

Peculiarities of abnormalities of locomotor apparatus of children at preschool age with scoliosis of I-II degree living in Central Russia



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ABSTRACT

Background: Early diagnostics of developing abnormalities in structure and functioning of locomotor apparatus of 5-6-year-old children, including manifestations of scoliosis, is necessary for the maximally early beginning of its adequate correction. Estimation of morphological and functional peculiarities of modern children with scoliosis, living in Central Russia, is of great practical interest. The aim is to estimate morphological and functional peculiarities of locomotor apparatus of living in Central Russia 5-6 year-old children, having scoliosis of I-II degree.

Methods: In our study, we applied methods of morphofunctional estimation of a human being with the processing of received results by Student's t-criterion.

Result: Conducted estimation of deviation of spinal column position from the vertical one in children with scoliosis allowed us to detect its increase in them on average 4.4cm. We found lowering of humeral index value on 23.3% is taken into investigation children having scoliosis. It was accompanied by a significant decrease in mobility degree of the spinal column in three planes of motion

performance. It was also attended by lowering of mobility degree of their spinal column to the left side – on 47.4%, to the right side – on 53.6%, backward – on 39.7%. Children with scoliosis manifestations were noted to have inhibition of morphometric characteristics' development in comparison with the indices of the control group. While defining the values of dynamometry of children with scoliosis we noticed the significant lowering of muscle strength level of both hands in comparison with the control level – on 19.4% from the left side, on 26.7% from the right side. The decrease of hands' muscle strength of children with scoliosis was accompanied by the decrease of the common power till 34.2 ± 0.16 kg against 36.8 ± 0.31 kg in the control group. Tolerance of body muscles of children with scoliosis was significantly lowered.

Conclusion: Living in Central Russia 5-6 year-old children with scoliosis of I-II degree are noted to have typical signs of evident inhibition of physical development. It lies in lowering of somatometric indices, the decrease of body muscles' strength and level of their tolerance, degree lowering of spinal column mobility.

Keywords: Children, preschool age, scoliosis, diagnostics, morphofunctional characteristics.

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INTRODUCTION

Different pathology among Russian population dictates the necessity of continuation of detailed studying of its different pathogenesis elements and manifestations.¹ Special attention should be paid to pathology spread among children as children are that part of country's population which must determine their future.² Basing on the data of children's examination in different regions of Russia, we can slightly establish wide prevalence of different pathological manifestations among preschoolers. Analyzing its structure we couldn't help noticing that pathology of locomotor apparatus occupied one of the leading positions with scoliosis being the most significant part of it.^{3,4} According to our information prevalence of scoliosis among Russian children of preschool age reached the level of 35%.⁵

At present, it is recognized that scoliosis development is mostly caused by genetically (hereditarily) conditioned weakening of supporting, elastic and

shock characteristics of skeleton, ligaments, and muscles.^{6,7} Developing deformation of locomotor apparatus influences rather negatively not only the state of spinal column but also creates conditions for development and gradual progressing of many dysfunctions in a body, including already in adulthood.^{4,8,9}

It's noted that the work of all the internals and hemodynamics in them mostly depend on the state of locomotor apparatus. Numerous functional disturbances appear rather early in case of development of different disturbances in the spinal column of a person's body. It caused by synthesis weakening of protein and biologically essential substances with the output increase of proinflammatory factors which cause apoptosis of cells.¹⁰ Blood, pulmonary and cardiovascular systems react rather keenly on the presence of sciotic process in children's spinal column.¹¹⁻¹³ In this connection scoliosis in

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Table 1 Peculiarities of Morphofunctional Characteristics of Examined Preschoolers with Scoliosis (Conventional signs: p – significance of parameters' differences of children with scoliosis and control group)

Parameters	Group with scoliosis, n = 112, M ± m	Control group n = 34, M ± m
Deviation of spinal column from the vertical position, cm	4.6 ± 0.44	0.2 ± 0.004 p < 0.01
Value of humeral index	0.69 ± 0.05	0.90 ± 0.06 p < 0.01
Mobility degree of spinal column in the course of tilts to the left side, cm	21.5 ± 1.31	32.8 ± 1.45 p < 0.01
Mobility degree of spinal column in the course of tilts to the right side, cm	22.2 ± 1.42	32.5 ± 2.44 p < 0.01
Mobility degree of spinal column in the course of tilts backward, cm	14.1 ± 0.89	22.6 ± 0.72 p < 0.01
Chest circumference, cm	59.4 ± 0.36	61.9 ± 2.56
Waist circumference, cm	51.3 ± 0.46	51.6 ± 0.86
Thigh circumference, cm	34.3 ± 0.85	35.8 ± 0.65
Crus circumference, cm	24.1 ± 0.49	25.4 ± 0.46
Arm circumference, cm	16.6 ± 0.36	17.2 ± 0.37
Forearm circumference, cm	16.3 ± 0.38	17.1 ± 0.36
Value of dynamometry from the right side, kg	10.21 ± 0.55	12.8 ± 0.04 p < 0.05
Value of dynamometry from the left side, kg	9.8 ± 0.27	11.7 ± 0.07 p < 0.01
Value of torso strength, kg	34.2 ± 0.16	36.8 ± 0.31 p < 0.05
Tolerance of back muscles (position on the abdomen), s	58.9 ± 2.35	77.6 ± 2.61 p < 0.01
Muscles tolerance of body lateral part (in position on the left side), s	56.7 ± 1.57	68.2 ± 2.15 p < 0.01
Muscle tolerance of body lateral part (in position on the right side), s	56.2 ± 2.53	67.3 ± 2.24 p < 0.01
Tolerance of abdomen muscles, quantity of possible body bendings	12.5 ± 1.63	21.0 ± 1.49 p < 0.01

children of preschool age is rightly considered to be a hazardous disease of spinal column leading to abnormalities in many internals because of development of hypoxia, weakening of metabolism in tissues and unfavorable morphofunctional changes in them against its background.¹⁴⁻¹⁶

Early diagnostics of developing abnormalities in structure and functions of locomotor apparatus of preschoolers, including scoliosis manifestations, can help in the maximally early beginning of its adequate correction conducting. In this connection, it can become the basis of not only preventing scoliosis progression but also health provision of many internals of developing the body.^{17,18} That's why, estimation of peculiarities of morphological and functional development of modern children living in Central Russia and having scoliosis symptoms, is of great practical interest. Taking given circumstances into account, we planned and conducted the present research. This study aimed to estimate morphological and functional peculiarities of locomotor apparatus of living in Central Russia 5-6-year-old children with scoliosis of I-II degree.

METHODS

The research was conducted on children of late pre-school age living in Central Russia (city Moscow and Moscow region). In our research, we took 34 healthy children of both sexes at the age of 5-6 years

(height 123.6 ± 1.41cm, body mass 24.2 ± 1.38kg) and also 112 children of both sexes of the same age with scoliosis of I-II degree (height 120.6 ± 0.84cm, body mass 21.8 ± 2.35kg) at the full absence of any accompanying diseases in them. Estimation of the health state of all the children, taken into the research, was conducted basing on the analysis of information from their medical records. This research was approved by local Ethics Committee of Russian State Social University on May 14, 2015 (record №5). Both parents of each taken into the research child gave written an informed agreement on participation of their children in the research. The children's approval was received in the oral form in the presence of their parents and witnesses.

The value of spinal column deviation in children from the vertical position was determined with the help of a test with pasting of prepared cord with a lead in the field of the 7th cervical vertebra by adhesive plaster.¹⁹ The distance from the vertical position, found by this lead, till acanthus was considered to be the degree of spinal curvature in the frontal plane. The value of humeral index was calculated in the course of dividing the breadth value of a child's humerus from the chest side (cm) on the breadth value of a humerus from the back side (cm).²⁰

The mobility of examined children's spinal columns was estimated in the course of body tilts

forward, backward and sideward. In the course of body tilts forward at straightened legs we determined the distance between the middle finger of each hand and floor surface (cm). In case of body tilts backward we determined the difference (cm) between the length of the line connecting the acanthas' tops of the 7th cervical vertebra with the initial part of the intergluteal fold (the estimation was carried out before making tilts and against the background of making tilts backward). Lateral mobility of spinal column was found in the course of distance estimation between the ends of hands' middle fingers and floor at maximum tilt sideward from the position of standing strictly vertically. The more given difference was, the more was the mobility of spinal column in the frontal plane.¹⁹ Estimation of circumference values of chest, waist, thigh, crus, arm, and forearm was conducted by traditional methods with the help of a tape measure.^{19,20}

Determining the level of back muscles' static tolerance was carried out against the background of maximum tilt backward (body bending) from the position of lying on the abdomen at obligatory legs' fixation. We carried out the estimation of the period of this pose' keeping. With the help of duration of body keeping in the pose of the biggest lateral tilt (body bending in frontal plane) from the initial position of lying sideways, we estimated muscle tolerance of side body parts. The tolerance of muscle groups was determined with the help of durable pose keeping on both sides separately. Clarification of static tolerance peculiarities of a muscle group of the anterior abdominal wall was conducted in position on the back with fixed legs, according to the number of body up-rises into sitting position.¹⁹ A strength of hands' muscles was determined in the course of application of carpal dynamometer, and for back muscles – by application of torso dynamometer. Muscles' strength was determined in the course of counteraction to the process of their isometric contraction when muscle tension increased without any changes in muscle length.^{19,20} Received in our study results were processed by Student's t-criterion.

RESULTS

Examined 5-6-year-old children with scoliosis had some lagging of morphofunctional characteristics from children's level in the control group (Table 1).

Conducted estimation of deviation of spinal column position from the vertical one in children with scoliosis allowed finding its rise on 4.4cm in them. Taken into our research children with scoliosis had to lower of humeral index value on 23.3%.

It was accompanied by a significant decrease in the degree of spinal column mobility in three planes of motion performance. Examined children with scoliosis had to lower the degree of their spinal column mobility to the left side – on 47.4%, to the right side – on 53.6%, backward – on 39.7%.

Children with scoliosis manifestations were noted to have inhibition of morphometric characteristics' development in comparison with the indices of the control group. Parameters of body length, the value of body mass and chest circumference of children with scoliosis were a bit less than indices of the group for comparison. Values of waist circumference, thigh circumference, crus circumference, arm circumference and forearm circumference inclined to be inferior to the same ones in the group of healthy children.

While determining the values of dynamometry of children with scoliosis we noticed a significant lowering of the level of both hands' muscle strength in comparison with the control level – on 19.4% from the left side, on 26.7% from the right side. A decrease of hands' muscle strength in children with scoliosis was accompanied by lowering of torso strength till 34.2 ± 0.16 kg against 36.8 ± 0.31 kg in the control group. Moreover, tolerance of body muscles of children with scoliosis also turned out to be lowered.

DISCUSSION

It's difficult to call exhaustive those data which have been accumulated in the physiology of children of preschool age by the present moment.⁴ Carrying out of regular investigations devoted to peculiarities of their locomotor system performance hasn't brought the necessary amount of information. It is acknowledged that different pathological manifestations in children's bodies can appear at the development of various abnormalities in environmental optimum which is necessary for their normal development.⁵ At present we see growing number of children with various disharmony of their physical status in developed countries. It was noticed that their locomotor apparatus was especially vulnerable.^{2,14}

Abnormalities of all kinds develop in children's musculoskeletal system in the course of their active growth against the background of unfavorable environmental impacts. Scoliosis, as one of these abnormalities, is considered to be rather widespread. The frequency of its occurrence at present significantly increased.²¹ In Russia, we have an evident tendency to the growth of preschoolers' number with the given pathology. Disturbances in different internals' performance are registered against the background of scoliosis with aging. It influences the health of

population on the whole negatively. First of all, it is connected with weakening of metabolism, lagging of physical development and inhibition of psychic activity.²²

It was noted that the level of metabolism and success of internals' work are under strong impact of the locomotor system. Low energy outlays in conditions of scoliosis inhibit anabolism in internals' cells strengthening existing abnormalities in a child's body. Deceleration of oxygen and nutrients' inflow into muscles and bones against this background and inhibition of different metabolic products' removal out of them deepen existing pathology.⁵ All these factors lead to the situation when in conditions of scoliosis the work of locomotor system takes place at constant energy deficiency which is caused by hypoxia and deceleration of microcirculation against the background of arterioles' spasm and platelets' activation.¹¹

In this connection working out of effective variants of scoliosis correction and efficient approaches to its prophylaxis is becoming more and more actual for rehabilitation of children with scoliosis.²³ Further investigations of impact mechanisms of various correction variants on a child's body with scoliosis should become a serious step for modern rehabilitology. Estimation of new and already known ways of given pathology correction in children of preschool age should be carried out taking into consideration the results of researchers connected with peculiarities of a morphofunctional status of children with scoliosis living in different regions.

CONCLUSION

In our research, we confirmed the facts about the development of scoliosis pathological manifestations in a child's body. Living in Central Russia 5-6-year-old children with scoliosis of I-II degree have typical signs of evident inhibition of physical development. It is confined to their lowering of somatometric indices, the decrease of body muscles' strength, level of their tolerance and degree lowering of spinal column mobility. It becomes clear that estimation of morphofunctional characteristics of 5-6-year-old children should be conducted regularly for timely scoliosis detection and high efficiency of correction impacts on the locomotor system. It will allow diagnosing of scoliosis development at an early stage.

CONFLICT OF INTEREST

All authors declare there is no conflict of interest regarding publication of this manuscript

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