Original Article

Assessment of motor skills of adolescents with cerebral palsy during hydrotherapy

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Abstract

Problem Statement. This article considers the problem of evaluation of some motor skills of adolescents with cerebral palsy (CP). The results of the theoretical analysis of the issue show the need for development of diagnostic methods to efficiently evaluate various therapy techniques for people with CP. Hydrotherapy, as a new method of therapy, needs an efficiency evaluation too.

Approach. The main feature of our approach is understanding of hydrotherapy as acquiring of certain motor skills of persons with CP in water. The authors consider that the technique of observation by means of which the expert can estimate the dynamics of development of motor skills of adolescents with CP can be developed.

Purpose. The research contains the attempt to develop diagnostic means for evaluation of motor skills of adolescents with CP in the course of hydrotherapy. Observation and expert method are used for assessment of the ability to: walk in water, swim and dive.

Results. Much attention was paid to the data of correlation. The correlation of levels of motor skills and amplitude of motions with the form of a CP were estimated. The factorial analysis has confirmed the validity of the diagnostic means.

Conclusions. The conclusion deals with an opportunity to use the offered diagnostic means when implementing adaptive physical educational programs for adolescents with CP.

Key Words: adolescents with cerebral palsy (CP); motor skills; diagnostic means; hydrotherapy

Introduction

It is known that the incidence of cerebral palsy (CP) in different countries is quite high, ranging between 1 and 8 cases per 1000 population. Thus, according to the Research Foundation of Cerebral Palsy Associations (UCPA), in the USA there are approximately 550,000 people with cerebral palsy, and their number has increased by 25% over ten years (Poletaeva, N.A. 2011). According to official data, in Russia in 2010 the amount of 0-14 year-old children with this diagnosis came up to 394, and in 2011 – to 399 cases (Statistical materials of Ministry of Health Care of the Russian Federation 2012). In the international practice, despite some differences in the national systems of rehabilitation of children and adolescents with CP, the dominant approach is based on the principle according to which a child with cerebral palsy develops in the same developmental principles as a child with the regulatory development, but at a slower pace. The primary goal of cerebral palsy therapy is the formation of verticalization and independent movements (Poletaeva, N.A. 2011), wherein the efficiency of motor activity in the development of not only muscle but also brain activities is proved (Damiano, D. 2013). We support the view of other authors that every child with cerebral palsy is so unique in the manifestations of disorders of the motor analyzer and its combinations with other diseases, that it is quite necessary to make individual physical rehabilitation programs based on the use of different methods. By the present time, various methods of rehabilitation of children of this category have been developed and successfully used: methods of hippotherapy (Lutsenko, S.A. 2014), stabilometry (Kotova, N.U. 2012), KinesioTaping (Ozgun Kaya Karaetal 2014), the use of different devices and simulators (Kunchevskaja, S.V 2014), etc. One of the innovative directions of rehabilitation of children with cerebral palsy is considered to be hydrotherapy. Advocates of this method claim that it improves respiratory function (Dorval, G, Tetreault, S & Caron, C. 1996), extends motor experience, provides an opportunity to move independently, has a beneficial effect on all organs and systems, and makes versatile impact on the whole body (Bronnikov, V.A. & Kiseleva, N.V. 2012) .

Materials & methods

Despite the fact that there are many tools to measure the features of motor development of children with cerebral palsy in the process of rehabilitation (Sršen, K.G., 212), the researchers point to the necessity of assessing the effectiveness of new methods of rehabilitation (Shariat. A. etal, 2014), which requires the development of relative diagnostic tools.

The purpose of this research is to develop diagnostic means for the evaluation of motor skills of adolescents with cerebral palsy during the process of hydrotherapy to check its effectiveness. As a part of the basic empirical research methods, observation, expert evaluation method, goniometry, and factor analysis were used.

The research was conducted at a rehabilitation center for children and adolescents with disabilities. Teenagers of 13-14 years old with cerebral palsy (n = 5) took part in the study.

When characterizing the severity of these children's diseases, it is necessary to point out motor disorders of significant degree: upper and lower limb disease, spasticity and muscle rigidity, paresis, age-related changes of the disease such as the formation of contractures and joints deformation. At the time of the research all subjects could only walk with the help of walkers.

As far as motor skills are concerned, the formation dynamics of which, in our opinion, reflects the impact of hydrotherapy on adolescents with cerebral palsy, the ability to walk on the bottom of the pool, along with the ability to swim and dive were determined.

To develop the diagnostic card (monitoring card) for each skill, evaluation criteria and indicators of the motor skills formation were worked out. For instance, two criteria were determined to evaluate the ability to walk on the bottom of the pool: the way of performing and a covered distance. Furthermore, for the criterion, "the way of performing," the following indicators were used: the degree and the nature of the help used (with the help of an instructor, using restraint devices – a belt, a rubber ring, a vest – holding on to the railing; using restraint devices – a belt, a rubber ring, a vest – with a swimming board; swimming on their own using a swimming board; swimming without any assistance). For the criterion, "a covered distance," the indicator was a number of segments equal to the length of the pool (14 m).

Similarly, the diagnostic card presented criteria and indicators to assess the formation of swimming skills ("use of restraint devices", "using arms and feet", "the way of swimming" and "the swimming technique") and the ability to dive ("the way of performing", "duration of stay under the water" and "distance covered under the water") (Tab. 1).

Table 1. Diving skill monitoring card

Diving (с поверхности воды)	Date of monitoring		
1. The way of performing			
1 point – submerges into the water holding the breath, does not dive			
2 points – submerges into the water holding the breath, can pick up an object			
3 points – dives to the depth to pick up an object, without any diving technique, once			
4 points – dives to the depth to pick up an object, without any diving technique, repeatedly			
5 points – dives to the depth to pick up an object, using the right diving technique, repeatedly			
2. Duration of stay under the water, in seconds			
3. Distance covered under the water, in meters			

Results

The evaluation of the motor skills formation using the described above diagnostic means has revealed the annual dynamics of motor skills of adolescents with cerebral palsy in the process of hydrotherapy (Tab. 2).

Table 2. Dynamics of motor skills of adolescents with cerebral palsy in the course of hydrotherapy (October 2015 – May 2016)

№	The main diagnosis	Dynamics of result assessment, in points		
		walking	swimming	diving
1	SP: spastic diplegia, left-sided tetraparesis	+5	+7	0
2	SP: spastic right-sided tetraparesis	+6	+7	+5
3	SP: spastic diplegia	+3	+5	0
4	SP: spastic diplegia, left-sided tetraparesis	+4	+8	+13
5	SP: spastic tetraparesis	+2	+9	+5

For statistical assessment of the validity of this diagnostic means, a factor analysis was made; it took into account the main diagnosis of the adolescents, the results of the assessment of formation of their motor skills in water and the results of goniometry (Tab. 3).

Table 3. Goniometry results of the lower extremities joints of the adolescents with PS, May 2016

№ п/п	Amplitude of the joints movements in accordance with the test types, in degrees											
	1	2	3	4	5	6	7	8	9	10	11	12
1	8	4	9	5	20	40	22	35	12	40	14	43
2	9	5	10	8	27	50	30	45	15	50	14	50
3	25	17	26	23	45	68	40	70	23	61	25	60
4	20	15	19	18	40	70	35	70	20	60	22	55
5	15	10	15	13	35	43	35	45	15	55	15	55

Notes, tests types: 1 – bending of the right hip joint; 2 - unbending of the right hip joint; 3 - bending of the left hip joint; 4 - unbending of the left hip joint; 5 - bending of the right knee joint; 6 - unbending of the right knee joint; 7- bending of the left knee joint; 8 - unbending of the left knee joint; 9 - bending of the right ankle joint; 10 - unbending of the right ankle joint; 11 - bending of the left ankle joint; 12 - unbending of the left ankle joint.

Using non-parametric T-test for Independent Samples the identity of the testees' parameters at $p < 0.05$ was revealed; between two children – at the level of $p < 0.5$, which indicates the identity of the disease character; and the parametric T-test for Independent Samples revealed the children with the identical form of the disease "cerebral palsy: spastic diplegia, left-side tetraparesis" at the level of $p < 0.05$.

The study of the factor structure of the components revealed the influence of two factors. It made it possible to detect a significant load on the first factor for all variables related to the lower limb mobility indicators (total share of variance is 74.67%). The second factor, which reflects the indicators of formation of motor skills in water, turns out to be less important (total share of variance is 18.09%).

Discussion

Let's consider the covariance of the main components on the two-factor solution using the reproduced (Reproduced Correlations) and residual (Residual Correlations) correlation matrix.

Reproduced correlation allowed for a more accurate interpretation of the results of the correlation analysis. In particular, in relation to walking, it was found out that the extensors of the right and left knee joints as well as the right ankle joint extensors make a positive effect on its results, which proves the diagnosis "left-side tetraparesis." At the same time, the mobility of hip joint, left and right knee joint flexors, right and left ankle joint extensors, left ankle joint flexors affect the ability to walk, which also proves the diagnosis "left-side tetraparesis."

Residual correlation allowed us to specify a dominant influence of the right knee joint extensors on the assessment results of the formation of the skill of walking on the pool bottom. In their turn, these extensors, due to lack of the hip joint work, have a positive impact on the bending of the left ankle joint. As was expected, negative correlation between the results of the exercise performance that improve the skills of walking and swimming, was determined.

Conclusions

Thus, the above factor analysis allowed us to statistically confirm the diagnostic validity of the diagnostic tool to assess the formation of motor skills of adolescents with cerebral palsy in the process of hydrotherapy, which gives the reason to recommend it for use in the practice of diagnostic support for this category of people.

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