

An influence of initial swimming training technology on technical preparedness indicators of children with consequences of cerebral palsy

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Purpose: to develop an innovative technology of elementary swimming training in the backstroke way of children with the consequences of infantile cerebral palsy (ICP) and to evaluate its effectiveness.

Material & Methods: methods were used: analysis of scientific and methodological literature, pedagogical experiment, expert evaluation, statistical methods. The pedagogical experiment involved 29 children diagnosed with cerebral palsy, of which two groups were formed: an experimental group consisting of 14 children, 6 of them with spastic diplegia and 8 with a hemiparetic form, and a control group of 15, of which 6 – with spastic diplegia and 8 – with a hemiparetic form of cerebral palsy. After the experiment, we conducted an expert survey in order to identify the experts' opinion on the level of mastering the technique of swimming by backstroke way of children with the consequences of infantile cerebral palsy.

Results: main means of implementing the technology is the web-based information system "SwimCP (Swimming with Cerebral Palsy)" developed by us, which promotes the effective learning of the swimming of children with the effects of infantile cerebral palsy in the initial stage of sports training by selecting and recommending an orienting set of exercises, in accordance with the specific form of infantile cerebral palsy and the stage of learning motor action.

Conclusion: with the help of expert assessment confirmed that the proposed technology is the initial training to swimming by backstroke way to children with consequences of cerebral palsy is effective.

Keywords: swimming technique, backstroke way, information technology, infantile cerebral palsy, expert assessment.

Introduction

A widely accepted opinion in modern society is the importance of rehabilitation, socializing, adaptive, integrative function of sports for people with disabilities. Usually their implementation is complicated by various problems of financial, material, medical, psychological, technological, methodological nature [3; 4; 6]. In the field of physical education and sports, scientists unanimously note that the training of athletes with disabilities is complicated by the physical and psychological characteristics of such athletes [8; 16].

Today, great competition in the Paralympics sport requires constant improvement of the training process of swimmers with limited abilities. There is a significant number of both foreign [12; 13; 14; 15], and domestic scientific works [2, 11], devoted to the study of this problem. However, the problem of teaching the technique of sporting methods for swimming children with consequences of infantile cerebral palsy (CP) at the initial stage of preparation remains insufficiently resolved [5; 7; 10; 17]. In our time, the use of information technology in the training process of swimmers will achieve an effective solution to the above problem [1; 9]. This testifies to the urgency of the problem of developing an innovative technology for primary education in sporting methods of swimming for children with consequences of cerebral palsy.

Relationship of research with scientific programs, plans, themes. The research is carried out according to the plan of research work of the Sumy State Pedagogical University name is A. S. Makarenko for 2011–2015. Within the framework of the topic "Raising the level of health and physical preparedness of various groups of the population by means of

physical culture" (state registration number 0111U005736) for 2016–2020 within the framework of the theme "Optimization of the training process of athletes in a multi-year training system" (state registration number 0116U000898).

The purpose of the research: to develop an innovative technology of elementary swimming training in the backstroke way of children with the consequences of infantile cerebral palsy (ICP) and to evaluate its effectiveness.

Material and Methods of the research

The pedagogical experiment involved 29 children diagnosed with cerebral palsy, from which two groups were formed: an experimental group consisting of 14 children, of which 6 with spastic diplegia and 8 with hemiparetic form, and control group – the number of 15 people, of which 6 – with spastic diplegia and 8 – with a hemiparetic form of cerebral palsy. At the beginning of the study, we analyzed and summarized the data of the scientific and methodological literature, which made it possible to determine the state of the study of the problem. After the experiment, we conducted an expert survey in order to identify the experts' opinion on the level of mastering the technique of swimming in the backstroke way of children with the consequences of infantile cerebral palsy. Statistical processing of research materials was carried out using the Microsoft Excel 2010 software package using well-known methods of mathematical statistics.

Results of the research and their discussion

The innovative technology of elementary education in swimming for children with consequences of cerebral palsy is un-

derstood as a scientifically grounded system for mastering the method of organizing and conducting swimming training using information technologies, practical skills in the use of methods and tools in accordance with the general pedagogical principles of education, taking into account the anatomical and physiological and psychological characteristics of children, with the help of which it is ensured the attainment of the stated goal of teaching sports methods of swimming of children with the consequences of cerebral palsy at the initial stage with the greatest efficiency with the minimum possible period for achieving it.

The basis for the creation of the technology of elementary swimming training by the backstroke way of children with the consequences of cerebral palsy:

- theoretical generalization and systematization of the information of scientific and methodical literature on the problem of teaching sports methods of swimming of children with consequences of CP at the initial stage of preparation;
- analysis of the results of questionnaires of trainers working with athletes with cerebral palsy;
- based on the analysis of literary sources, the features of motor disorders of children with spastic diplegia and the hemiparetic form of cerebral palsy;
- kinematic characteristics of the technique of swimming on the back of qualified athletes with the consequences of cerebral palsy are defined;
- observation of the training process swimmers with the consequences of cerebral palsy.

Technology developed by us allows the trainer to organize a process of initial training of the children's by the backstroke way of swimming with spastic diplegia and a hemiparetic form of cerebral palsy based on the account of motor disorders. Technology includes four structural components: the target (the purpose and objectives of the activity of the trainer and children with the consequences of cerebral palsy during the initial stage of learning swimming by the backstroke way), basic (especially the motor disorders of children with consequences of cerebral palsy and their influence on the process of learning movements in the aquatic environment and the biokinematic characteristics of the technique of swimming of qualified athletes with consequences of cerebral palsy), methodological (forms, methods and means of swimming training) and control (methods of control and criteria for assessing the effectiveness of the developed technology of elementary education for children with consequences of cerebral palsy).

So, before each training session, the trainer should prepare such a set of physical exercises from the ones recommended by us and in such sequence individually for each child, so that he assists in the assimilation of swimming movements, promotes the development of the child's motor skills and stimulates the growth of his sports achievements. In this case, the coach must take into account the motor disabilities and deviations that swimmers have with the consequences of cerebral palsy. In order for the specialist not to search each time for the recommended set of exercises, we propose to do this using a modern Web-oriented information system in accordance with the level of mastering the technique of swimming. Therefore,

we have developed a Web-based information system "Swim-CP (Swimming with Cerebral Palsy)", which is appropriate to use both for learning to swim by the backstroke way of children with the consequences of cerebral palsy during the initial stage of sports training, and to improve the skills of coaches working with such children. With the help of this system, the forms, means and methods of teaching the swimming by the backstroke way of child are selected individually for each child, taking into account the forms of cerebral palsy, the available motor disabilities in accordance with each individual training session, the stage of training the motor actions, the technical element of training and all the features initial training.

In order to test the effectiveness of the technology of swimming training by the backstroke way, we conducted an expert survey on the level of mastering the technique of backstroke way of swimming by children with cerebral palsy. The experimental group (EG) learned to navigate the developed technology, which included the use of the Web-based information system "SwimCP (Swimming with Cerebral Palsy)", and in the control group (CG) the training process was built using traditional, most common methods. It should be noted that at the beginning of the formative experiment, the absence of statistically significant differences between the groups ($p > 0,05$). To determine the effectiveness of training in swimming techniques, experts were offered control cards and evaluation criteria separately for children with spastic diplegia and hemiparetic form of cerebral palsy in a differentiated way. Expert evaluation of the technique of backstroke way of swimming was carried out using the following components: the position of the swimmer's body, movement of the legs, movements of the hands, coordination of movements, which are the basic indicators of effective techniques of swimming. Experts evaluated each criterion separately. As a result of their work, each child received the appropriate scores, and then the questionnaires were checked and translated into a differentiated-total score, that is, after determining the effectiveness of the technique of each element of the swimming method, an overall assessment of the swimming technique.

To determine the statistical criterion for the reliability of the differences between the parameters of the control and experimental groups, the normality of the distribution of the score was studied using the traditional technique and the technology developed by us. Considering the number of elements in the samples, one can use the usual approximation and estimate the degree of discrepancy between the samples mean scores by the Wilcoxon-Mann-Whitney criterion (Table 1).

Table 1
Comparison of the results of expert assessment of the level of mastery of the swimming technique of EG and CG at the end of the experiment

Characteristic	CG (n=15)	EG (n=14)
	$\bar{X} \pm S_{\bar{x}}$	
Body position	3,91±0,25	4,56±0,19
Leg movements	3,69±0,30	4,44±0,14
Hand movements	3,96±0,40	4,78±0,19
Coordination of movements	3,59±0,29	4,49±0,25
Generalized evaluation of techniques	3,79±0,28	4,57±0,18
Differences (B)	0,78	
Reliability of differences (W_{emp})	4,45	
Significance level (p)	<0,05	

The empirical value of the Wilcoxon-Mann-Whitney criterion of the technique of swimming by the crawl is $W_{emp}=4,45$. We have that $W_{emp}=4,45 > W_{0,05}=1,96$, that is, at the significance level of 0,05 we accept the alternative hypothesis that there is a significant difference between the average scores of the samples. This means that the difference in the average points of the level of mastery of the technique by backstroke way of swimming on the back of children with cerebral palsy of the control and experimental groups can not be explained only by random factors, and the reliability of the differences in the samples that were compared is 95%.

The difference in scores received by children with consequences of cerebral palsy of the control and experimental groups by body position is 14%. For the technique of leg movements, the children of the experimental group received 17% more points than the children of the control group. For the technique of hand movements, this difference is 17%. The coordination of the movements of the children of the control group was estimated to be 20% less than that of the experimental group. Overall score of the level of mastering the technique by backstroke way of swimming for the children of the control group is $3,79 \pm 0,28$, and for the children of the experimental group – $4,57 \pm 0,18$. Children of the control group received the highest scores for hand movements, and the lowest ones for the consistency of movements. Children of the experimental group received the highest scores for hand movements, and the lowest points for movements with their feet (Figure 1).

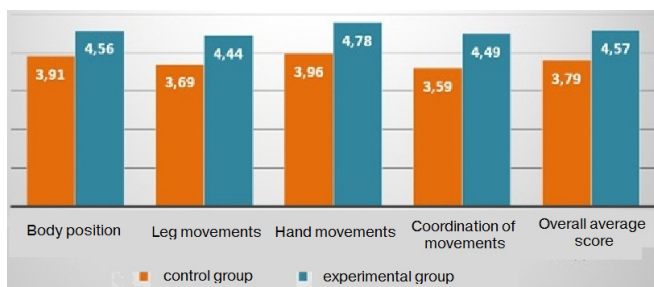


Fig. 1. Comparison of the level of mastering the technique by backstroke way of swimming of the control and experimental groups after the experiment

So, during the experiment it was confirmed that the level of mastering the swimming technique of children who studied according to the developed technology was objectively higher by an average of 20% of the same index in the group that studied by traditional, most common methods.

We also calculated the average score of the level of mastery of swimming technique, obtained by each swimmer of both groups from six experts for each method of navigation. According to these data, a generalizing table was constructed (Table 2).

The primary analysis of the data in Table 2 shows that children with a hemiparetic form of cerebral palsy are better at mastering sports swimming styles than children with spastic diphteria. This difference is 8%. For the children of the experimental group, the same trend persists; the difference is about 7%. To determine the reliability of the differences between the indicators of children of different forms of cerebral palsy, the degree of discrepancy between the selective average scores by the criterion of Cramer-Welch. For sample points, statistical

Table 2

Comparison of the results of expert assessment of the level of mastering the technique of swimming of EG and CG of different forms of cerebral palsy at the end of the experiment

Form of CP	CG (n=15)	EG (n=15)
	$\bar{X} \pm S_x$	
HF	3,82±0,25	4,70±0,22
SD	3,55±0,21	4,39±0,26

Remark. SD – spastic diplegia; HF – hemiparetic form of cerebral palsy.

calculations were performed for the null hypothesis that there were no differences between the indices of groups of children with spastic diplegia and the hemiparetic form of cerebral palsy and an alternative hypothesis about the nature of differences between the indices of groups of children with spastic diplegia and hemiparetic form of cerebral palsy. For the control group $T_{emp}=1,76 < T_{cr}=1,96$, so at the significance level of 0,05, we accept the hypothesis that the characteristics of the swimming techniques of the crawl on the back of children with spastic diplegia and the hemiparetic form of cerebral palsy. For the experimental group $T_{emp}=2,5 > T_{cr}=1,96$, so the reliability of the differences in the characteristics of swimming techniques by backstroke way of children with spastic diplegia and hemiparetic form of cerebral palsy is 95%.

So, in the control group, children with both forms of cerebral palsy took possession of the swimming technique at the same level, and in the experimental group, children with hemiparetic form of cerebral palsy acquired better swimming skills than children with spastic diphteria.

The consistency of the experts' opinions on the level of mastering the technique of swimming was also determined by statistical methods (the concordance coefficient was calculated). For the control group of children with consequences of cerebral palsy, it is equal to $W=0,94$, and for the experimental group – $W=0,94$. Since the values of the concordance coefficients for both groups are greater than 0,9 and close to 1, the obtained data indicate a high degree of agreement between the experts' opinions on the level of mastering the swimming techniques by backstroke way by children with consequences of cerebral palsy of the control and experimental groups.

The statistical reliability of the concordance coefficient was estimated using the Pearson criterion χ^2 . Because the $\chi_p^2=79,09 > \chi_T^2=29,14$, then we make a conclusion about the statistical significance of the concordance coefficient for the control group of children with the consequences of cerebral palsy, there is an examination took place. For the experimental group of athletes with the consequences of cerebral palsy $\chi_p^2=72,57 > \chi_T^2=27,69$, also conclude that the concordance coefficient is statistically significant, that is, there is a consistency of opinions of experts and an examination was also held.

Conclusions

1. Developed by us technology for teaching swimming techniques by backstroke way of children with cerebral palsy allows us to optimize the process of technical training for beginner swimmers.

2. Main means of implementing the technology is the Web-based information system developed by us "SwimCP (Swimming with Cerebral Palsy)".

3. Effectiveness of the proposed technology of initial swimming training by backstroke way of children with cerebral palsy is confirmed by expert evaluation and statistical methods.

Prospects for further research in this area are the expansion of the functionality of the developed system "SwimCP" for use in the training of swimmers with severe forms of cerebral palsy and training in swimming techniques by other sports methods.

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