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The Effect of Selected Motor Program on Neuropsychological Variability and Motor Function at Children with Developmental Coordination Disorder

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Keywords

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Abstract

Objective: The purpose of this study was to investigate the effect of exercise intervention on some Event Related Potential and motor performance variables in children with developmental coordination disorder.
Methods: In this Quasi-experimental study were selected 28 people with Developmental Coordination Disorder among 7-10 years male students in Tehran. They were screened for study according to the 4th edition of the Diagnostic and Statistical Manual of Disorder. PsyTask software made by Mitsar Russia was used to build and run the response inhibition test. Movement Assessment Battery for Children (MABC-2) was used to measure motor function. The analysis of the covariance was used for data analysis.
Results: The analysis of the covariance the posttest ERP showed that latency of NoGo P300 component in Fz and P4 regions, amplitude of NoGo P300 component in Cz region improved significantly after exercise training. Likewise, the results showed that the experimental group improved significantly in manual dexterity, aiming and catching, balance, but there was no significant change in Threading Lace item.
Conclusion: According to the results of this study, it seems that Physical training interventions has a signification effect on some neuropsychological and motor performance indices of children with Developmental Coordination Disorder.

Introduction

Developmental Coordination Disorder (DCD) is used to describe children who have coordination problems that affect their academic and social functioning without neurological disease or specific medical problems. The range of these problems is very wide and may vary from the problem of moving on a straight line to the problem of writing. These children have difficulty doing personal tasks such as changing clothes and some daily activities, and also find it difficult to do physical activities in sports classes (Valentini et al., 2014). Children and adolescents with DCD are reluctant to engage in activities that require physical and motor responses and have a low level of intolerance, failure, and low self-esteem (Bouwien Smits et al., 2020) as well as in the optimal use of time. Completion of tasks, tactile perception and perceptual-motor skills are difficult (Johnny et al., 2020).

Despite the relatively high prevalence of DCD, there is no single etiology. The review of sources shows that in general, two sets of theories have been mentioned to explain the cause of this disorder, which are theories of growth retardation and brain damage and theories of cognitive neuroscience (Roy, 2008). In the second theory, technological advances have helped to understand the neural infrastructures of motor processes and the dynamic interaction of the brain and the environment during development (such as the Functional Magnetic Resonance Imaging (FMRI), Electro Encephalo Graphy (EEG), Transcranial Magnetic Stimulation (TMS), and Event-Related Potential (ERP) studies). One of the tools that allows neurological study of cognitive processes during the performance of various tasks is the event-dependent potential measurement tool or ERP. ERP measures the brain's response, which is a direct result of sensory, cognitive, and motor events (Morrison, 2020).

In summary, event-related potentials are a more advanced method than brainwaves for extracting sensory, cognitive, and motor events using simple mediation techniques while performing a task (Hajcak et al., 2020). Most scientific studies rely on P300 component measurements (250 to 500 thousandths of a second after stimulus presentation) to evaluate ERP, especially when making decisions, because most cognitive impairments alter the P300 waveform. Use cognitive function (Lin Yu, 2021). Research has shown that component N200 (200 to 350 thousandths of a second after stimulus presentation) in the ERP graph also generally executive cognitive control functions (Lingxiao, 2020).

According to Morton's model, DCD children's problems are thought to be addressed at three levels: biological, cognitive, and behavioral. Observed behavioral problems, such as writing, balance, manual dexterity, poor coordination and time estimation, follow problems at the biological and cognitive levels (motor planning, Execution, feedback, and timing).

Initially, the DCD literature relied on the study of behavioral defects and believed that the sensorimotor system had abnormal functioning. Based on a review by Diaz-Perez et al. (2020), studies have shown that individuals with DCD have poor performance in the areas of motor sense accuracy, visual perception, static balance and postural control, attention control, strength, temporal and spatial variability, and motor fitness.

The most important issue that is examined at the level of cognition is executive performance. Executive performance refers to higher order control system that manages new situations and includes: planning / decision making, error correction, working memory, set shifting, and adaptive sequencing (Johnny, 2020). DCD children often have difficulty with complex tasks (Piek and Coleman, 1995). They are also weaker in error detection (Lord and Hulme, 1987) and working memory (Alloway, 2008). All of this includes performance processing that takes place under the shadow of executive performance. Therefore, it can be said that executive performance in children with DCD is lower than the desired level (Brown, 2011).

Response inhibition is another aspect of executive performance. Findings from limited studies in this area show that DCD children have more errors in manual response inhibition tasks than their peers (Sartori et al., 2020; Pike et al., 2007). The findings of Mirabella et al. (2020) also point to inhibitory deficits in children with DCD.

Problems with the organization and integration of this cognitive control mechanism may significantly impair successful adaptation to daily tasks. Queme et al. (2008) examined and reported fMRI of go / do task. Children with DCD had significantly stronger anterior cingulated activity and weaker anterior activity to inhibit response and error detection than their peers. These two areas play a key role in deterrence and error detection (Houwen, 2019).

According to Morton (2004) model, the question arises whether motor interventions based on gaining experience at the level of (motor) behavior, have the ability to affect cognitive infrastructures? One of the problems that children with DCD face is a defect in the executive and sensory-motor functions, which, if they can be helped through sports activities, can be expected to be treated at a young age and in the early stages, or from the severity of their disorder will be reduced and they will face fewer problems in the future. One of the factors that can play an important role in increasing appropriate training opportunities for motor skills and motor concepts is play and physical activity (Morten, 2015). Considering the role of play and physical activity on physical, motor, cognitive and emotional development, it seems that play can be considered as an effective factor in the educational program (Farhat, 2016).

Accordingly, and due to the lack of research in the field of providing a special exercise program for children with movement coordination problems, we decided to eliminate or minimize these disorders and shortcomings by regularly performing a series of exercises in the form of games in preschool. The aim of this study was to investigate the effect of Spark exercise program based on educational activities in the form of play on some neuropsychological variables (two components of P300 and N200 event-dependent potential) in children with DCD. In addition to cognitive analysis, the study of motor performance variables as behavioral results through standard motor tests such as children's mobility assessment tests Movement Assessment Battery for Children (MABC-2) to measure the perceptual-motor abilities of subjects (manual dexterity skills, aiming and catching and balance) It is used in children with developmental coordination disorder are other objectives of this study.

Method

The present study was a developmental study and quasi-experimental research method and causal-comparative research design. Due to the nature of the research topic, the type of research is quasi-experimental. The statistical population of this study consists of 7–10-year-old boys in District 22 of Tehran who were educated in schools of District 22 of Tehran. First, prepare a list of all preschools and schools in District 22, and after distributing the researcher-made questionnaire and filling it out by the children's parents, select a statistical sample based on G-Power 3.0.10 software and select the required number of conditions to attend. They had the research, they were selected. By providing general information about children with developmental coordination disorders to parents, children who were likely to have the disorder were identified and pretested.

Since this research is looking for special or unusual cases, purposeful sampling method is used. This means that the subject is selected based on the judgment of the researcher or the objectives of the study. Then, 28 children with DCD were selected from them. The reason for choosing seven-year-olds was that this is the only age when children are formally assessed by the Department of Health Education to enter first grade.

The second version of the children's movement assessment test was reviewed by Henderson et al. In 2007. Using a mobile checklist, it was possible to identify motor dysfunction disorders in three age ranges: 3-6 years, 7-10, and 11-16 years. Has provided. This test has three main components: manual dexterity (including three subtests), aiming and catching skills (including two subtests) and balance (including three subtests). For each child, the raw score of that subtest (for example, seconds or number of repetitions) can be calculated as the standard score of the subtest (ISS), the standard score of the test component (CSS), the overall standard score (TSS), and the percentage score. The validity and reliability of this test has been measured by Akbari, Shojaei and Daneshfar in Tehran, Iran, which is 0.923 for manual dexterity, 0.999 for aiming and catching, 0.988 for balance and 0.985 for the total score.

Exercise protocol

First, MABC-2 pre-test was performed on all subjects. Then, the first group (experimental) performed 16 sessions of selected Spark motor activities, which included 3 sessions of 45 minutes per week, according to the motor problems of children with developmental coordination disorders and motor performance, including static and dynamic balance movements, movements Coordinated and simultaneous and identifying different directions, weakness of body posture and etc., for this purpose, they performed the selected movement program taking into account their problems and how to implement it is as follows. This exercise program, which was based on the Spark exercise program, includes 45 minutes per session, which is divided into four parts: the first 10 minutes of the program include warm-up, then 15 minutes of play, including movement skills such as jumping rope, hopping in a loop, walking, etc., then 10 minutes of play includes manipulating skills such as shooting the ball, aiming and throwing the ball into the basket, bowling, etc. and finally 10 minutes of cooling, the control group performed their usual activities during this time and finally. , From both groups, post-test was performed and the results were recorded.

Statistical analysis

An exploratory analysis was performed to verify the distribution and determine the normality of the data, using the Shapiro-Wilk test is used to and the Levin test is used to determine the homogeneity of variances. Data analysis will be performed using analysis of covariance. Values are expressed as median and standard deviation and 95% confidence interval. An α of 95% was used to define statistical significance. To evaluate the magnitude of the significant differences, the effect size Hedges was calculated. The magnitudes of effect size were interpreted as follows: <0.2, trivial;

0.2-0.6, small; 0.6-1.2, moderate; 1.2-2.0, large; 2.0-4.0, very large; and >4.0, perfect (Hopkins et al., 2009). For the descriptive analyzes and inferential tests, SPSS (IBM, USA) was used.

Table 1 shows the mean and standard deviation of the three research variables in pre-test and post-test.

Results

The statistical method of analysis of covariance was used to investigate the latency and amplitude of the P300 component in the regions of Fp1, Fp2, F3, F7, Fz, F4, F8, C3, Cz, C4, P3, Pz and P4. The assumptions of this test are homogeneity. Regression slope (linearity of the relationship between random and dependent variables), normality of distribution (Shapiro-Wilk test) and homogeneity of variance of groups (Levin test) which have been studied in all cases, the results are as follows:

First, the homogeneity of regression slope (linearity of the relationship between random and dependent variables) was investigated. The interaction of the group with the latency of the P300 component in the target areas was not statistically significant ($p < 0.05$), therefore, the data support the assumption of homogeneity of regression slope. The results of the Levin test are respectively, Fp1 ($F=0.008$, $p=0.931$), Fp2 ($F=0.726$, $p=0.404$), F3 ($F=0.804$, $p=0.381$), F7 ($F=0.148$, $p=0.705$), Fz ($F=0.387$, $p=0.541$), F4 ($F=0.691$, $p=0.415$), F8 ($F=0.657$, $p=0.427$), C3 ($F=3.996$, $p=0.059$), Cz ($F=4.255$, $p=0.052$), C4 ($F=2.625$, $p=0.120$), P3 ($F=3.996$, $p=0.059$), Pz ($F=1.510$, $p=0.233$) and P4 ($F=1.963$, $p=0.176$). In none of the variables a significance level greater than 0.05 was obtained, so the assumption of equality of variances between the two groups is established.

The results of Shapiro-Wilk test show that the test result in all variables is more than 0.05 and the data distribution is normal. Therefore, the covariance test is applicable. Respectively for control group and experimental group are in the regions of Fp1 (0.360-0.593), Fp2 (0.155-0.385), F3 (0.563-0.997), F7 (0.915-0.116), Fz (0.227-0.354), F4 (0.896-0.711), F8 (0.078-0.055), C3 (0.320-0.083), Cz (0.512-0.144), C4 (0.511-0.999), P3 (0.237-0.169), Pz (0.724-0.493) and P4 (0.05-0.188). The results of analysis of covariance show that the differences in the two regions Fz and P4 are significant ($p < 0.05$) and no significant difference is observed in other regions ($p < 0.05$).

Table 1. Analysis of covariance to compare the post-test differences of the control and experimental groups for the amplitude of the P300 component in ERPs.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Fp1	16.149	1	16.149	1.732	0.204	0.084
Fp2	3.761	1	3.761	0.315	0.581	0.016
F7	7.973	1	7.973	0.955	0.340	0.046
F3	1.475	1	1.475	0.123	0.729	0.006
Fz	0.236	1	0.236	0.028	0.869	0.001
F4	8.455	1	8.455	0.768	0.391	0.037
F8	0.050	1	0.050	0.006	0.937	0.001
P3	6.740	1	6.740	0.564	0.461	0.027
Pz	21.632	1	21.632	1.750	0.201	0.080
P4	0.865	1	0.865	0.068	0.797	0.003
C3	6.740	1	6.740	0.564	0.461	0.027
Cz	34.071	1	34.071	4.059	0.048	0.191
C4	0.309	1	0.309	0.076	0.785	0.004

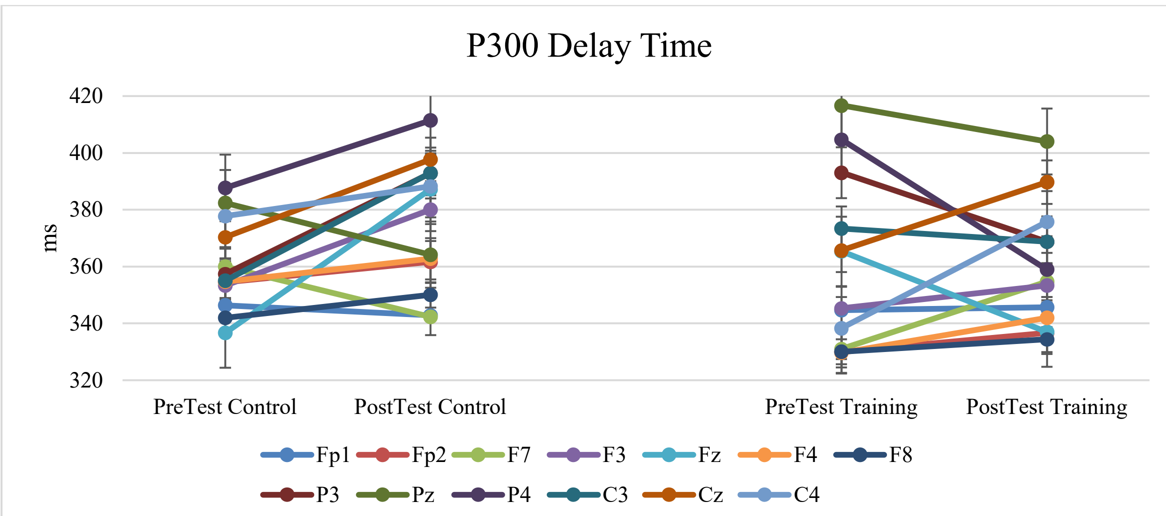

Figure 1. Compare pre-test and post-test differences between control and experimental groups.

First, the homogeneity of regression slope (linearity of the relationship between random and dependent variables) was investigated. The interaction of the group with the latency of the MABC-2 Test component in the target areas was not statistically significant ($p < 0.05$), therefore, the data support the assumption of homogeneity of regression slope. The results of the Levin test are respectively, Placing Pegs (F=1.480, p=0.235), Threading Lace (F=0.278, p=0.603), Drawing Trail (F=0.001, p=0.997), Catching with two hands (F=0.010, p=0.922), Throwing Beanbag (F=0.719, p=0.404), one Board Balance (F=0.040, p=0.843), Walking Heel to Toe (F=0.037, p=0.849), Hopping on Mats (F=0.408, p=0.529). In none of the variables a significance level greater than 0.05 was obtained, so the assumption of equality of variances between the two groups is established.

The results of Shapiro-Wilk test show that the test result in all variables is more than 0.05 and the data distribution is normal. Therefore, the covariance test is applicable. Respectively for control group and experimental group are in Placing Pegs (0.251-0.253), Threading Lace (0.346-0.381), Drawing Trail (0.521-0.418), and catching with two hands (0.648-0.310), Throwing

Beanbag (0.251-0.253), one Board Balance (0.629-0.569), Walking Heel to Toe (0.533-0.704), and Hopping on Mats (0.490-0.591). The results of analysis of covariance show that the differences in the seven Items are significant (p <0.05) and no significant difference is observed in Threading Lace Item (p <0.05).

Table 2. Analysis of covariance to compare post-test differences between control and experimental groups.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Placing Pegs	9.841	1	9.841	8.833	0.006	0.261
Threading Lace	1.038	1	1.038	3.943	0.058	0.136
Drawing Trail	15.774	1	15.774	8.796	0.000	0.260
Catching with two hands	20.243	1	20.243	93.182	0.000	0.795
Throwing Beanbag	27.153	1	27.153	144.978	0.000	0.853
One Board Balance	10.309	1	10.309	19.976	0.000	0.444
Walking Heel to Toe	8.828	1	8.828	4.301	0.49	0.147
Hopping on Mats	9.019	1	9.019	34.011	0.000	0.576

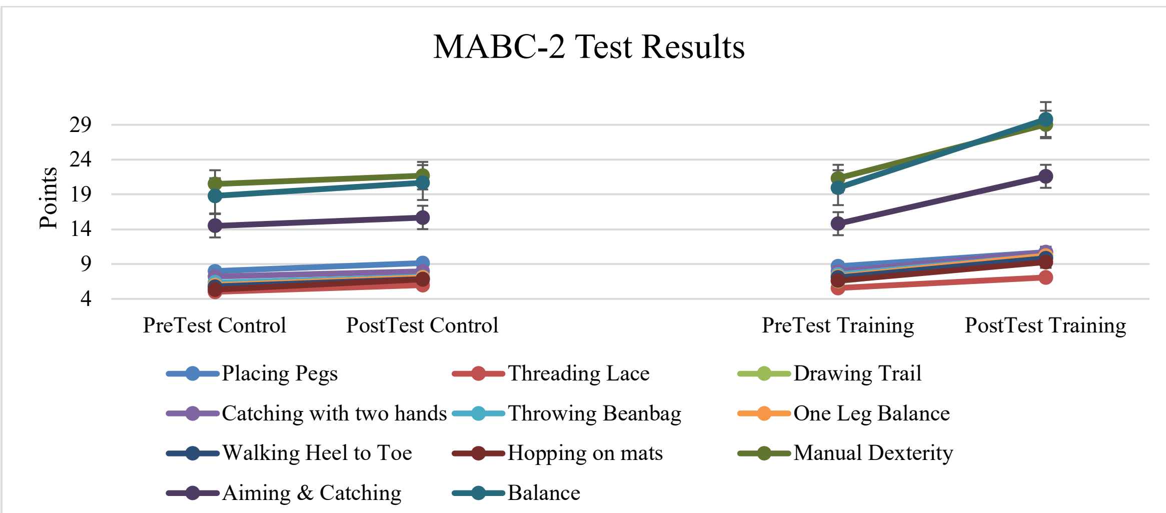

Figure 2. Compare pre-test and post-test differences between control and experimental groups.

Discussion and Conclusion

The aim of this study was to investigate the effect of a period of physical exercise intervention on neuropsychological variables and functional variables in children with developmental coordination disorder. Brain wave potential was assessed to evaluate some neuropsychological variables. In this study, the characteristics of the P300 component, which is representative of high-level cognitive functions, were investigated. MABC-2 test was used to evaluate motor function.

The results of this study showed that after the training intervention, the latency of the P300 component in the Fz and P4 regions was significantly reduced. After the training intervention, the amplitude of the P300 component in the Cz region increased significantly. After the training intervention of the experimental group in seven sub-tests "placing pegs", "drawing trail", "throwing beanbag", "catching with two hands", "walking on heel to toe" and "on board balance" and "Hoping on mats" They had a significant improvement and no significant change was observed in the "Threading Lace" subtest.

Examination of the set of hypotheses about the amplitude and latency of the P300 components of the event-dependent potential showed that after the training intervention, the latency of P300 in the Fz and P4 regions, the P300 amplitude in the Cz region improved significantly. The most common ERP components reported for inhibitory activity are the P300 inhibitory component. P300 components may reflect early inhibition (Hajcak, 2020). The P300 component has been studied in tasks that require some form of inhibition and has its roots in the anterior cingulate cortex (Lin Yu et al., 2021).

As mentioned earlier, in the study of the causes of DCD, various positions have been assigned to inhibitory actions, including the cerebellar parietal network in predictive control, the parietal frontal cycle in restraint, the posterior parietal in internal representation of actions, and the anterior in parietal network. MRI studies also showed that the lateral frontal cortex, the anterior cortex groove and the parietal cortex, the posterior frontal cortex, and the lateral anterior cortex are involved in inhibitory activity (Lingxiao et al., 2020). Contradictory results have also been reported for the activity of the left and right lobes of the cerebral cortex. For example, Fawcett et al. (1999) stated that in inhibitory activities, the central part of the forehead is more active. Perez et al. (2020) show that right lobe activity is stronger in inhibitory activities, and Morrison et al. (2020) suggested that P300 activity in inhibitory tasks is shifted to the left hemisphere, and that the left frontal region plays a role in executive control of behavior. Therefore, in this study, all electrodes except the posterior and temporal regions were examined to allow a more complete examination.

In a 2012 study by Tsai et al., The effect of soccer training on the inhibition of DCD children in an external orientation task was similar to that of the Posner model, and an ERP evaluation was performed. In another 2009 study by Table Tennis on table tennis training on the inhibitory capacity of DCD children, only behavioral responses were assessed in the same task. In both studies, the task of inhibition is closely related to attention and the aspects of motor inhibition are less. However, in this study, the task is designed in such a way that the motor aspects of the task are emphasized more than the attention aspects.

Kropotove (2009), citing a 2003 study by Jonkman et al., Suggested that P300 activity was more closely related to inhibition in children than the N200 component at a behavioral level, so that the P300 component, which is a significant behavioral stimulus, was identified as A defective brain is used from a healthy one. In the study of Tsai et al. 2010, the characteristics of P300 and N200 components of children with normal growth and children with DCD were observed differently. This difference was observed in the amplitude of both the P300 component and the delay, and these results were repeated in 2012, so the P300 component seems to be more valid for investigating defects in the DCD inhibition control mechanism. The latency of the P300 component is related to the speed of cognitive stimulus processing and response selection (Morrison , 2020) and the N200 has been shown to represent conflict detection. Contrary to Tsai's theory, the study of these two components together provides a more complete view of conflict detection and then the inhibition that occurs following conflict detection. In the present study, there was a significant improvement in P300 latency in Fz and P4 region, P300 amplitude in Cz region and N200 latency in Fz, F4, C3, P3 and P4 region, which shows a significant improvement in the cognitive processing status of the inhibition task. Children DCD occurred.

A combination of motor skills for DCD children may enhance the neural networks responsible for faster cognitive processing as well as more efficient stimulus evaluation and categorization (Lin Yu et al., 2021). The main mechanism of this process may be the P300 less delay. Cognitive processing plays an important role in behavioral performance and even has many topographic similarities with each other (Hajcak et al., 2020). In 2012, Tsai et al. Found that DCD children were weaker than their normal-growing counterparts in tasks that required conflict resolution. The findings show that DCD children have a longer P300 response time and latency, and a shorter P300 amplitude than normal-grown children, so DCD children have poorer cognitive processing than their peers.

Querne et al. (2009) reported that DCD children had stronger anterior cingulate cortex activation and poorer anterior activity compared to healthy counterparts but did not differ in the number of correct inhibitions. This finding led them to suggest that people with DCD were less likely than their healthy counterparts to switch programs. Despite this difference in activation pattern, there is a compensation in the performance of DCD individuals, which may indicate that DCD individuals find the task more difficult because imaging studies of healthy individuals have shown an increase in the difficulty of inhibiting cortical activity. Anterior has increased (Hajcak, 2020).

As the results show, the most changes were observed during the component latency. Tsai (2012) also observed changes only during the delay. He noted that this indicates that the P300 delay time is more affected by exercise in DCD children. Referring to the study by Polich, and Kok (1995), Tsai states that previous studies have shown that the biological results of long-term exercise have a direct effect on the delay time of this component and not its amplitude.

Imaging studies have shown that the problems of voluntary release of attention from invalid cues are attributed to the frontal-parietal network (Riggins et al., 2020), while the frontal-complex nodules may be attributed to the problems of stopping inhibitory movements against a forced target. , Be involved. In this study, significant changes were observed in the latency of component N200 in regions P3 and P4 (located in the parietal lobe) and Fz and F4 (located in the frontal lobe) and also changes in the latency of component P300 in regions Fz and P4. Although continuous experimental work is needed to elucidate the role of detoxification and its neural infrastructure in abnormal motor development, the above results suggest that physical exercise may improve inhibition.

Participation in physical activity is associated with better cognitive function in children and is especially true for exercises that require attention and skillful movements. These exercises have been shown to lead to Plastic changes in cognitive processing (Parke et al., 2020). Many studies show a significant increase in P300 amplitude due to short-term physical exercise. This effect may be due to the facilitation of pre-activation parts of the neural network of cognitive function (Riggins, 2020). But in the 2012 Tsai study, no change in the amplitude of this component was observed.

Hajcak et al. (2020) and Rwada et al. (2005) stated that executive attention networks and inhibitory control efficiency are practicable in developing children. Rueda used a five-day computer inhibition control exercise game in normal-grown children. Diamond et al. Also developed a mind training tool to improve executive functions, including inhibition control, working memory, and cognitive flexibility, and found that using such games improved cognitive skills. Due to this, the ability to control inhibition in developing children can be improved. Studies by Tsai et al. In 2009 and 2012 showed that physical intervention could also improve inhibition control in children with DCD, but the reality is that DCD children are less involved in general physical activity, organized play, and physical education (Rivilis, 2011).). The results of the reviewed studies and the results of this study show that enriching exercise programs for DCD children or even healthy children improves cognitive activities such as response inhibition.

The results showed that after the training intervention of the experimental group in seven subtests "placing pegs", "drawing trail", "throwing beanbag", "catching with two hands", "walking on the heel" and "static balance" and "Hoping on mats" had a significant improvement and no significant change was observed in the "Threading Lace" subtest. Therefore, the exercise program has significantly helped to improve the variables that are the basis of goal setting and balance. Failure to observe significant changes in the variable of manual spinning agility may be due to their difficulty in coordinating fine motor skills (Sartori, 2020).

In a study conducted by Soltani Nejad et al. (2020) and EbrahimiSani et al. (2020) on the effect of perceptual-motor exercises on improving motor skills of children with developmental coordination disorder, it was noted that the experimental group after a period of training Perceptual-motor had significantly better performance in motor tests compared to the control group. Perez et al. (2020) also found that cognitive games play an active role in the acquisition of new skills in children with DCD.

Tsai's 2012 study found that exercise improved MABC subtests, arguing that exercise facilitated the development of motor skills. Taghi garehbagh et al. (2020) stated that physical exercises improve neuromotor activation by improving strength, coordination between limbs, and complex coordination movements.

The question arises those children who have participated in this exercise program and this exercise program has significantly improved their motor skills, are no longer considered as DCD children. The fact is that although these children are more able to complete the motor tasks studied on the MABC-2 test than before, this does not mean that they are skilled, but rather that they have to learn and practice skills appropriate to their age. On the other hand, according to the statistical and diagnostic guidelines for mental disorders, motor tests have a screening aspect and are not a criterion for diagnosis, because lack of motor proficiency alone is not a decision criterion in this field, but all four criteria mentioned in DSM IV-TR must be considered.

Although DCD is classified as a mental disorder, Mahmoodifar et al. (2018) have stated that poor sensory and motor coordination has long been recognized as a cause of movement problems in children with developmental coordination disorders, and improvement of this problem has led to this disorder. Improves. Therefore, motor enrichment is expected to play a significant role in the treatment of this disorder. According to Rinat et al. (2020) in their study, the majority of children with developmental coordination disorders who, if affected by movement and participation in physical activity, will partially compensate for their retardation, and even 5 people in the case group. Their study became complete.

Children's abilities are developed in different ways in different tasks and their experience will have a great impact on the development process. As a result of this study, it can be said that physical exercise interventions may improve motor skills in children with coordination disorders.

One of the major limitations of the present study is to consider the group of children with normal development. This issue allows the comparison of motor skills of children with developmental coordination disorders after performing interventions with the healthy group. As Tsai et al. Acknowledged in 2012, although DCD children’s scores on the MABC test improved after soccer practice, they did not reach the normal scores of children with normal growth, indicating that children with developmental coordination disorder had mild signs of neurological deficits. The brain (Tsai et al., 2009) has minimal damage or malfunction in the brain (Wilson & Butson, 2006) that causes a disruption in the attention network (Posner, 2007).

The results of this study and the literature on children with DCD show that although they are weak in physical activity, interventions based on physical activity improve their motor performance. This is so important that Parke and his colleagues in 2020, in an article on educating DCD children, make suggestions for their physical education. They stated that it is more difficult for these people to improve their motor skills in physical training and that their motor function should be focused. One strategy is to develop these children to the level of their own abilities to develop their self-esteem and increase physical activity for fitness and health over a long period of time. In teaching physical activities to these children, attention should be paid to the recreational activity so that their effort and participation in the activity is more than their skill level.

Games should not be competitive and goals and records should be based on their individual performance. Another strategy is to divide the class into small groups to practice skills to feel less of an obstacle. When new skills are learned in the classroom, we can select them as an educational model so that they have the opportunity to practice the skill both visually and motor. In ball skills, we adjust the skill to both reduce the likelihood of injury and increase successful experiences. Using bean bags, balloons and large balls are useful guidelines. Extracurricular activities can also be considered for those activities that do not require adaptation to environmental changes such as running, skating, swimming and cycling. Athletic lifestyle improves their level of health and physical activity.

Finally, the results of this study showed that the exercise program presented in this study may be able to improve the psychological indicators related to the event and motor function of children with developmental coordination disorders.

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