lungs (1) for primary school students (7–11 years old) increases in the sequence of schools in deserts, steppes, foothills and mountainous climatic geographical regions. Obvious differentiation of these values was noted among schools #17 in the desert area and #5 located in the foothills, where the minimum–maximum values are the vital capacity of the lungs (l) for boys, and also for girls, respectively – 1.15–1.28 (1.26) and 1.2–1.39 (1.36) respectively.

The study showed that the rate of increase in vital capacity of the lungs (1) among primary schoolchildren (7–11 years old) was 39.2% among boys aged 7–11 years, 6.1% at 7–9 years, at 9 – 11 years 31.2%. It was found that the value of this indicator is 20%, 8.2% and 10.9% respectively for girls.

The study also found that the growth rate of the vital capacity of the lungs (*l*) among primary schoolchildren at school #26 was 31.5% among boys aged 7–11 years, between 7–9 years old 17.7% and 11 years, 11.6% respectively. It was found that the value of this indicator is 19.5%, 8.5% and 19.5% respectively for girls.

At the next school #30, the growth rate of the lung vital capacity of pupils in primary classes was 32% in boys in the age range of 7–11 years old, 8.8% in the age of 7–9 years, 21.3% in the age range of 9–11 years. It was found that the value of this indicator is 23.2%, 8% and 14% respectively for girls.

The study showed that the rate of increase in lung capacity (*l*) among primary schoolchildren at school #4 was 26.3% for boys aged 7–11 years, 22.6% for children aged 7–9 years, 9% for children aged 9–11 years. The value of this indicator was found in girls – 39%, 33.4% and 4.3% respectively.

At school #5, where studies were carried out, the rate of increase in vital capacity of the lungs (*l*) at primary schoolchildren was 36.5% in boys aged 7–11 years, 28.5% in the age group 7–9–11 years and 6 , 3% in the age group of 9–11, respectively. It was

found that the value of this indicator is 39.7%, 25.4% and 11.4% respectively for girls.

In general, the dynamics of the growth rate of lung capacity (*l*) among primary schoolchildren (7–11 years old) of secondary schools #17, #26, #30, #4 and #5 (7–11 years old) is shown in the following figure (Figure 3A, B).

At the next stage of the study, the values of the functional activity of the cardiovascular system were analyzed in primary schoolchildren. Heart rate (times/min), systolic/diastolic blood pressure (mm.s.s.) were studied comparatively (Table 2).

From the results it can be seen that the heart rate of pupils (times/min) of primary classes (7–11 years old) at schools #17, #26, #30, #4– and #5 was 95–79; 93–79; 94–78; 93–80 and 94–82 respectively. The value of this indicator for girls was 93–82; 95–85; 94–86; 93–85 and 87–85 respectively. At the same time, it was found that the heart rate in the age group of 7–11 years decreases in linearity in both sexes.

It is known that the functional state and reserve capacity of the cardio–respiratory system in the human body determine the degree of adaptation of the organism to physical activity, the formation of appropriate responses in changing environmental conditions [16, 3–22].

Anthropometric indicators also show a significant change in children in the context of various diseases, including respiratory diseases [10, 7–14]. For example, some researchers analyzed using spirometry in primary schoolchildren, the characteristics of the respiratory tract and the ecological state of posture formation, based on measuring the vital capacity of the lungs (*l*) [17, 4–18].

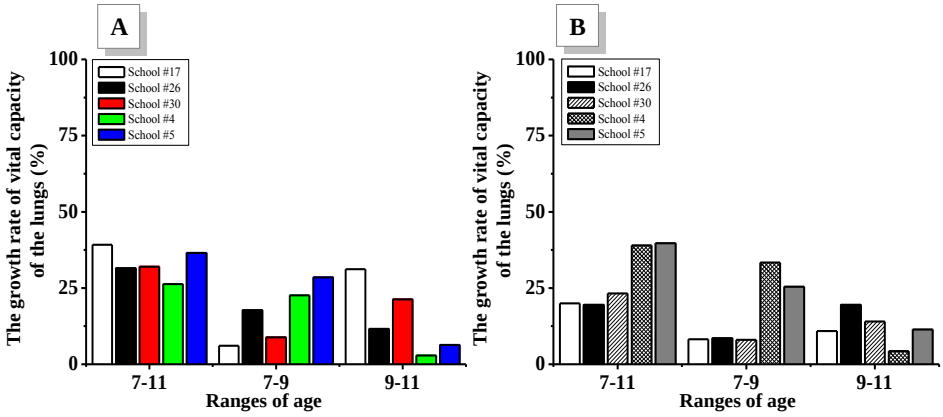

Figure 3. The value of indicators of an increase in the growth rate of primary school students in the age range of 7–11 years. A. In boys. B. In girls.

Table 2. Functional indicators of the cardiovascular system of primary schoolchildren (7–11 years old) at some schools of Andijan region of the Republic of Uzbekistan (*M*±*m*)

Secondary school number 17 in Ulugnor district										
Readings	**Boys** (*n*=85)					**Girls** (*n*=79)				
	7 y.o. (*n*=19)	8 y.o. (*n*=21)	9 y.o. (*n*=16)	10 y.o. (*n*=17)	11 y.o. (*n*=12)	7 y.o. (*n*=16)	8 y.o. (*n*=12)	9 y.o. (*n*=19)	10 y.o. (*n*=18)	11 y.o. (*n*=14)
Heart rate (times/min)	95±4	92±4	89±3	84±5	79±4	93±4	93±2	85±5	83±3	82±5
Arterial pressure (mercury column): systolic; diastolic	101.4±5.8	101.8±4	104±6.6	102±3.8	100.5±4.7	103.3±4.4	102±5.6	101.5±5.4	104.4±4.8	104.8±5.2
	55.2±2.2	59.6±4.6	60±4.4	62.2±4.3	63.7±5.6	58.4±3.5	60.7±4.3	61.4±4.5	64.2±6.7	64.8±5.5
Secondary school number 26 in Pakhtaobod district										
Readings	**Boys** (*n*=90)					**Girls** (*n*=82)				
	7 y.o. (*n*=16)	8 y.o. (*n*=19)	9 y.o. (*n*=11)	10 y.o. (*n*=21)	11 y.o. (*n*=23)	7 y.o. (*n*=17)	8 y.o. (*n*=16)	9 y.o. (*n*=12)	10 y.o. (*n*=24)	11 y.o. (*n*=13)
Heart rate (times/min)	93±3	94±3	92±3	86±3	79±2	95±3	94±3	92±4	88±3	85±5
Arterial pressure (mercury column): systolic; diastolic	103.4±5.2	100±5.4	102.6±4.4	104.6±4.7	102.8±5.6	101.6±3.5	105±5.8	98.7±5.8	104.2±4.7	104.7±4.6
	60.4±3.6	64.4±5.3	65.3±5.2	65.7±4.4	64.1±3.8	61.2±4.6	63.5±4.4	65.5±4.8	63.7±5.7	65.3±5.2
Secondary school number 30 in Markhamat district										
Readings	**Boys** (*n*=76)					**Girls** (*n*=88)				
	7 y.o.	8 y.o.	9 y.o.	10 y.o.	11 y.o.	7 y.o.	8 y.o.	9 y.o.	10 y.o.	11 y.o.

	(*n*=14)	(*n*=18)	(*n*=12)	(*n*=13)	(*n*=19)	(*n*=11)	(*n*=22)	(*n*=17)	(*n*=23)	(*n*=15)
Heart rate (times/min)	94±2	93±3	90±2	84±2	78±3	94±3	94±4	87±4	85±2	86±4
Arterial pressure mercury column): systolic; diastolic	102.7±4.6	98.7±4.8	101.8±5.7	102.4±3.5	103.5±5.7	103.6±3.8	104.5±5.2	103.5±4.6	105.4±4.5	105.7±5.8
	58.6±2.7	65.2±4.5	63.9±3.7	64.8±2.4	65.8±3.6	60.7±3.9	62.7±5.5	64.3±4.7	65.2±5.8	67.4±4.6
Secondary school number 4 in Andijan city										
Readings	**Boys** (*n*=82)					**Girls** (*n*=78)				
	7 y.o. (*n*=14)	8 y.o. (*n*=12)	9 y.o. (*n*=18)	10 y.o. (*n*=20)	11 y.o. (*n*=18)	7 y.o. (*n*=16)	8 y.o. (*n*=11)	9 y.o. (*n*=17)	10 y.o. (*n*=22)	11 y.o. (*n*=12)
Heart rate (times/min)	93±4	94±5	90±3	84±3	80±4	93±5	90±3	88±5	86±3	85±5
Arterial pressure (mercury column): systolic;diastolic	102±3	102.7±5.6	103.8±4.7	102±4.5	101±6.8	102.6±4.6	105.5±5.5	104.5±3.8	104±5.9	104±4.7
	59±3.6	63±4.8	64±3.3	65.8±5.5	65.9±4.6	61±4.4	63.7±4.5	64.8±4.8	66.3±5.2	67.4±6.8
Secondary school number 5 in Khonodod city										
Readings	**Boys** (*n*=87)					**Girls** (*n*=84)				
	7 y.o. (*n*=19)	8 y.o. (*n*=14)	9 y.o. (*n*=24)	10 y.o. (*n*=13)	11 y.o. (*n*=17)	7 y.o. (*n*=14)	8 y.o. (*n*=17)	9 y.o. (*n*=18)	10 y.o. (*n*=16)	11 y.o. (*n*=19)
Heart rate (times/min)	94±3	90±4	95±5	85±4	82±4	87±5	90±5	84±4	84±3	85±5
Arterial pressure (mercury column): systolic;diastolic	105.2±4.4	104.7±5.4	105.8±5.2	103.6±2.8	105.6±6.4	104.6±6	104.8±5.7	105.4±3	105±7.2	104.4±6.2
	61.5±3.2	68.2±5.6	68.9±6.7	66.8±4.4	67.7±4.6	63.9±5.7	65.7±3.5	65.5±4.9	66.3±4.6	69±4.5

Note: *. ** – express the statistical significance of the difference between the other experimental groups compared with the first (7 years) groups (* – $p<0.05$; ** – $p<0.01$).

In the study. it was found that in the control group. the vital capacity of the pupils in primary classes is 2.12–2.35 *l* and a significant decrease in the condition of scoliosis [17, 4–18].

In the conducted studies it was revealed that the value of blood pressure (systolic/diastolic) in primary school pupils (7–11 years old) at schools #17–, #26–, #30–, #4– and #5 was – 101.4/55.2–100.5/63.7; 103.4/60.4–102.8/64.1; 102.7/58.6–103.5/65.8; 102/59–101/65.9 and 105.2/61.5–105.6/67.7 respectively. The value of this indicator for girls in the sequence of schools is 103.3/58.4–104.8/64.8; 101.6/61.2–104.2/65.3; 103.6/60.7–105.7/67.4; 102.6/61–104/67.4 and 104.6/63.9–104.4/69, respectively.

Theart rate (times/min), and the spectrum value of the blood pressure indicator (systolic/diastolic) (mm) in general terms corresponds to the values of the normal standard. In particular. in the existing literature, the heart rate from 6 to 12 years is 78–100 times/min, and the systolic/diastolic blood pressure is 100–126/60–82 mm Hg.

At the same time, in the circle of individual schools there is no difference in the dynamics of growth rates of blood pressure indicators (systolic/diastolic), but at a school located in the desert zone blood pressure (systolic/diastolic) decreases in comparison with the school in the foothill zone. In particular. the blood pressure value (systolic/diastolic) in primary school pupils (7–11 years old) at schools #17 and #5 of boys and girls, respectively, is 1.03/1.12 and 1.02/1.08 times higher.

These results are consistent with available literature data. In particular, a study in the Kyrgyz Republic showed that high rates of functioning of the cardiorespiratory system in children (7–12 years old) in an average mountain region (altitude 1050 meters above sea level) were high [18, 4–18; 19, 4–21].

In addition. the researchers found that in some climatic and geographical regions. the value of heart rate in girls of primary school is much higher than that of boys [1; 3–18]. In particular. it was found that boys aged 9 children and girls aged 11 years high blood pressure. lung capacity is high in boys aged 11–12 years and girls 12 years old [1; 3–18].

Conclusion

In studies. the data obtained indicate that the vital capacity of the lungs (*l*) among primary schoolchildren (aged 7–11 years) in the desert. Steppe, foothills and mountain climatic zones increases linearly. Obvious differentiation of these values was registered among schools #17 in the desert area and in schools #5 in the foothills. where in the data of the indicated schools the vital capacity of the lungs (*l*) with the minimum – the maximum indicators for boys, as well as for girls – 1.15–1.28 (1.26) and 1.2–1.39 (1.36), respectively. For pupils of schools #17, #26–, #30–, #4– and #5 of junior schoolchildren (7–11 years old). the heart rate (times/min) for boys is 95–79; 93–79; 94–78; 93–80 and 94–82; for girls, 93–82; 95–85; 94–86; 93–85 and 87–85 respectively. It was found that in both sexes in the age group 7–11, heart rate decreases in a

linear fashion. The value of blood pressure (systolic/diastolic) in primary school pupils (7–11 years old) in schools #17 and #5 in desert and mountain climatic geographical zones (mm Hg c.) For boys and girls is 1.03/1.12 and 1.02/1.08 times respectively.

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