

# Structure of adaptive physical education classes for children with cerebral palsy based on heart rate indicators

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## Abstract

**Objective of the study** was to determine the structure of classes for children with cerebral palsy based on the analysis of heart rate indicators.

**Methods and structure of the study.** Scientific work was carried out at the Center for Adaptive Physical Culture of Petrozavodsk State University for 12 months. The experimental group consisted of 13 people aged 12-22 years with a diagnosis of cerebral palsy. Throughout the study, during adaptive physical education classes, heart rate indicators were recorded using a chest heart rate monitor with each change in the direction of physical exercises, as well as their order.

**Results and conclusions.** Analysis of the results showed that a uniform heart rate response to a change in the direction of exercise was not observed, but two variants of the structure of the exercise were identified, in which the physiological curve of the study participants lined up as close as possible to the reference values. In the first option (according to 60% of participants), exercises alternate in the following sequence: strength exercises (heart rate from 80 to 95 beats/min), cyclic exercises (heart rate 120 beats/min), statokinetic stability exercises (heart rate 131), joint gymnastics (heart rate 75 beats/min). In the second option (according to 40% of participants), the exercises alternate as follows: joint gymnastics (heart rate 65 beats/min), statokinetic stability exercises (heart rate 124 beats/min), aerobic exercises (heart rate 131 beats/min), strength exercises (heart rate 74 beats/min).

The results of the study are recommended to be used when planning the structure of classes for children with cerebral palsy.

**Keywords:** *physiological curve, structure of classes, heart rate, cerebral palsy, adaptive physical culture.*

**Introduction.** Children with cerebral palsy, as a rule, lead a sedentary lifestyle, which leads to delays in physical and functional development, difficulties in self-care and communication. Insufficient understanding of the need to expand motor activity and stimulate a disabled child to move delays the realization of his motor potential. At the same time, well-organized regular classes that allow disabled children to be involved in physical activity contribute to the effective development of their motor skills, stimulate them to independently perform movements, and improve their quality of life. [1] The most difficult task is to determine adequate physical activity for disabled people with cerebral palsy, since the limiting link is the low functional capabilities of the body [2]. Due to significant difficulties in coordination when performing or changing motor actions, the dynamics of heart rate during one session is not predictable.

There is no data on the norm for measuring or monitoring the functional state in disabled children, designed to determine the level of motor activity for children with cerebral palsy, which is complicated by the nature of the disease and the lack of research in this direction [3].

The simplest method of studying the response to physical activity of a child with cerebral palsy is to measure the heart rate (HR), carried out over time [1].

Long-term studies confirm the importance of monitoring the functional capabilities of the body of children with cerebral palsy, which provides invaluable information about their individual capabilities for the well-founded construction of an adaptive physical education program.

**Objective of the study** was to determine the structure of classes for children with cerebral palsy based on the analysis of heart rate indicators.



**Methods and structure of the study.** Scientific work was carried out at the Center for Adaptive Physical Culture of Petrozavodsk State University for 12 months. The experimental group consisted of 13 people aged 12-22 years with a diagnosis of cerebral palsy (7 people - spastic diplegia, 5 - spastic tetraparesis, 1 - hyperkinetic form), motor functions in 10 participants correspond to the third level according to the GMFCS classification, in three participants - to the fourth level according to the GMFCS classification. Most participants cannot move independently, have difficulty maintaining balance, and have contractures in the elbow and knee joints. All participants regularly engage in adaptive physical education 2 times a week.

Throughout the study, during adaptive physical education classes, heart rate indicators were recorded using a chest heart rate monitor with each change in the direction of physical exercises, as well as their order. Heart rate indicators were recorded for sixteen options for the structure of classes. Over the next five sessions, control heart rate measurements were taken to confirm the data obtained. The standard for heart rate dynamics was the traditional physiological curve of a physical education lesson, but taking into account the characteristics of the physical and functional state of the participants and according to the recommendations described in similar studies [1, 4], changes in heart rate were allowed no more than 25% of the previous value. The structure of the lesson included cyclic exercises aimed at developing endurance, strength exercises aimed at strengthening the extensor muscles of the upper and lower extremities,

exercises for statokinetic stability and joint gymnastics (Table 1).

The duration of the lesson was 40 minutes, the exercises changed every 7-10 minutes.

**Results of the study and discussion.** Analysis of the results showed that a uniform heart rate response to a change in the direction of exercise was not observed, but two variants of the structure of the exercise were identified, in which the physiological curve of the study participants lined up as close as possible to the reference values.

In the first option (according to 60% of participants), exercises alternate in the following sequence: strength exercises (heart rate from 80 to 95 beats/min), cyclic exercises (heart rate 120 beats/min), statokinetic stability exercises (heart rate 131), joint gymnastics (heart rate 75 beats/min) (Table 2).

In the second option (according to 40% of participants), the exercises alternate as follows: joint gymnastics (heart rate 65 beats/min), statokinetic stability exercises (heart rate 124 beats/min), aerobic exercises (heart rate 131 beats/min), strength exercises (Heart rate 74 beats/min) (Table 3).

Despite the fact that the time for performing cyclic exercises is not long, the target heart rate is achieved from 1 to 5 minutes of continuous work, i.e. quite quickly, because participants experience difficulties in performing them. Exercises aimed at statokinetic stability have the same effect on the cardiovascular system. Those. By combining cycling and statokinetic stability exercises, heart rate targets can be achieved to provide an aerobic effect.

*Table 1. Options for exercises in the structure of adaptive physical education classes for children with cerebral palsy*

Cyclic exercises	Walking on a treadmill, walking in a Gross simulator, pedaling on a simulator for active-passive mechanotherapy "Ortovent-moto",
Strength exercises	Exercises on block machines with a load of 10-12% of the maximum, exercises with your own weight (squats, leg extensions), exercises with free weights (dumbbells 0.5-1 kg), walking on a stepper with resistance
Exercises for statokinetic stability	Overcoming an obstacle course in a Gross simulator, with unstable equipment, with Nordic walking poles, "Heron" exercise
Joint gymnastics	Wide-amplitude movements aimed at preventing contractures in the elbow, shoulder, knee, hip and ankle joints (flexion-extension, pronation-supination, circumduction)

*Table 2. Heart rate indicators of the first version of the lesson structure for children with cerebral palsy*

No.	Exercises	Execution start time	Completion time	Heart rate indicator (average value)
1	Strength exercises	00'00''	09'33''	89±5,2
2	Cyclic exercises	11'00''	21'00''	120±5,9
3	Exercises for statokinetic stability	22'30''	31'50''	131±2,8
4	Joint gymnastics	32'25''	38'58''	75±4,4



Table 3. Heart rate indicators of the first variant of the lesson structure for children with cerebral palsy

No.	Exercises	Execution start time	Completion time	Heart rate indicator (average value)
1	Joint gymnastics	00'00''	10'24''	65±5,2
2	Exercises for statokinetic stability	11'25''	18'00''	124±3.0
3	Cyclic exercises	18'53''	28'53''	131±0,8
4	Strength exercises	32'25''	39'22''	74±3,8

**Conclusions.** Based on the analysis of heart rate indicators, two optimal sequences of exercises in the structure of the lesson for children with cerebral palsy were determined, which may be one of the conditions for the rational distribution of physical activity for the development of the functional capabilities of the child's body.

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