Evaluation of the Effectiveness of Training Russian Chess Players with Musculoskeletal Disorders

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Abstract

Low psychophysical activity of persons with pathology of the musculoskeletal system makes it relevant to search for opportunities to increase it. To solve this problem, it seems promising to use the intellectually stimulating and socializing potential of "mental" sports. As the main variant of adaptive sports for people with disabilities of the musculoskeletal system, chess can be used. The research was carried out on the basis of the Russian Internet portal "Chess Planet". The study involved 28 people 19-27 years old with lesions of the musculoskeletal system in the form of infantile cerebral palsy, living in Moscow. Out of these, 25 people were at the stage of sports specialization and 3 people were at the stage of improving sportsmanship. Methods of testing and statistical processing of the obtained data were applied. Based on the results of the study, we can talk about the effectiveness of chess sports training in Russia in persons with impairments of the musculoskeletal system. It turned out to be very effective in terms of building up general chess training and in terms of stimulating sports-significant intellectual skills in persons with signs of cerebral palsy.

Keywords: Adaptive sports, Chess, Cerebral-palsy, Musculoskeletal system

Introduction

The presence of functional and morphological disorders in the human body can lead to the appearance of many diseases (Ibrahim *et al*., 2019; Amiri *et al*., 2020; Karpov *et al.,* 2020a; Zavalishina 2020a). They impair the work of many organs and systems (Vorobyeva *et al.,* 2018; Zavalishina *et al.,* 2021a), often significantly weakening the body as a whole (Zavalishina, 2018; Karpov *et al.,* 2021a) and sometimes leading to disability (Karpov *et al.,* 2021b; Zavalishina *et al.,* 2021b). Modern trends in society are very humanistic (Zavalishina *et al.,* 2021c). They are aimed at increasing the level of integration of disabled people

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into society (Bespalov *et al.,* 2018), especially by involving them in sports activities (Karpov *et al.,* 2020b; Zavalishina, 2020b).

Comprehensive understanding of the problems and difficulties that hinder the increase in psychophysical activity of persons with pathology of the musculoskeletal system, puts forward the need to use the intellectually stimulating and socializing potential of "mental" sports based on stimulating mental actions (Pomerantsev *et al.,* 2020; Vorobyeva *et al.,* 2020). Innovative forms and methods of chess sports based on the active use of mental exercises and actions without significant muscular activity can be used as the main vector of involving people with disabilities in adaptive sports (Bozhdai and Sviridova, 2017).

The development of chess as an adaptive sport in Russia began in 1896 after the creation of chess clubs for visually impaired people in Moscow and St. Petersburg. The world community actively supported this step and created the International Association of Blind Chess Players (IBCA, 1948), the International Chess Committee of the Deaf (ICCD, 1949), and the International Association of Chess Players with Locomotor Impairment (IPCA, 1992). All of these organizations are currently part of the International Chess Federation. The first official chess world championship for disabled people took place in 2013 in Dresden. This indicates the full recognition by the world community of the need to develop adaptive chess in all regions of the world (Mikhaylova, 2019).

At the same time, serious problems remain in the scientific and methodological support of chess training for persons with disabilities (Potkin, 2011; Fayzullina *et al.,* 2020). Unfortunately, the issue of long-term purposeful training of chess players with various pathologies remains poorly studied. Unfortunately, the work on this issue is multifaceted. For this reason, it is not yet possible to generalize the world experience of chess training for persons with disabilities, including taking into account their existing nosology. This circumstance does not allow to provide them with full sports integration, creating for them fully agreed norms of training in adaptive chess. This requires additional research, in connection with which the goal of the work is to assess the dynamics of psycho-social components of participation in chess by persons with pathology of the musculoskeletal system.

Materials and Methods

The research was carried out on the basis of the Russian Internet portal "Chess Planet" (Moscow). In total, the study involved 28 people 19-27 years old, living in Moscow, with lesions of the musculoskeletal system in the form of infantile cerebral palsy. Out of these, 25 people were at the stage of sports specialization and 3 people were at the stage of improving sportsmanship. The preparation of chess players was carried out according to the methodology previously developed by the authors (Alifirov *et al.,* 2020).

The examination of all those taken under observation was carried out at the stage preceding the experiment, directly during the experiment and at the control stage at the end of the experimental stage. At each of the three stages of the experiment (preliminary, experimental and control), 4 series of examinations were performed (every 3 months). These surveys made it possible to draw up a picture of the dynamics of changes in the indicators taken into account throughout the year.

During each study, tests were applied to clarify difficulties in mastering chess, knowledge of the basic opening, middlegame and endgame ideas. The surveyed persons were subjected to testing to check the effectiveness of mastering the skills of the game by assessing intellectual characteristics. Testing was also carried out for working memory, operational thinking and evaluative function.

To check the significance of the samples, the parametric Student's t-test was applied. The calculation of the Student's coefficient was carried out according to the formula for testing the null hypothesis:

$$T = \frac{X_1 - X_2}{\sqrt{(m_1^2 + m_2^2)}} \tag{1}$$

In addition, the Pearson correlation coefficient was calculated in the traditional way. Although the calculations used the results of the same group of observables, at different time stages, the volume of the groups under consideration at the preliminary, experimental and control stages was equal to each other (n = 28). In accordance with the size of the sample and the equality of groups at different stages of observation, the number of its degrees of freedom (f) was calculated using the formula:

$$f = 2n - 2 \tag{2}$$

Results and Discussion

Based on the results of testing for problems and difficulties during the passage of adaptive chess training, two blocks of correlation pleiades were built, formed by the signs shown in **Figure 1**.
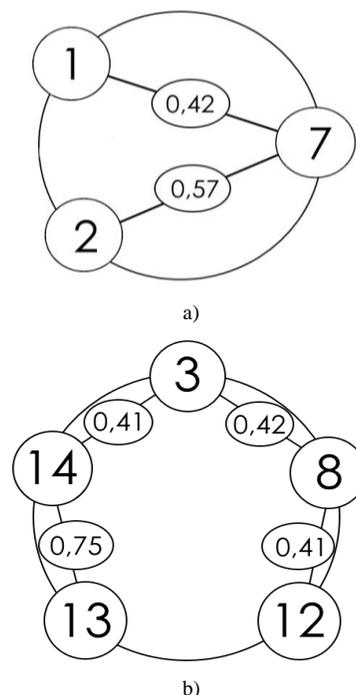

Figure 1. Correlation Galaxy of Difficulties Identified by Respondents

The first correlation pleiades, with a capacity of 3 units, a "star" shape and a strength of 0.50, formed by such difficulties as an insufficient number of adaptive chess competitions (No.7), lack of necessary adaptive training methods and means of transporting chess players (No. 1, 2). It can be interpreted as the presence of flaws in the organization of adaptive chess competitions, or rather in the formation of their material and technical base. Based on the analysis of the galaxy, we can also say that the lack of transportation means for chess players (p=0.42) and means of training them, taking into account nosologies (p=0.57), are one of the factors in reducing the number of participants in the competitions.

The second galaxy ("star" shape, power 5 units and strength 0.50), based on the strength of the bond, can be divided into two groups of signs. The first one, which has the highest correlation coefficient (p=0.75), indicates the illiterate use of volunteer resources (insufficient number of volunteers (No. 13) due to the lack of standard and special equipment (No. 14)). The second galaxy, which has an average correlation coefficient (p=0.41), indicates insufficient information illumination of adaptive chess-sports activity (lack of information about chess clubs, sections and clubs (No.3), about the benefits of playing chess (No. 8)) due to its insufficient funding (No. 12).

Difficulty factors - an insufficient number of coaches (No. 6), scientific and methodological literature (No. 10), as well as specialized children's and youth schools (No. 5) were not included in the block of the constellations of this stage, which can be explained by the residual functioning of a qualified sports personnel and educational base. The factors of difficulties in

obtaining information about the possibility of distance learning (No. 4) and the development of adaptive chess in the media (No. 9) did not fall into the galaxy.

From the graph "Change in the confidence coefficient" **(Figure 2)** it is clear that starting from the sixth slice, the Student's t-test exceeds its critical value ($t_{critical} = 2.005$) in accordance with the calculated number of degrees of freedom f and the required significance level p (for f = 54 and p <= 0.05).

Confidence factor change

Student's test (t)

..... Opening
— Endgame
— - Tactics

— · Middlegame
— Strategy
— Critical

a)

Dynamics of the group's average score in chess tests

....· Opening
— Endgame
— - Tactics

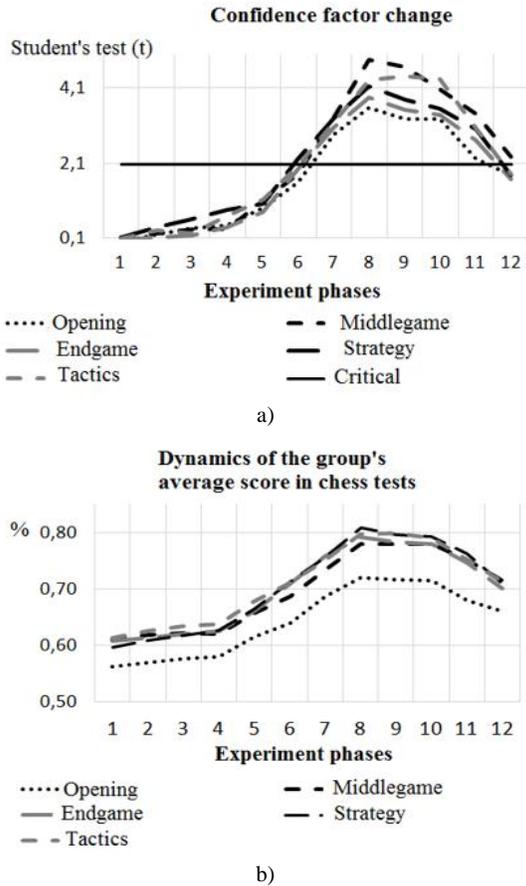— · Middlegame
— · Strategy

b)

Figure 2. Change in Confidence Coefficient / Dynamics of the Average Group Result in Chess Tests

Since the results of the study, which lie within the confidence interval, are statistically significant, from the second slice of the experimental stage of testing, we can assume with a 95% probability that trained chess players with musculoskeletal disorders will show positive results in testing chess mastery.
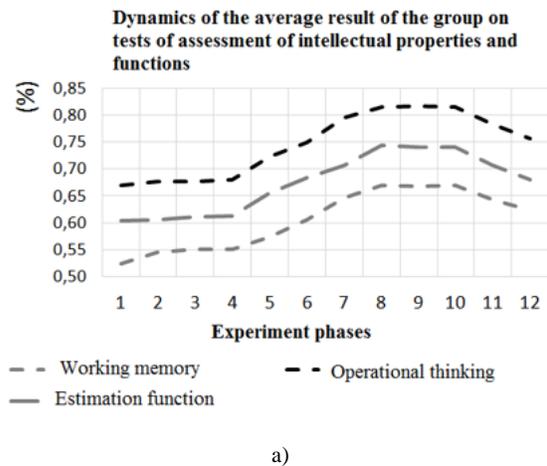
Analyzing the dynamics of the average results of the subjects in the chess tests, it was possible to note a general tendency towards an increase in indicators at the preliminary stage (1-4 "slice") and during training on the portal "Chess Planet" (5-9 "slice"). At the preliminary stage of testing, when training was carried out in accordance with traditional methods, there was a slight increase in the test subjects' playing skills, on average about 3%. The results in the "Debut" series tests by the 4th slice showed an increase of 2%, the results in the "Midgame" series increased by

3%, in the "Endgame" series the average result increased by 5%, in the "Strategy" series the result increased by 5%, in the tests of the Tactics group - by 4%.
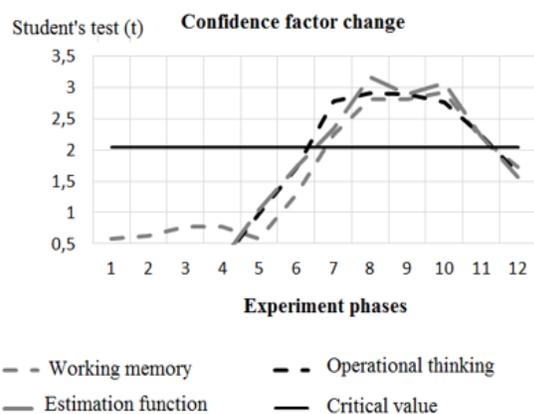
At the next stage, based on the results of the application of the experimental teaching methodology, there was a noticeable increase in the level of the subjects' indicators in all series of tests, which ranged from 24 to 26% at the end of the final stage of testing, depending on the series of tests. The increase in the results in the "Debut" test series was 6% at the end of the 1st "slice", 4% at the time of the 2nd "slice", 7% at the 3rd "slice" and another 5% at the final 4th "slice", the final increase in the average group was 24%. The increase in results in the Midgame series was 6% at the end of the 1st slice, 4% at the time of the 2nd slice, 7% at the 3rd slice and another 6% at the final 4th slice, the final increase in the average chess skill in the group was 25%. The increase in results in the "Endgame" series was 6% at the end of the 1st "slice", 7% at the moment of the 2nd "slice", 7% at the 3rd "slice" and another 4% at the final 4th "slice", the final increase in chess skill in the group amounted to 26%.

The control stage of the study, carried out after the subjects completed the training course, revealed that the increase in the chess mastery of the tested people achieved with the use of the author's methodology decreases, starting from the end of the experimental stage. By the final 4th "slice" the decrease was 9% in the Debut test series, 11% in the Midgame tests, 12% in the Endgame series, and 11% in the Strategy and Tactics series. Apparently, this is due to the termination of group chess lessons and a decrease in the involvement of the research subjects in the process of sports training.

From the graph "Change in the confidence coefficient" **(Figure 3)** starting from the sixth "slice" it can be seen that the Student's t-test exceeds its critical value ($t_{critical} = 2.005$) in accordance with the calculated number of degrees of freedom f and the required level of significance p (for f = 54 and p < = 0.05) for this stage.

Dynamics of the average result of the group on tests of assessment of intellectual properties and functions

— — Working memory
— Estimation function

— · Operational thinking

a)

b)

Figure 3. Change in the Confidence Coefficient / Dynamics of the Average Result of the Group in Tests for Assessing the Intellectual Properties and Functions of the Subjects

Since the results of the study, lying within the confidence interval, are statistically significant already from the second "slice" of the experimental stage of testing, it can be assumed with a 95% probability that chess players with musculoskeletal disorders, trained in accordance with the applied methodology, will show a positive dynamics in the development of their intellectual functions.

Analyzing the dynamics of the average results of the subjects in the tests for the assessment of intellectual functions, one can note a general tendency towards an increase in indicators at the preliminary stage (1-4 "slice") and during training on the portal "Chess Planet" (5-9 "slice"). At the preliminary stage of testing, when training was carried out in accordance with traditional methods, there was a slight increase in the test subjects' playing skills, on average about 2.5% (the results in the tests of the "Working memory" series showed an increase of 5% by series "Operational thinking" increased by 1.5%, in the series "Evaluation function" the average result increased by 1.5%).

At the next stage, following the results of the application of the experimental teaching methodology, there was a noticeable increase in the level of the subjects' indicators in all series of tests, which ranged from 20 to 21% at the end of the final stage of testing, depending on the series of tests. The increase in the results in the series of tests "RAM" was 4% at the end of the 1st "slice", 6% at the time of the 2nd "slice", 7% at the 3rd "slice" and another 4% at the final 4th "slice": the final increase in the average in the group was 21%. The increase in the results in the "Operational thinking" series was 6% at the end of the 1st "slice", 4% at the time of the 2nd "slice", 6% at the 3rd "slice" and another 3% at the final 4th "slice": the final increase in the average chess skill in the group was 20%. The increase in the results in the "Evaluation function" series was 8% at the end of the 1st "slice", 4% at the moment of the 2nd "slice", 3% at the 3rd "slice" and another 6% at the final 4th "slice", the final increase in chess skill by group was 21%.

The control stage of the study, carried out after the subjects completed the training course, revealed that the increase in the chess mastery of the test takers achieved with the use of the author's methodology decreases, starting from the end of the experimental stage (by the final 4th "slice", the decrease was 7% in the series of tests "Working memory", in the tests "Operative thinking" - 7%, in the series "Evaluation function" - 8%), in connection with the termination of group chess lessons and a decrease in the involvement of research subjects in the process of sports training.

Conclusion

Based on the results of the study, we can talk about the representativeness of the results obtained and about the effectiveness of the applied methodology of chess sports training of persons with lesions of the musculoskeletal system. It turned out to be very effective in terms of building up general chess training and in terms of stimulating sports-significant intellectual skills in persons with signs of cerebral palsy.

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