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# Impact of daily wearing of medioprophyllactic clothes on the state of locomotor system of 5-6-year old children with scoliosis of I-II degree



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## ABSTRACT

**Background:** Efficient variants of scoliosis correction should be applied maximally early, as soon as its first symptoms are detected. One of such variants is daily wearing of medioprophyllactic clothes (MPC). At the same time, dynamics of morphological and functional characteristics of locomotor apparatus in 5-6-year old children with scoliosis against the background of their daily wearing of MPC is still studied rather poorly.

**Method:** Dynamic indices of locomotor apparatus of 5-6-year old children with scoliosis of I-II degree who wore author-designed MPC daily for 6 months were tracked.

**Results:** Examination of 5-6-year old children with scoliosis of I-II degree was noted to have typical manifestations of physical development inhibition in their initial state such as lowered somatometric indices, decreased body muscle strength, lowered tolerance level, and reduced spinal mobility. Conclusion. Daily MPC wearing for half a year provided children with scoliosis evidence of lower spinal curvature, an increase in body muscle strength, and a closer tolerance of relevant indices to control values.

**Keywords:** Children, preschool age, scoliosis, morpho-functional characteristics, medioprophyllactic clothes.

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## INTRODUCTION

During the last few years, researchers have devoted much attention to the problem of physical development in children with scoliosis.<sup>1</sup> It was noted many times that these children had decreased overall physical development.<sup>2</sup> It is known that children with scoliosis are often registered to have lagging of body part size from the age standards, tension growth of their respiratory and cardiovascular function.<sup>3,4</sup> It is acknowledged that worsening spring abilities of spinal column lead to continuous brain micro-injuries and spinal cord microtraumas. All these lead to the development of abnormalities of the internal organ function.<sup>5</sup> At the same time in their cells rapidly violate the synthesis of protein and regulatory substances.<sup>6,7</sup> This situation is aggravated by the fact that children with scoliosis develop early violations of the rheological properties of blood cells.<sup>8</sup> They exacerbate the existing dysfunction in the body<sup>9</sup> as a result of the appearance of hypoxia and the weakening of metabolism in tissues.<sup>10,11</sup>

At present, it is considered necessary to start aggressive scoliosis correction early, as soon as its first symptoms are detected. Such correction may be beneficial for not only preventing scoliosis progression but also for conservation of children's health.<sup>12</sup> One of the variants of scoliosis correction

and prophylaxis is to wear medioprophyllactic clothes (MPC). Currently, its potential to correct the morpho-functional status of locomotor apparatus is still poorly- studied. Hence, the aim of this study is to estimate the dynamic evidence of morphological and functional peculiarities of locomotor apparatus in 5-6-year old children with I-II degree scoliosis against the daily wearing of MPC for six months period.

## MATERIALS AND METHODS

The research was conducted on children living in Central Russia (Moscow city and Moscow region). The participants of the study were 34 healthy children of both gender at the age of 5-6 years (height  $123.6 \pm 1.41$  cm, body mass  $24.2 \pm 1.38$  kg), and 39 children of both gender of the same age with scoliosis of I-II degree (height  $118.7 \pm 0.73$  cm, body mass  $21.2 \pm 2.10$  kg) at the full absence of any accompanying diseases in them. This study was approved by the local Ethics Committee of Russian State Social University on May 14<sup>th</sup>, 2015 (record №5). Both parents of the child gave a written informed agreement on participation of their children in the research. The children themselves agreed in oral form in the presence of their parents and witnesses.

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**Table 1** Dynamics of morphofunctional characteristics of the examined children with scoliosis against the background of MPC wearing

Registered parameters	A group of children with scoliosis wearing MPC, n = 39, M ± m			Control, n = 34, M ± m
	initial state	3 months	6 months	
Deviation of spinal column from the vertical position, cm	4.5 ± 0.29	2.9 ± 0.37 p1 < 0.01	1.46 ± 0.14 p1 < 0.01	0.2 ± 0.004 p < 0.01
Humeral index value	0.72 ± 0.16	0.76 ± 0.09	0.82 ± 0.06 p1 < 0.05	0.90 ± 0.06 p < 0.01
Degree of spinal column mobility while tilting to the left side / cm	21.6 ± 1.24	24.5 ± 0.30	27.8 ± 0.27 p1 < 0.05	32.8 ± 1.45 p < 0.01
Degree of spinal column mobility while tilting to the right side / cm	22.4 ± 1.34	24.7 ± 0.24	27.9 ± 0.17 p1 < 0.05	32.5 ± 2.44 p < 0.01
Degree of spinal column mobility while tilting backward / cm	14.5 ± 0.72	16.3 ± 0.41	18.7 ± 0.38 p1 < 0.05	22.6 ± 0.72 p < 0.01
Chest circumference / cm	59.8 ± 0.27	60.5 ± 0.33	61.7 ± 0.45	61.9 ± 2.56
Waist circumference / cm	53.4 ± 0.38	52.7 ± 0.27	51.9 ± 0.40	51.6 ± 0.86
Thigh circumference / cm	33.0 ± 0.70	34.3 ± 0.28	35.4 ± 0.33	35.8 ± 0.65
Crus circumference / cm	24.1 ± 0.26	24.8 ± 0.34	26.0 ± 0.27	25.4 ± 0.46
Arm circumference / cm	16.8 ± 0.32	17.2 ± 0.26	18.3 ± 0.35	17.2 ± 0.37
Forearm circumference / cm	16.4 ± 0.30	16.7 ± 0.27	17.8 ± 0.34	17.1 ± 0.36
Value of dynamometry from the right side / kg	10.5 ± 0.49	10.9 ± 0.27	11.2 ± 0.30	12.8 ± 0.04 p < 0.05
Value of dynamometry from the left side / kg	9.7 ± 0.25	10.6 ± 0.20	11.0 ± 0.18	11.7 ± 0.07 p < 0.01
Value of torso strength / kg	34.5 ± 0.18	35.1 ± 0.17	35.9 ± 0.20	36.8 ± 0.31 p < 0.05
Tolerance of back muscles (in the position on the abdomen) / s	60.1 ± 1.24	64.2 ± 1.34	68.2 ± 0.92 p1 < 0.05	77.6 ± 2.61 p < 0.01
Tolerance of lateral muscles* (in the position on the left side) / s	58.2 ± 1.20	61.0 ± 1.02	63.8 ± 1.26 p1 < 0.05	68.2 ± 2.15 p < 0.01
Tolerance of lateral muscles* (in the position on the right side) / s	57.3 ± 1.86	59.7 ± 1.34	64.4 ± 1.54 p1 < 0.05	67.3 ± 2.24 p < 0.01
Tolerance of abdominal muscles, the quantity of possible body bending	13.7 ± 1.45	15.8 ± 1.37 p1 < 0.05	18.8 ± 1.05 p1 < 0.01	21.0 ± 1.49 p < 0.01

\* - m. pyramidalis, m. obliquus externus abdominis, m. obliquus internus abdominis, m. transversus abdominis

Deviation degree of the spinal column in children was determined with the help of a test with pasting of special cord with lead in the field of the 7<sup>th</sup> cervical vertebra by adhesive plaster.<sup>13</sup> The distance from the vertical position until acanthus was found with the help of this lead. It characterized the degree of spinal curvature in the frontal plane. The value of the humeral index was calculated by dividing the value of a child's humerus width from the chest side (cm) by the value of humerus width from the back side (cm).<sup>14</sup>

The degree of spinal mobility in examined children was estimated throughout body tilted forward, backward and side ward. During body tilted forward at straight legs, we determined the distance from the middle finger of each hand into floor surface (cm). In the case of body tilted backward, we determined the difference in the length of line (cm) which connected the tops of acantha of

the 7<sup>th</sup> cervical vertebra and the initial part of the intergluteal fold. The estimation was conducted in a vertical position and at the tilt backward position. Lateral spinal mobility was measured throughout the distance estimation from the tip of middle fingers in upper extremities to the floor at maximum lateral bending from standing position. The greater the given difference, the greater spinal mobility in the frontal plane is.<sup>13</sup>

Estimation of the circumference of chest, waist, thigh, crus, arm, and forearm was conducted by traditional method with the help of a tape measure.<sup>13,14</sup>

The level of static tolerance of back muscles was estimated during maximum backward tilt (body bending) from abdomen lying position at obligatory fixation of legs within 10 seconds. We estimated muscle tolerance of lateral body parts according to the duration of body keeping in the position of the biggest lateral tilt (bending in frontal plane)

from the initial – side-lying – position. Tolerance of muscle groups was determined on both sides separately. Determination of static tolerance of the anterior abdominal wall muscle was conducted during back lying with fixed legs according to the number of body lifts in sitting position.<sup>13</sup> Hand muscle strength was found in the course of carpal dynamometer application, as for back muscles – by torso dynamometer application.<sup>13,14</sup>

All the children from experimental group were recommended to wear daily MPC, designed by the author, for scoliosis correction.<sup>15</sup> Applied MPC contained a button band, and a panel was provided by elastic straps in the upper part. Their ends were connected to both panel sides. The panel was made of a non-stretching material, and there were pockets with inflexible plates on it within the area of blade bones' inner corner. The ends of elastic straps were fixed to both panel sides on the level of blade bones, and pockets were attached to the reverse side of the panel. The panel and the button band were supplied with sleeves, collars, skirts or trousers of any material. Given MPC were put on in a vertical position. The arms were drawn backward with the help of elastic straps. Inflexible plates pressed the inner part of blade bones promoting flattening of the back. The presence of elastic belt did not hamper normal breathing and, at the same time, promoted right fit of clothes on the body. The clothes were worn during the whole day. They were put off before going to bed. In this research, all the children with scoliosis were recommended daily wearing of MPC during the whole day for 6 months.

The children from experimental group were observed and examined at the beginning and in 3 and 6 months of continuous MPC wearing. The control group was observed and examined once. The results obtained in work were processed by Student's criterion (t).

## RESULTS

In the beginning, the examined children with scoliosis had a lag of morphofunctional indices compared with the children from the control group (table 1).

## CONVENTIONAL SIGNS

p-value of parameter differences of children with scoliosis and control group. p1 – value of relevant indices dynamics of children with scoliosis during correction in comparison with the beginning.

Within 3 months of continuous MPC wearing, 55.2% of the children with scoliosis had a lower deviation degree from the vertical position.

It continuously decreased until the end of the research into  $1.46 \pm 0.14$  cm. The use of MPC within 3 months reduced humeral index value by 5.5%. By the end of the research, the number kept decreasing and reached the value of  $0.82 \pm 0.06$  (table 1).

Application of MPC for 3 months provided the children with scoliosis a tendency to increase spinal mobility in three planes which reached the statistically significant level in 6 months (to the right side until  $27.9 \pm 0.17$  cm, to the left side until  $27.8 \pm 0.27$  cm, backward until  $18.7 \pm 0.38$  cm).

The children with scoliosis who had been wearing MPC regularly for three months tended to have an increase in dynamometry index. The strength of hand muscles from the right side reached  $10.9 \pm 0.27$  kg, while the strength of hand muscles from the left side reached  $10.6 \pm 0.20$  kg with an average value of torso strength at  $35.1 \pm 0.17$  kg. After six months of MPC wearing, children with scoliosis had some additional rise of relevant parameters (Table 1).

Children with scoliosis who regularly wore MPC had an increase of muscle tolerance in relevant muscle regions. Within three months, these children had a tolerance rise in abdominal muscle by 15.3%, back muscle by 6.8%, left lateral muscle by 4.8%, and right lateral muscle by 4.2%. Regular and continuous use of MPC in children with scoliosis helped to deepen the given positive dynamics of strength characteristics of back and abdominal wall muscles. However, it has not led to their normalization (Table 1).

Discussion: Development of various dysfunctions in a human being at any age is mostly related to the presence of definite genetic mutations in the event of negative environmental conditions. Given situation determines the development of negative phenotypic manifestation of existing hereditary defects. Polymorphism of single nucleotides is the most widespread of them.<sup>16,17</sup> The realization of many variants of human pathology takes place, including the development of cardiovascular diseases,<sup>18,19</sup> their different complications,<sup>20,21</sup> development of many metabolic disturbances,<sup>22,23</sup> dysfunctions of the central nervous system,<sup>24</sup> and abnormalities in locomotor apparatus function.<sup>25</sup> The last variant of pathology is seen more often in Russia at present among preschool-age children. Most of such cases are related to scoliosis.<sup>2</sup> Nearly 2 million children with bearing disturbances and scoliosis live in Russia at present. It was noted that scoliosis was often found at late preschool age, while I and II degrees were discovered in 75-80% of cases.<sup>26</sup>

It is necessary to work out efficient correction variants of the given state for rehabilitation of

children with scoliosis. This will allow conducting prophylaxis for different somatic pathology development in the future.<sup>27,28</sup>

Further investigation of delicate impact mechanisms of various correction variants on a child's body with scoliosis should become a serious step for modern rehabilitation.<sup>1</sup> One of them is continuous MPC wearing. The degree of its impact on the morpho-functional status of children with scoliosis is not yet fully studied.

In the results of conducted research, we can state that the regular use of MPC in 5-6-year old children with scoliosis had a positive influence on the humeral index value, and also on the level of muscle strength and tolerance. Continuous maintenance of physiologically favorable body position optimizes the course of vital processes in the musculoskeletal system of children with scoliosis and in all the organs in children's body. This situation leads to the inflow of necessary quantity of nutrients and oxygen to bones and muscles which causes active washing of toxic products out of them. All this provides reinforcement of growth and development in the child's locomotor system on behalf of the increase in body mass, bone thickening, and optimization of their functional state. Developmental changes in a body create all physiological preconditions for strengthening of continuous resynthesis of adenosine triphosphate.<sup>29</sup> The synthesis of nucleic acids and proteins in locomotor system and internals is inevitably stimulated in these conditions. Given changes should be considered as a physiological basis of MPC rehabilitating impact. The daily wearing reduced the complications of scoliosis in children.<sup>15</sup> This situation created the most favorable conditions for metabolism and adaptation of a child's body to the environment.<sup>30,31</sup>

## CONCLUSION

Children with age 5 to 6-years with scoliosis of I-II degree in Central Russia had typical manifestations of evident inhibition of physical development. It was pointed out by lowered somatometric indices, decreased body muscle strength and level of their tolerance, as well as lowered degree of spinal mobility. Daily wearing of MPC by children with scoliosis for half a year can lower the evidence of spinal curvature, increase strength and level of body muscle common tolerance. However, it does not provide full normalization of these indices.

## CONFLICT OF INTEREST

No conflict of interest to declare.

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