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*Dychko O. A.***STUDY OF DYNAMICS OF INDIVIDUAL INDICATORS OF FUNCTION OF VEGETATIVE NERVOUS AND CARDIORESPIRATORY SYSTEM OF CHILDREN 11-14 YEARS WITH SCOLIOSIS**

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Introduction. A person's ability to adapt physically and socially is complex and diverse. It is determined by many factors, including somatic condition, ability to endure physical and psycho-emotional load, degree of training, etc [1,2,3,4,5,6,7].

Disruption of the spatial configuration of the spine leads to significant functional and subsequently pathological changes in the activity of the cardiovascular and respiratory systems of the body [1,2,3,4,5,6,7]. Disruption of the activity of cardiovascular and respiratory systems in scoliosis deformation of the spine is associated not only with the displacement or compression of the chest organs, but also with constant irritation of the endings of the autonomic vegetative nervous system, clinical manifestation of which are the symptoms of vegetative disbalance [1,2,3,4,5,6,7].

Taking into consideration the peculiarities of the development of children with scoliosis, and the causes of their pathology, there is a problem of properly educating such a contingent of children / adolescents in order to prevent possible secondary abnormalities in emotional and physical development, as well as early disability [1,2,3,4,5,6,7].

Object of the research is to study the dynamics of individual indicators of the function of the vegetative nervous and cardiorespiratory systems of children aged 11-14 years with scoliosis compared with their almost healthy peers from secondary school.

Object and methods of research. There were 43 children aged 11-14 years under our supervision. Each age group included both healthy children and children with scoliosis.

The main group consisted of 19 children with scoliosis, 9 of them are boys and 10 are girls. The control group consisted of 24 practically healthy peers – 12 boys and 12 girls.

Physical performance of the children under research was determined on the basis of an analysis of myocardial demand in oxygen, Kerdo index, endurance ratio, Robinson index, maximal stroke blood volume, minute blood volume, average blood pressure (**table**).

The results obtained were processed using MUSTAT.12 (USA) applications. The reliability of the data for the independent samples is calculated by the t criterion student (when distributing arrays close to normal). The difference was considered significant at $P > 0.05$.

Research results. The dynamics of the results of individual indicators of the function of the autonomic nervous and cardiorespiratory systems of children aged 11-14 years with scoliosis are shown in **table**.

Analysis of the dynamics of the test of physical performance of children aged 11-14 years showed that the need for myocardium in oxygen both during rest and during exercise, as well as the first and second rest was the same among practically healthy children and boys and girls with scoliosis (**table**).

During physical activity, myocardial oxygen demand increased sharply and equally both among girls and boys of 11-14 years of age as in the control group and in experimental control group without significant gender difference ($p > 0.05$; **table**).

There were no gender differences in the Kerdo index in the group of almost healthy adolescents of 11-14 years and adolescents with scoliosis of the same age ($p > 0.05$; **table**). However, when comparing between observation groups, one immediately draws attention is that several times exceeding the value of the Kerdo index in the group of children with scoliosis, and this pattern is characteristic for both girls and boys (**table**). The determined fact indicates that the extremely powerful activation of the sympathetic nervous system is found in children with scoliosis also persists in adolescence.

During physical activity the same tendency persists in the distribution of the parameter of the Kerdo index: a significant excess of the index in the group of girls and boys aged 11-14 years with scoliosis compared with the control group. In addition, the Kerdo index in adolescent girls with scoliosis statistically significantly exceeded the corresponding values of adolescent boys with scoliotic disease ($p < 0.05$; **table**). The detected tendency persists during the first and second rest.

Determination of the degree of training of the cardiovascular system on the basis of the calculation of the endurance coefficient allowed us to establish that the corresponding coefficient was not significantly different among the groups under study in the state of rest and physical activity, as well as the first and second rest from the physical activity ($p > 0.05$; **table**).

Analysis of the systolic heart rate according to the Robinson index showed that in the rest state the highest index was found in almost healthy adolescent girls, although statistically significant difference was found only among the girls of the experimental and control groups ($p < 0.05$; **table**). The same pattern was observed in childhood: in adolescents with scoliosis, as well as in children of 7-10 years, the Robinson index is lower compared to almost healthy children. The control group of

Table – Dynamics of physical performance test results of children with scoliosis aged 11-14 years

Indicators	Units of measurement	Practically healthy children			Children with scoliosis					
		Boys (n = 12)	Girls (n = 12)	P	Boys (n = 9)	Girls (n = 10)	P	P ₁	P ₂	
The need for myocardium in oxygen	rest	ml /min/m ²	9,67±5,44	10,15±3,48	>0,05	9,20±2,53	9,01±0,18	>0,05	>0,05	>0,05
	physical activity	ml /min/m ²	25,78±3,78	25,09±5,59	>0,05	21,10±4,31	25,37±0,29	>0,05	>0,05	>0,05
	1 rest	ml /min/m ²	11,37±2,32	11,50±4,00	>0,05	10,56±1,85	12,18±0,43	>0,05	>0,05	>0,05
	2 rest	ml /min/m ²	11,77±3,93	11,92±4,42	>0,05	12,59±2,37	14,51±0,25	>0,05	>0,05	>0,05
The Kerdo Index	rest	st.un	6,82±3,32	2,18±1,50	>0,05	33,76±2,67	32,42±0,09	>0,05	<0,01	<0,01
	physical activity	st.un	20,55±6,69	18,20±2,77	>0,05	53,16±5,25	65,44±0,13	<0,05	<0,01	<0,01
	1 rest	st.un	6,22±1,59	4,39±2,17	>0,05	33,06±4,15	39,54±0,02	>0,05	<0,01	<0,01
	2 rest	st.un	5,22±1,88	4,69±2,14	>0,05	39,36±5,20	45,45±0,11	>0,05	<0,01	<0,01
Endurance ratio	rest	st.un	3,32±1,68	3,50±1,42	>0,05	3,24±1,72	2,95±0,01	>0,05	>0,05	>0,05
	physical activity	st.un	6,75±1,63	6,13±1,63	>0,05	9,80±2,71	12,84±0,13	>0,05	>0,05	<0,01
	1 rest	st.un	4,03±2,14	4,22±1,72	>0,05	4,20±2,11	5,32±0,04	>0,05	>0,05	>0,05
	2 rest	st.un	4,15±2,28	4,22±1,72	>0,05	5,13±2,52	6,34±0,02	>0,05	>0,05	>0,05
The Robinson Index	rest	st.un	83,13±11,11	92,75±3,29	>0,05	84,01±7,32	83,23±0,63	>0,05	>0,05	<0,05
	physical activity	st.un	243,50±5,08	237,17±6,47	>0,05	191,30±0,60	224,36±0,17	<0,01	<0,01	>0,05
	1 rest	st.un	103,33±4,00	105,50±5,08	>0,05	95,21±0,36	107,38±0,09	<0,01	<0,05	>0,05
	2 rest	st.un	107,80±4,53	108,70±7,82	>0,05	113,18±0,31	130,56±0,37	<0,01	>0,05	<0,05
Maximum stroke volume of blood	rest	ml/str	51,70±4,30	50,50±5,17	>0,05	59,50±0,11	62,28±0,08	<0,01	>0,05	<0,05
	physical activity	ml/str	51,13±4,97	52,50±7,00	>0,05	42,59±0,21	37,24±0,09	<0,01	>0,05	<0,05
	1 rest	ml/str	47,43±5,02	45,70±6,03	>0,05	54,46±0,39	49,30±0,36	<0,01	>0,05	>0,05
	2 rest	ml/str	47,70±4,30	45,70±6,03	>0,05	53,44±0,20	49,49±0,12	<0,01	>0,05	>0,05
Minute blood flow	rest	l/min	3,08±1,89	3,28±1,53	>0,05	2,85±0,35	2,65±0,02	>0,05	>0,05	>0,05
	physical activity	l/min	6,32±1,68	6,42±2,92	>0,05	5,31±0,05	4,95±0,02	<0,01	>0,05	>0,05
	1 rest	l/min	3,30±1,78	3,45±2,08	>0,05	3,30±0,09	2,84±0,03	<0,01	>0,05	>0,05
	2 rest	l/min	3,37±1,86	3,43±2,07	>0,05	3,82±0,09	3,37±0,23	>0,05	>0,05	>0,05
Average blood pressure	rest	mm Hg	90,90±4,73	91,58±2,92	>0,05	76,08±0,24	71,42±0,09	<0,01	<0,01	<0,01
	physical activity	mm Hg	133,40±6,00	132,90±5,42	>0,05	88,16±0,03	83,09±0,08	<0,01	<0,01	<0,01
	1 rest	mm Hg	99,25±8,79	99,62±5,55	>0,05	77,18±0,25	75,42±0,47	<0,01	<0,05	<0,01
	2 rest	mm Hg	100,80±6,30	101,17±4,67	>0,05	78,31±0,09	78,91±0,08	<0,01	<0,01	<0,01

Notes: P – the difference is reliable between practically healthy boys and girls and with scoliosis ones. P₁ – the difference is reliable between practically healthy boys and with scoliosis ones. P₂ – the difference is reliable between practically healthy girls and with scoliosis ones.

adolescents demonstrated better cardiovascular function compared to children of 7-10 years of age (table). The best energy potential of the body of adolescents with scoliosis in comparison with almost healthy adolescents persists since childhood.

The Robinson index increased while physical activity, with a statistically significantly higher index in the experimental group of girls compared to male adolescents (p < 0.05; table). The same tendency was found both during the first and the second rest (table).

The highest maximum stroke volume of blood at rest was found in adolescent girls with scoliosis. Moreover, this indicator statistically significantly exceeded both the corresponding value in boys with scoliosis and the stroke volume of blood in almost healthy boys and girls. During physical exercises, the maximum shock volume of blood decreased in both the adolescent group with scoliosis and the control group (table), however, the lowest values were recorded in the experimental group both among girls and boys. The lowest values of maximum stroke volume during physical exercises and during the first and second rest were recorded in girls with scoliosis, while the highest values were observed in boys from the experimental group.

The value of minute volume of blood at rest and during the first and second rest was not significantly different among almost healthy children aged 11-14 years compared with their peers with scoliosis (p > 0.05; table). During physical exercises a statistically significant lower value of minute blood volume was observed only

in adolescent girls with scoliosis compared to adolescent boys in the study group (table).

Average blood pressure was not statistically significantly different in girls and boys of control group (table), but it was statistically significantly lower in the group of adolescents with scoliosis. As in childhood, the lowest blood pressure was detected in adolescent girls with scoliosis, and this indicator was statistically significantly different from the corresponding values of both healthy girls of the same age group and boys with scoliosis (table). The same pattern was maintained during physical activity and during the first and second rest.

Conclusions. Thus in the result of our study it was found that children with scoliosis are behindhand their almost healthy peers in terms of autonomic nervous function and cardiorespiratory systems. Myocardial oxygen demand at rest, during physical activity and during restitution was lower in scoliosis children than in practically healthy ones. The Kerdo index in children with scoliosis before, during and after exercises was higher than in practically healthy ones. Children with scoliosis had lower Robinson's index.

Prospects for further research were to study the dynamics of autonomic nervous and cardiorespiratory function in adolescents aged 15-17 years with scoliosis compared with their relatively healthy peers from secondary school.

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ВИВЧЕННЯ ДИНАМІКИ ОКРЕМИХ ПОКАЗНИКІВ ФУНКЦІЇ ВЕГЕТАТИВНОЇ НЕРВОВОЇ І КАРДІОРЕСПІРАТОРНОЇ СИСТЕМ ДІТЕЙ ВІКОМ 11-14 РОКІВ ІЗ СКОЛІОЗОМ**Дичко О. А.**

Резюме. Стаття присвячена вивченню показників функції вегетативної і кардіореспіраторної систем у дітей. Проводилося дослідження 43 дітей 11-14 років, з них 19 дітей із сколіозом, та 24 практично здорових однолітків. Таким чином, встановили, що сколіоз у віці 11-14 років асоціює із значною активацією симпатoadреналової системи організму, котра статистично значимо переважає у дівчат зі сколіозом, серцево-судинна система підлітків зі сколіозом характеризувалася достатнім рівнем тренуваності, котрий не поступався коефіцієнту тренуваності підлітків контрольної групи.

Ключові слова: діти 11-14 років, сколіоз, вегетативна нервова система, кардіореспіраторна система.

ИЗУЧЕНИЕ ДИНАМИКИ ОТДЕЛЬНЫХ ПОКАЗАТЕЛЕЙ ФУНКЦИИ ВЕГЕТАТИВНОЙ НЕРВНОЙ И КАРДИОРЕСПИРАТОРНОЙ СИСТЕМ ДЕТЕЙ В ВОЗРАСТЕ 11-14 ЛЕТ СО СКОЛИОЗОМ**Дычко Е. А.**

Резюме. Стаття посвящена изучению показателей функции вегетативной и кардиореспираторной систем у детей. Проводилось исследование 43 детей 11-14 лет, из них 19 детей со сколиозом, и 24 практически здоровых сверстника. Таким образом, установили, что сколиоз в возрасте 11-14 лет ассоциирует со значительной активацией симпатoadреналовой системы организма, которая статистически значимо преобладает у девушек со сколиозом, сердечно-сосудистая система подростков со сколиозом характеризовалась достаточным уровнем тренированности, которая не уступала коэффициенту тренированности подростков контрольной группы.

Ключевые слова: дети 11-14 лет, сколиоз, вегетативная нервная система, кардиореспираторная система.

STUDY OF DYNAMICS OF INDIVIDUAL INDICATORS OF FUNCTION OF VEGETATIVE NERVOUS AND CARDIORESPIRATORY SYSTEM OF CHILDREN 11-14 YEARS WITH SCOLIOSIS**Dychko O. A.**

Abstract. The article is devoted to the study of indicators of function of the autonomic and cardiorespiratory systems in children. A study was conducted of 43 children of 11-14 years, including 19 children with scoliosis, and 24 practically healthy peers.

The purpose of the study was to study the dynamics of individual indicators of the function of the autonomic nervous and cardiorespiratory systems of children aged 11-14 years with scoliosis compared with their almost healthy peers from secondary school.

Analysis of the dynamics of the test of physical performance of children aged 11-14 years showed that the need for myocardium in oxygen both during rest and during exercise, as well as the first and second rest was the same among practically healthy children and boys and girls with scoliosis.

During physical activity, myocardial oxygen demand increased sharply and equally both among girls and boys of 11-14 years of age as in the control group and in experimental control group without significant gender difference.

There were no gender differences in the Kerdo index in the group of almost healthy adolescents of 11-14 years and adolescents with scoliosis of the same age. However, when comparing between observation groups, one immediately draws attention is that several times exceeding the value of the Kerdo index in the group of children with scoliosis, and this pattern is characteristic for both girls and boys. The determined fact indicates that the extremely powerful activation of the sympathetic nervous system is found in children with scoliosis also persists in adolescence.

During physical activity the same tendency persists in the distribution of the parameter of the Kerdo index: a significant excess of the index in the group of girls and boys aged 11-14 years with scoliosis compared with the control group.

Determination of the degree of training of the cardiovascular system on the basis of the calculation of the endurance coefficient allowed us to establish that the corresponding coefficient was not significantly different among the groups under study in the state of rest and physical activity, as well as the first and second rest from the physical activity.

Analysis of the systolic heart rate according to the Robinson index showed that in the rest state the highest index was found in almost healthy adolescent girls, although statistically significant difference was found only among the

girls of the experimental and control groups. The best energy potential of the body of adolescents with scoliosis in comparison with almost healthy adolescents persists since childhood.

The Robinson index increased while physical activity, with a statistically significantly higher index in the experimental group of girls compared to male adolescents. The same tendency was found both during the first and the second rest.

The highest maximum stroke volume of blood at rest was found in adolescent girls with scoliosis. Moreover, this indicator statistically significantly exceeded both the corresponding value in boys with scoliosis and the stroke volume of blood in almost healthy boys and girls.

The value of minute volume of blood at rest and during the first and second rest was not significantly different among almost healthy children aged 11-14 years compared with their peers with scoliosis. During physical exercises a statistically significant lower value of minute blood volume was observed only in adolescent girls with scoliosis compared to adolescent boys in the study group.

Conclusions. Thus in the result of our study it was found that children with scoliosis are behindhand their almost healthy peers in terms of autonomic nervous function and cardiorespiratory systems. Myocardial oxygen demand at rest, during physical activity and during restitution was lower in scoliosis children than in practically healthy ones. The Kerdo index in children with scoliosis before, during and after exercises was higher than in practically healthy ones. Children with scoliosis had lower Robinson's index.

Prospects for further research were to study the dynamics of autonomic nervous and cardiorespiratory function in adolescents aged 15-17 years with scoliosis compared with their relatively healthy peers from secondary school.

Key words: children 11-14 years old, scoliosis, vegetative nervous system, cardiorespiratory system.

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Завгородня В. А.

ЗМІНИ ЦЕНТРАЛЬНОЇ ГЕМОДИНАМІКИ ПРИ ГІПОКАПНІЇ ДИХАННЯ У МОЛОДИХ ЧОЛОВІКІВ З РІЗНИМ ВИХІДНИМ РІВНЕМ PetCO_2

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Зв'язок публікації з плановими науково-дослідними роботами. Дана робота є фрагментом НДР за темою «Вплив гіпо- та гіперкапнії на функціональний стан серцево-судинної системи людини», № державної реєстрації 0116U003829.

Вступ. Гіпервентиляція – це стан газообміну, при якому об'єм легеневої вентиляції надлишковий по відношенню до певних потреб організму, що призводить до зниження CO_2 в артеріальній крові – викликає гіпокапнію. У здорових людей вона має виражене пристосувальне значення і є компенсаторною реакцією системи дихання. Останнім часом, у зв'язку зі збільшенням стресового впливу, гіпервентиляція стала одним з факторів, який супроводжує сучасне життя [1]. Є дані про розвиток гіпервентиляції у спортсменів та у людей при фізичних навантаженнях, під впливом фармакологічних препаратів, що викликає ряд супутніх захворювань. Довільну гіпервентиляцію використовують у хірургічній практиці і акушерстві при проведенні анестезії, застосовують в терапевтичних цілях (для лікування бронхіальної астми, реабілітації при захворюваннях серця та судин тощо) [2,3], призначають у процесі психотерапевтичних сеансів холотропного дихання, в професійній діяльності, під час тренувань для підвищення витривалості та розширення меж адаптаційних можливостей в різних видах спорту [4]. Гіпервентиляційна проба має важливе значення для оцінки адаптаційного резерву організму і виявлення патологій [5], при професійному відборі у сфері трудової діяльності, для оцінки системи дихання в спортивній медицині, у клініці.

Втім аналіз наукової літератури показує, що досліджень індивідуальних особливостей змін гемодинамічних показників при пробах з гіпервентиляцією та після них недостатньо.

Мета дослідження. Проаналізувати індивідуальні зміни центральної гемодинаміки упродовж проби регламентованого дихання з частотою 30 циклів за хвилину у здорових молодих чоловіків залежно від вихідного рівня PetCO_2 .

Об'єкт і методи дослідження. Вимірювання здійснені на 81 практично здоровому чоловікові віком 18-22 роки. Всі особи брали участь у дослідженні добровільно, за даними медичного обстеження були практично здоровими, не мали гострих та хронічних захворювань. Перед виконанням завдань вони інформувались відносно мети та задач вимірювань, послідовності та змісту тестових навантажень, дали письмовий дозвіл на проведення дослідження та наукове використання їх результатів. За добу до проведення обстежень досліджувані не приймали алкогольних напоїв, кави, збуджуючих чи заспокійливих засобів, не мали великих емоційних та фізичних навантажень.

Дослідження здійснено в умовах наближених до стану основного обміну з 8 до 11 години, з дотриманням вимог біоетичних положень Конвенції Ради Європи про права людини і біомедицини (1997 р.), Гельсінської декларації Всесвітньої медичної асоціації про етичні принципи проведення наукових медичних досліджень за участі людини (1994-2008 рр.), а також наказу МОЗ України № 690 від 23.09.2009 р.