

Morphological and functional indicators of 10–13 year-old adolescents with the scoliosis of I–II degree

Anastasia Podolyaka
Oleg Podolyaka
Ruslan Iskandarov

Federal State Educational Institution of Higher Professional Education Cherepovets State University, Cherepovets, Russia

Purpose: to study the features of morphological and functional indicators of 10–13 year-old adolescents suffering with the scoliosis of I–II degree, to determine the main directions in the preparation of comprehensive rehabilitation programs for improving posture in children.

Material & Methods: based on the analysis of the specialized literature and the generalization of the obtained data of the conducted study of 42 school-age children, which are divided into two groups – the basic (with scoliosis deformation of the spine) and the control (practically healthy children of the same age), the main directions for the compilation of comprehensive rehabilitation programs.

Results: It established the fact of violations of the cardiovascular and respiratory systems in children with scoliosis. Indicators of boys and girls have different directions.

Conclusion: preparation of corrective programs requires not only the formation and consolidation of the habit of correct posture, the creation of a muscular corset, but also the focus on improving the development of a cardiovascular and respiratory systems with a special approach to children of different sexes.

Keywords: scoliosis, pupils, morphological and functional indicators.

Introduction

Problems of formation, preservation and strengthening of health of adolescence, propagation of a healthy lifestyle, rehabilitation of existing deviations from normal development have always been and remain a priority in any modern society. Scoliosis, as one of the types of curvature of the spine, is today a fairly common problem, which will subsequently occur even more often, doctor's state. [3]. Scoliosis is usually formed and progresses during active growth of the body in adolescence, especially during growth spikes in puberty. Traditionally it is believed that the cause of scoliosis is unknown in 80% of cases, in the remaining 20% it is a consequence of congenital deformations of the vertebrae [7].

There are a number of works on the formation of posture, the study of the impact of impaired posture and scoliosis on the functions of the body of children of different age groups, in which scientists point to the progression of spinal deformity at school age. The growth in this period, the static load and a decrease in motor activity, due to the learning process at school, leads to a reduction in the functional state of the musculoskeletal system, stimulates and strengthens the spine deformation [11; 12]. Despite the existence of numerous studies, available scientific data lead to various characteristics of physical and functional changes occurring in the child's body due to the appearance of scoliosis, sometimes even contradictory. Therefore, the question of further studies of children with scoliosis and the changes occurring in their body, is relevant.

The purpose of the research

To study the features of morphological and functional indicators of 10–13 year-old adolescents suffering with the scoliosis of I–II degree, to determine the main directions in the preparation of comprehensive rehabilitation programs for improving posture in children.

To achieve this purpose, the following tasks were identified:

- 1) to analyze and summarize the data of the special literature on the study of morphological and functional indices of the musculoskeletal system in adolescents aged 10–13 and in the treatment of scoliosis;
- 2) to determine the main directions for compiling comprehensive rehabilitation programs for improving the bearing in children.

Material and Methods of the research

The main following methods were used: theoretical analysis and synthesis literature data; comparison of morphological and functional indicators of adolescents 10–13 years of age; mathematical statistics for processing received data.

For the study of morphological and functional indices, 42 children of school age were studied, which were divided into two groups – the main (MG) and control (CG). The main group in-

cluded 20 children 10–13 years age with scoliotic deformity of the spine of I–II degrees (8 boys and 12 girls), in the control group – 20 practically healthy children of school age (10 boys and 10 girls). All children were subjected to anthropometric measurements with determination of body weight, height, chest circumference (CC), chest excursion (CE), Rohrer and Pinje indices were calculated, the functional state of the cardiovascular system was determined by heart rate at rest (HR), Respiratory system (Stange and Genci tests). The resulting study MG and CG parameters were compared, and the probability of differences was determined by Student's t test (tab. 1).

Results of the research and their discussion

Theoretical analysis and generalization of the specialized literature allow us to talk about the main points of getting rid of scoliosis [1; 5; 6; 8; 12].

Modern concepts of scoliosis treated as a disease, the basis of which there are violations of exchange of the connective tissue system, under which the locomotor's system occurs scoliosis deformity of the spine, leading to deformation of the hip, legs, chest, head,. It affects not only the formation of bone structures, their interrelation, the morphology and functional state of other systems, in particular, the nervous system, chest organs, abdomen [10].

In connection with the limitation of the volume of muscular activity, pronounced atrophic and dystrophic changes are observed, motor skills and coordination of movements occur [12]. The results of scientific research [4] and the experience of a number of European countries [2; 13] convincingly show that increasing the motor activity of the child and the proper planning of physical rehabilitation solves a number of problems associated with the incidence and prevalence of deformation of the musculoskeletal system, significantly in-

creases the resistance of children to various kinds of adverse environmental factors.

As a result of statistical analysis of anthropometric measurements found that children with scoliosis observed a significant ($p<0.05$) increase in average body weight in girls and height at boys and girls. Accordingly, in children with scoliosis a significant increase in the indices of the Rohrer and Pinje indices ($p<0,05$). Anthropometric indices exceed the age norms [9] to a greater extent in children with scoliosis. There is a significant deterioration in CC parameters, although CE corresponds to the norm, which indicates the limited movement of the chest due to the pathological process. As a consequence of the foregoing, heart rate in children with scoliosis is significantly greater ($p<0,05$) compared with healthy, both in boys and girls.

The average indices of the Pinje index of both groups of children show an approximation to the "hypersthenic" (brachymorphic) type of physique, although they have a significant difference between the groups, which indicates an obvious unevenness of almost all indicators.

Samples with a delayed respiration showed that in healthy children 10–13 years of age the functional state of the respiratory system corresponds to the age norm, the values obtained for the Stange and Gentcha test parameters were within the limits of normal values. In children with scoliosis (both in boys and girls), the mean values of respiratory retention on inspiration and exhalation were significantly less than those in healthy children ($p<0,05$).

The average results of a group of practically healthy children were taken as a basis for determining the positive or negative difference in the percentage of results of children with scoliosis (Fig. 1).

Table 1
Indicators of morphological and functional features of children 10–13 years old (M±m)

	Indicators	Practically healthy children, n=20	Children with scoliosis I-II degree, n=22
Boys	Height, cm	148,8±1,40	152,4±0,77*
	Body weight, kg	45,5±1,15	47,1±1,39
	CC, cm	67,2±0,74	69,9±1,27
	CE, cm	4,85±0,12	2,05±1,54*
	Rohrer index, kg cm ⁻³	12,7±0,7	13,9±1,2*
	Pinje Index, cond. units	32,7±4,89	33,8±1,35*
	HR, beats·min ⁻¹	72,5±0,85	82,9±2,02*
	Stange test, s	47,4±4,82	45,9±3,64*
	Genci's test, s	25,7±2,43	23,2±3,04*
	Girls	Height, cm	150,2±0,65
Body weight, kg		47,2±2,29	42,7±1,45*
CC, cm		65,3±1,40	60,4±2,43*
CE, cm		3,8±1,52	2,35±2,33*
Rohrer index, kg cm ⁻³		13,9±0,7	11,3±2,5*
Pine Index, cond. units		32,8±3,68	35,0±1,85*
HR, beats·min ⁻¹		73,0±1,41	85,6±2,12*
Stange test, s		43,9±3,13	39,2±2,45*
Genci's test, s		24,0±2,92	23,7±1,81*

Note. * – $p<0,05$.

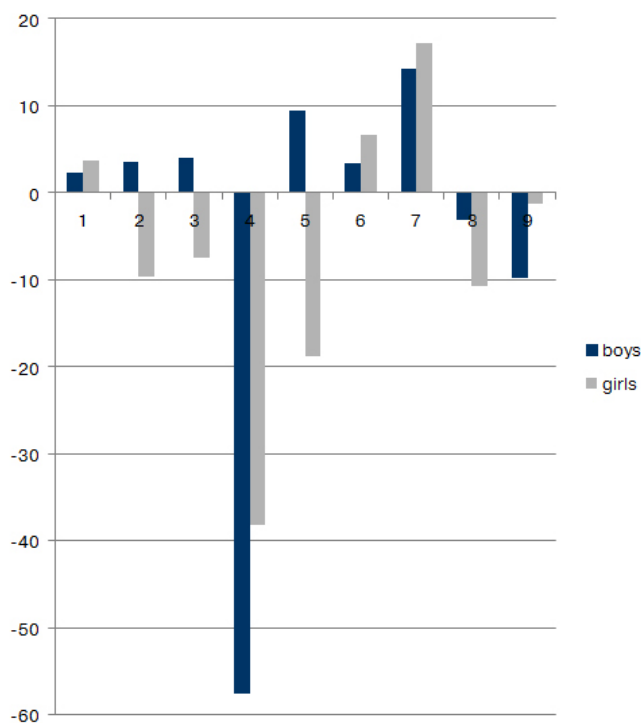


Fig. 1. Deviation of the average morphological and functional indicators of boys and girls suffering from scoliosis of I-II degree, from the average indices of a group of practically healthy children (%): 1 – Height; 2 – Body weight; 3 – CC; 4 – CE; 5 – Rohrer index; 6 – Pinje Index; 7 – HR; 8 – Stange test; 9 – Genci's test.

The similarity of indicators is observed in the change: growth and heart rate. Indicators of body weight, CC, Rohrer index for boys and girls have the opposite changes of the indices of CG (Fig. 1).

Conclusions

1. The fact of development of violations from the cardiovascular and respiratory systems in children with scoliosis was established even at the initial stages (I–II degree). Thus, the organization of comprehensive rehabilitation programs for improving the posture in children requires not only the formation and consolidation of the habit of correct posture, the creation of a muscular corset, but also the focus on improving the development of the cardio respiratory system, training the balance, balance, coordination, enhancing the nonspecific resistance of the organism by maintaining a healthy regime of the day, tempering and nutrition.

2. Multidirectional changes in indicators require the preparation of corrective programs with a special approach to children of different sexes.

3. Most measures for the treatment of scoliosis should be performed by the patient independently, therefore, depending on how the patient treats himself; the successful disposal of the deformity of the spine depends very much.

Correct deformities in the early stages of scoliosis are possible due to comprehensive rehabilitation programs.

In the future, it is planned to develop a comprehensive rehabilitation program for children aged 10–13 with scoliosis of I–II degree

Conflict of interests. The authors declare that no conflict of interest.

Financing sources. This article didn't get the financial support from the state, public or commercial organization.

References

1. Vyshinskaya, L. (2013), "Scoliosis – a threat to the life of a teenager", *Evening conduct*, No 188 (1088), 11 December, p. 8. (in Russ.)
2. Gertsyk, A. (2016), "Creating a program of physical rehabilitation / therapy for disorders of the locomotor system", *Slobozhans'kij naukovо-sportivnij visnik*, No 6(56), pp. 37–45 (in Ukr.)
3. Kaszuba, V. A. (2003), *Biomekhanika osanki* [Biomechanics of Posture], Olympic Literature, Kiev. (in Russ.)
4. Cord Mahnaz (2008), "Influence of physical rehabilitation program on the spatial organization of children 8 years in violation of the body posture in the frontal plane and scoliosis I and II degree", *Teoriya i method. fiz. viovannya i sport*, No 2, pp. 64–68. (in Russ.)
5. "Prevention of scoliosis", available at: http://www.zdorow.dn.ua/skolioz/Profilaktika_skolioz.html (accessed 22 January 2017).
6. "Prevention of scoliosis in children", available at: http://www.ayzdorov.ru/Lechenie_skolioz_prof.php (accessed 31 January 2017).
7. "Scoliosis, scoliosis treatment, the causes of scoliosis", available at Online Clinic «Medicine»: https://www.medicina.ru/services_add/skaliuz/ (accessed 29 January 2017).
8. Uleschenko V.A. (2011) "Conservative treatment of scoliosis", Kiev. (in Russ.)
9. "Physical development of children", available at: http://intranet.tdmu.edu.ua/data/kafedra/internal/pediatria2/classes_stud/ru/med/lik/rtn/Пропагандистическая%20педиатрия/3/Тема%2002%20Физическое%20развитие.htm (accessed 27 January 2017).
10. Halemsky, G. A., Lobanov, J. A. & Martynenko, T. I. (2001), *Fizicheskoe vospitanie detey so skoliozom i narusheniem osanki* [Physical education of children with scoliosis and a violation of posture], Moscow. (in Russ.)
11. Khrushchev, S. V., Polyakov, S. D. & Sobolev, A. M. (2006), "Computer physical health monitoring technology students", *Physical education in the prevention, treatment and rehabilitation*, No 4, pp. 4–8. (in Russ.)
12. Shramko, Y.I. & Nekhay, S. P. (2008), "The use of physical training for the correction of scoliosis in children of primary school age", *Materials of the international scientific-practical conf. with the International. Participation*, Simferopol, pp. 117–119. (in Russ.)
13. Hresko, T. (2013), "Idiopathic Scoliosis in Adolescents", *NEW ENGLAND JOURNAL OF MEDICINE*, No 9(368), pp. 834–841.

Received: 12.02.2017.

Published: 30.04.2017.

Information about the Authors

Anastasia Podolyaka: PhD (Physical Education and Sport); Cherepovets State University; 5, Lunacharsky prospect, Cherepovets, Vologda

region, 162600, Russia.

ORCID.ORG/0000-0002-5842-9323

E-mail: anpodol@mail.ru

Oleg Podolyaka: PhD (physical education and sport), Associate Professor; *PhD (Physical Education and Sport); Cherepovets State University: 5, Lunacharsky prospect, Cherepovets, Vologda region, 162600, Russia.*

ORCID.ORG/0000-0001-5606-1409

E-mail: podol@inbox.ru

Ruslan Iskandarov: *Cherepovets State University: 5, Lunacharsky prospect, Cherepovets, Vologda region, 162600, Russia.*

ORCID.ORG/0000-0002-3153-8730

E-mail: rrriskanrrr@yandex.ru