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COMPARATIVE ANALYSIS OF EXTERNAL RESPIRATION SYSTEM AMONG 9-YEAR-OLD BOYS DURING SCHOOL YEAR

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Abstract:
During the school year (autumn, winter, spring), they analyzed both the dynamics of the respiratory system parameters, determined at rest, and the system reactivity, assessed by the degree of changes in pulmonary volume and lung capacity under the influence of static load. The 9-year-old boys with an average level of physical development, belonging to the first and second health groups, took part in the study.
The values obtained in the state of rest were taken as the control of external respiration parameters. The change of external respiration parameters to the test sample was recorded during the first minute after the static load completion. They performed the correlation analysis of interrelations between all analyzed parameters of the respiratory system.
The comparative analysis of the external breathing system among 9-year-old boys during the school year showed that positive age dynamics of pulmonary volume and ventilation capacity are observed in the state of rest. Dosed isometric load causes unfavorable shifts in external respiration rates, the decrease of the respiratory system reserve capabilities. By the end of the second year of training among 9-year-old boys there is the increase of reactivity and the decrease of respiratory system reaction cost-effectiveness in response to a static load.
Keywords: ***respiratory system, adaptation, junior school age.***

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INTRODUCTION:

The beginning of educational activity is accompanied by the emergence of a complex of loads and adverse factors that affect the health of children. The discrepancy between the intellectual and physical components of loads, the increase of the training program intensity, and the manifestation of "school hypokinesia" are observed. All these factors cause the development of long-term passive adaptation among children and the emergence of functional shifts in the state of the children's body systems [6]. The breathing system is one of the most important physiological systems that determines both mental and physical performance of children in the process of ontogeny and the adaptation to learning activity [5, 7]. The required levels of minute breathing volume can be provided only if there is a corresponding functional reserve and the maturity of the regulation mechanisms [3, 10]. It is known that the age of 7-10 years is on the border of two important periods of respiratory system development: (1) 6-7 years, when there is a significant decrease of bronchial resistance, which leads to the increase of inspiration and expiration volume, and (2) 10-11 years - the period of kung volume intensive increase. The age of 7-10 years is characterized by smooth changes of morphofunctional indicators, the increase of external respiration reserve and functional capabilities. There is the tendency to decrease the relative value of the minute volume of breathing, deepen and decrease the respiratory rate when you become older. Among 7-year-old girls and older, the minute volume of breathing increases more than among boys. During physical loads of moderate and high intensity, the volume velocities of breathing decrease, indicating the respiratory muscle fatigue [4, 8, 9]. Children demonstrate the immaturity of the mechanoreceptor and central mechanisms of breathing regulation, which can cause inadequate physiological changes in the respiratory system during the process of younger schoolchildren adaptation to the training load. The literature has the works devoted to the study of learning activity influence on external respiration functions [1]. In most studies, they studied the adaptation of the respiratory system of children and adolescents to the physical loads of different intensities, meteoclimatic and environmental conditions [2]. The study of static load effect on the functions of external respiration of schoolchildren is of scientific interest. The purpose of our work was to study the adaptive responses of 9-year-old boys' respiratory system to the dosed isometric load in the school year dynamics.

METHODS:

During the school year (autumn, winter, spring), they analyzed both the dynamics of external respiration parameters, determined at rest, and the reactivity of the system, assessed by the degree of pulmonary volume and lung capacity changes under the influence of isometric loading. The study involved 38 9-year-old boys with an average level of physical development, belonging to the first and the second groups of health, studying in the second grade of the general school in Kazan. The automated cardiopulmonary complex AD-03M on the basis of Pentium 3 was used for the analysis of external respiration parameters. They assessed such respiratory system parameters as the vital capacity of lungs (MVL), the minute volume of respiration (MVR), respiratory volume (RV), respiratory rate (RR), reserve volume of inspiration (RVI) and exhalation (RVE), the reserve volume at quiet ventilation of lungs (QVL) and maximum ventilation of lungs (MVL). In order to assess the economics of breathing, the ratio of the inhalation and expiration time to the total duration of the respiratory cycle was studied. Pulmonary volumes and the indices of ventilation capacity of lungs are given in the BTPS system. The dosed isometric load created by the handgrip method [1] was used as the functional muscle test: the sitting subject squeezed the dynamometer with his left hand for 1 minute with the force equal to 50% of the maximum one. The average value of three attempts was taken for maximum effort indicator. The values obtained in the state of rest were taken as the control of external respiration parameters. The change of external respiration parameters to the test sample was recorded during the first minute after the static load completion. The correlation analysis of interrelations between all analyzed parameters of the respiratory system was carried out. The statistical processing of the study results was carried out in accordance with the standard methods of variation statistics, the standard values of the Student's t-test were used to estimate the statistical significance of the differences.

RESULTS:

The results of the study and their discussion: According to the results of the study of 9-year-old boys' respiratory system in the state of physiological rest performed at the beginning of the academic year, the MVR was 11.54 ± 0.36 l/min, RV - 0.59 ± 0.09 l, RR - 19.49 ± 0.3 of cycle per minute, VCL - 1.85 ± 0.17 l. The indicators reflecting the reserve volumes of lungs - RVI, RVE, QVL, MVL - made 0.35 ± 0.07 l., 1.00 ± 0.08 l., 63.87 ± 1.18 l. and 73.23 ± 1, 04 l. respectively. The study of the respiratory system adaptive reactions to the isometric load among the boys of the second year of schooling at the beginning of the school year showed that the value of the MVR increased to 13.26 ± 0.29 l/min (by 14.81%, p ≤0.05), RR - up to 21.04 ± 0.39 cycles per minute (by 7.9%, p≤0.05), while RV remained almost unchanged (Figure 1). Consequently, during the first period of the study, isometric loading leads to MVR increase among boys only due to the frequency component of pulmonary ventilation (RR). The magnitude of the VCL and the indicators reflecting the reserve volumes of lungs after the functional test, on the contrary, tended to decrease (Fig. 1). The VCL after the load decreased to 1.71 ± 0.15 l., RVI - up to 0.83 ± 0.119 l, RVE - up to 0.33 ± 0.12 l, and the magnitude of QVL and MVL decreased significantly according to statistics. Thus, the magnitude of the QVL after the load was 55.8 ± 1.05 l, MVL - 68.44 ± 1.08 l (the decrease by 12.6 and 6.5%, respectively, p≤0.05). In general, the results of adaptive response study, obtained at the beginning of the school year, reflect the insufficient preparedness of 9-year-old boys' respiratory system for isometric exercise. However, in the middle of the academic year, the basic values of the respiratory system indicators (at rest) among the boys of the second year of study, did not have statistically significant differences with the results of the previous study period and had a stable upward trend. Isometric loading led to a slight respiration increase and respiration and MVR increase, the RV value remained unchanged. At the same time, after the end of the load, the decrease of VCL (from 1.85 ± 0.18 to 1.67 ± 0.15 l), QVL (from 66.35 ± 1.04 to 52.90 ± 1.06 L) and MVL (from 76.18 ± 1.07 to 65.57 ± 1.11 L) was recorded and, thus, the decrease of QVL/MVL ratio (p ≤0.05) was noted. The obtained results testify to the unfavorable nature of adaptive reactions of respiration biomechanical parameters in response to isometric loading and reflect the low reserve capabilities of the respiratory system. The value of the other studied parameters of external respiration did not differ markedly from the background state after isometric loading.

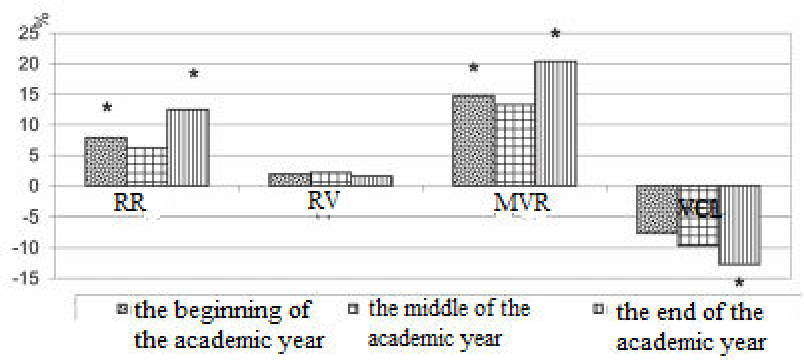

Fig. 1. The dynamics of external respiration parameters in response to the dosed isometric load among 9-year-old boys during the school year (% in relation to the indicator at rest); RR - respiration rate; RV - respiratory volume; MVR - minute volume of respiration; VCL - vital capacity of lungs; * The difference with the state at rest is statistically significant (p<0.05).

The studies carried out at the end of the second year of study showed that, in comparison with the previous analyzed periods, the values of MVR, RR, QVL, and MVL at rest were significantly increased. MVR was 15.07 ± 0.41 l/min, RR - 23.76 ± 0.38 cycles per minute (p ≤0.05), QVL - 69.70 ± 1.27 l, MVL - 79.59 ± 1.20 l, whereas in the dynamics RV, VCL, RVI and RVE had only a trend towards a positive age-related growth of indicators. After the isometric exercise at the end of the school year, the boys had a significant increase of MVR (up to 18.94 ± 0.58 l, p ≤0.05), due to the increase of RR (up to 27.49 ± 0.49 cycles per minute, p ≤ 0,05). The growth of MVR was 20.4%, RR - 14.8%. The value of RV after the load did not change (see Figure 1). At the same time, there was a marked decrease of many external respiration indices: QVL (up to 57.00 ± 1.07 l, p ≤ 0.05), MVL (up to 71.33 ± 1.01 l, p ≤0.05), VCL (from 1.89 ± 0.03 to 1.65 ± 0.03 l, p ≤ 0.05), RVI (from 1.02 ± 0.11 to 0.60 ± 0.10 l, p ≤ 0, 05). The RVE value tended to decrease (from 0.44 ± 0.18 to 0.38 ± 0.14 l), and the ratio of QVL/MVL decreased significantly according to statistics (p≤0.05). At the end of the school year, there is the tendency to increase the ratio of expiratory time to the total duration of the respiratory cycle and to decrease the ratio of inspiratory time to the total duration of the respiratory cycle (from 0.47 ± 0.08 to 0.53 ± 0.08 s and from 0.53 ± 0,07 to 0,47 ± 0,06 s, respectively, $p \leq 0{,}05$), which indicates the decrease of external respiration economy during this period of the study. The comparative analysis of pulmonary volume age dynamics and the indices of ventilation capacity of lung among 9-year-old boys during the school year showed that all parameters of the respiratory system, determined at rest, have a clearly pronounced tendency to increase from the beginning to the end of the school year. The most significant increase was noted for such indicators as MVR (12.5%, $p \leq 0.05$) and RR (12.5%, $p \leq 0.05$). The increase of RV is expressed to a lesser extent and makes only 1.6% (Figure 1). It is noteworthy that in the dynamics of the academic year, the increase of MVR value at rest takes place with the participation of both the frequency and the volume component of ventilation, which is indicative of a rather favorable age-related dynamics of the respiratory system indices among 9-year-old boys. A positive fact is the age-related increase of indicators reflecting the reserve capabilities of the respiratory system. By the end of the academic year, there was a marked decrease in QVL (18.2%, $p \leq 0.05$) and MVL (13.4%, $p = 0.05$). During all periods of the study, the indicators VCL, RVI, RVE, MVL, QVL decrease as compared to their level at rest, negative correlations between MVR-RV-RR appear, which indicates an adverse reaction of the system to the presented test sample.

CONCLUSION:

Thus, the increase of MVR in response to the isometric load is mainly due to the contribution of the frequency component (RR) against the background of a slight change of RV. By the end of the second year of education, the boys showed the increase of reactivity and the decrease of respiratory system reaction effectiveness to the static load, which reflects the intense functioning of the analyzed system by the end of the school year.

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REFERENCES:

1. Burkhanov A.I. Characteristics of external respiration among the schoolchildren of the grade 5-7 from the general education school // Hygiene. health officer. - 1994. - № 4. - pp. 51-53.
2. Roschevsky M.P., Evdokimov V.G., Varlamov N.G., Ovsov A.S. Regional and seasonal features of the cardiorespiratory system operation among the inhabitants of the North // Physiol. of people. - 1994. - V. 20, №6. - pp. 75-82.
3. Sokolov G.V., Kuznetsova T.D., Samburova I.P. Age development of respiratory system reserve and adaptive capabilities / Physiology of child development. - M.: Medicine, 2000. – pp. 167-184.
4. Coats E.M., Rossiter H.B., Day J.R. et al. Intensity dependent tolerance to exercise after attaining V(O2) max in humans // J. Appl. Physiol. — 2003. — Vol. 95. — P. 483–490.
5. Ferguson C., Whipp B.J., Cathcart A.J. et al. Effects of prior very-heavy intensity exercise on indices of aerobic function and high-intensity exercise tolerance // J. Appl. Physiol. — 2007. — Vol. 103. — P. 812–822.
6. Jack S., Rossiter H.B., Warburton C.J., Whipp B.J. Behavioral influences and physiological indices of ventilatory control in subjects with idiopathic hyperventilation // Behav. Modif. — 2003. — Vol. 27. — P. 637–652.
7. Miura A., Sato H., Sato H. et al. The effect of glycogen depletion on the curvature constant parameter of the powerduration curve for cycle ergometry // Ergonomics. — 2000. — Vol. 43. — P. 133–141.
8. Ozyener F., Rossiter H.B., Ward S.A., Whipp B.J. Influence of exercise intensity on the on- and off-transient kinetics of pulmonary oxygen uptake in humans // J. Physiol. — 2001. — Vol. 15. — P. 891–902.
9. Ozyener F., Rossiter H.B., Ward S.A., Whipp B.J. Negative accumulated oxygen deficit during heavy and very heavy intensity cycle ergometry in humans // Eur. J. Appl. Physiol. — 2003. — Vol. 90. — P. 185–190.
10. Ward S.A., Whipp B.J. Supraspinal locomotor centers do: do not contribute significantly to the hyperpnea of dynamic exercise in humans // J. Appl. Physiol. — 2006. — Vol. 100. — P. 1077–1079.