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The Effects of a Period of Selected Physical Activity on Improving Manipulative and Locomotors Skills of Children with Neuropsychological Learning Disabilities

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ABSTRACT

Background: the aim of this research was to investigate the effects of a period of selected physical activity on improving the fundamental skills of manipulation and locomotion in children with neuropsychological learning disabilities.
Methods: The present research was semi-experimental. A total of 30 students with neuropsychological learning disorders with an average age of 7.76 participated in this research selected by available sampling. The instrument utilized in this research was the test of Gross Motor Skills. After performing the pretest of locomotor and manipulative skills, the participants were classified homogeneously into experimental and control groups. The experimental group, in addition to taking part in their routine classes at school, also participated in twelve 45-min sessions (three sessions per week) in the Spark program. The control group took part in only their own routine classes. By the end of the 12th session, a posttest was performed. The data were analyzed through covariance analysis in SPSS 22. The significance level was considered as $P<0.05$.
Results: the results showed that in the variables of locomotion (running ($P<0.001$), hopping ($P=0.001$) and long jump ($P=0.001$), as well as manipulative variables (kicking ($P<0.001$), overhead throwing ($P<0.001$) and catching ($P=0.0001$) there was a significant difference between the experimental and control groups. Based on the main differences, the experimental group displayed better performance compared to the control group.
Conclusion: overall, it can be stated that a 12-session course based on a selected physical activity can result in improved locomotor and manipulative skills in children with neuropsychological learning disorders.

Introduction

The most important motor development period is childhood, and the characteristics of motor development include constant physical, motor, cognitive, and emotional development; the primary experiences and learning in this period are very effective in subsequent learning for a person [1]. One of the most important issues in the motor development of children is the fundamental development of motor skills. They are categorized into three classes of stability skills such as static and dynamic balance, locomotor skills such as running and jumping, as well as manipulative skills such as catching and throwing [2]. In the process of development of fundamental motor skills in children, in addition to maturation, the actual task used as well as the environmental conditions including opportunity for exercise, encouragement, and training are also effective [3].

In most societies, there are individuals who are classed

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as abnormal in terms of developmental, mental, and motor activities [4]. Learning disability is an issue that can be well observed in most communities. Although children with learning disabilities have a normal IQ, they have numerous problems in learning different skills [5]. Learning disability involves a kind of cognitive defect in mental processes, directly affecting the development of psychological, educational, and neuropsychological functions [6, 7]. Generally, the prevalence of learning disabilities in the world has been reported to be 3-17.5% [8]. In Iran, the prevalence of learning disabilities in children has been stated as being 2.7-30% [9].

Neuropsychological learning disability covers disorders including memory disorders, attention disorders, biological/genetic disorders, visual processing disorders, auditory processing disorders, and perceptual motor disorders [10]. Preschooler children with developmental neuropsychological learning disorders are weak and inefficient in terms of mental organization; they start to walk later, have visual-motor perception problems, are slow and disorganized, and have problems in fine movements and motor control [11].

Three approaches of ability-achievement discrepancy, pattern of strengths and weakness, and response-to-intervention have been reported for diagnosing children with learning disabilities [12]. The rate of cognitive, mental, emotional, and physical development of children is greater at the terminal years of childhood, covering 7-10 years, when the child is more correctable. Accordingly, interventions such as presenting suitable, planned, and regular physical and motor activities during these ages can play a significant role in motor development, the level of knowledge, and learning of different tasks among children [1, 4]. Usage of spatial interventional strategies in children with learning disabilities can set the ground for improving their primary skills required for their future academic progress [13].

Physical activity, games, and exercise have always been of interest to researchers and scholars of different areas as a suitable interventional approach. One of the most important features of all these activities is that they are enjoyable, facilitating the learning process in students with a learning disability who have extensive experience of failure in the learning and acquisition of different skills [14]. In a research, Joseph & Gruber (2013) found that a period of physical activity can improve physical, academic, and social conditions in children with learning disabilities [15]. Swanson & Jerman (2013) observed that exercise and physical activity can cause diminished cognitive disorders in reading and writing of children with neuropsychological learning disorders [16]. Also, the impact of exercise and physical activity has been confirmed on improving perceptual-motor skills in children with learning disability [11], attention and working memory [17], hand-eye coordination [18] and improving executive as well as attention [19]. Although in the mentioned studies, the role of physical activity in improving different variables in different individuals has been supported, no research was found examining the variable of fundamental skills in children with neuropsychological learning disability.

Considering the importance of development of fundamental skills as the basis for development of specialized skills and the role these activities play in the daily life [1], and since children with learning disabilities have many motor problems [20] and research so far has not examined the impact of physical activity on fundamental skills including manipulative and locomotor skills, this research attempts to answer the following question: "does a period of selected physical activity affect improvement in the manipulative and locomotor skills in children with neuropsychological learning disorder?"

Methods

The research method employed in this study was semi-experimental, and applied in terms of the objectives, which was performed using pretest-posttest design alongside a control group. The participants in this research were 30 students with neuropsychological learning disorders chosen through available sampling from exceptional schools of Gorgan city.

In order to investigate the extent of the neuropsychological learning disorder, the files available at school were used with the co-operation and discretion of the students' teacher. The learning disorder was assessed using Conners neuropsychological skill questionnaire administered by the authorities and teachers of the school. Acquisition of a score above 5 in items of 10, 25, 31, and 37 indicated learning disorders in children.

An age range between 7 and 10 years, a neuropsychological learning disorder, normal motor development and absence of physical or behavioral problems were the inclusion criteria. All of the participants, teachers, and heads of schools were assured that participation in this research would be absolutely voluntary and that any participant could withdraw from the study at any time. Participants voluntarily participated in the study and written consent was obtained from them. The present research received an ethics code from the physical education and sport sciences research center of the ministry of science with the code no: IR.SSRC.REC.1398.017.

Instruments

Conner's neuropsychological skill test: this test was prepared by Connors in 2004, which aimed to assess neuropsychological skills across four spectra (unobserved to severe) for 5-12-year-old children, which has also been translated and normalized in Iran. This questionnaire has 48 items which investigates different disorders including conduct disorder, learning disorder, psychosomatic disorders, impulsivity, anxiety, and hyperactivity. Internal consistency has been reported using Cronbach alpha coefficient within the range of 0.75-0.90, while the test-retest reliability coefficient with an eight-week interval has been reported to be 0.6-0.9 [11].

The test of gross motor skills II: this test consists of two subtests. The two subtests measure gross motor skills in the primary stages of development. This test has been designed to estimate the gross motor function in 3-10-year-old children, with reliability and validity of 87% and 96%, respectively [21]. Locomotor subtest: this subtest measures gross motor skill associated with coordinated and psychosomatic movements at the time of movement in both direct and indirect paths. (Running, hopping, horizontal jumping) Manipulation subtest: this subtest includes skills involving force exerted to an object or receiving force from that object in control and accuracy (hitting *******OR 'punching' **********a fixed object, static dribbling, catching, hitting with the legs********** OR 'kicking' **********, overhead throwing, and rolling).

Selected physical activity: in order to present the selected physical activity, Spark motor program was used. This program lasts around 45 minutes and the aim is to provide games and entertainment for children, and is presented in four parts. At the beginning of the session, 15 minutes is allocated to warming up. Then, the children perform locomotor skills for 10 minutes as well as 10 minutes on manipulative skills. Eventually, the last 10 minutes is dedicated to cooling down the body [22]. In the part related to locomotor skills long jump, running, and hopping were used, while in the part related to the manipulative skills, exercises such as catching a ball, overhead throwing of the ball, and rolling the ball on the ground and between the two legs were employed.

Method of Implementation

After coordinating with the related organization to carry out training and education of exceptional children in Gorgan city and acquiring the necessary permission to conduct the research, first a pretest was done on all participants. Then, the subjects were categorized into experimental and control groups homogeneously based on the scores obtained. The experimental group in addition to taking part in their routine classes at school also performed twelve 45-min sessions (three sessions per week) in the selected physical activity program presented by a master of physical education. During this period, the control group only received their routine classes, i.e. they received no intervention. After the completion of the 12th session, posttests were performed on both the experimental and control groups [23, 24]. The scores of each subject were calculated to evaluate the gross motor skill development. Specifically, each of the subjects performed three manipulative and three locomotor skills separately. Then based on the checklist, the performance of each subject was scored. If the subject performed every part of the skill based on the checklist properly, they would receive 1 score, while wrong implementation led to a score of zero.

The data were analyzed by Shapiro-Wilks test (for normality of the data), along with Leven test for investigating equality of variances, independent t-test (for intergroup comparison), and paired t-test (for intragroup comparison) in SPSS software (Version 22). The significance level was considered as $P<0.05$.

Results

The results related to the mean and standard deviation as well as t-test for investigating the demographic characteristics of the subjects are presented in Table 1.

As can be observed in Table 1, there is no significant difference between the demographic characteristics of the subjects in terms of demographic variables. The mean and standard deviation of the scores related to the locomotor and manipulative variables in the two groups are shown in Table 2.

As provided in Table 2, in the experimental group, the posttest scores improved compared to the pretest, but there was no difference in the control group between the pre-and post-test scores.

For the pre-test-posttest group of the experimental and control groups regarding the locomotor and manipulative variables, ANCOVA covariance analysis was used. Initially, the presumptions of this test were investigated. The first presumption of this test is equality of the covariance matrix. Considering the insignificant level of Box test (P=0.25), the covariance matrix of the data is equal. Also, the results of Leven test (P=0.14) confirm the assumption of homogeneity of variances.

The relevant multivariate statistic, i.e. Lambda Wilks test is significant at the confidence interval of 99% ($=\eta^2$،0/001=sig، 01/37=$_{28،1}$F=0.74). This suggests rejection of null hypothesis. Thus, it is found that the results of the multivariate covariance analysis tests are generally significant. The results related to the covariance analysis tests are provided in Table 3.

Based on the results of ANCOVA test, there is a significant difference between the experimental and control groups regarding the variables of running (P=0.001), hopping (P=0.001), long jump (P=0.001), kicking (P=0.001), overhead throwing (P=0.001), and catching (P=0.001). Based on the mean differences, the experimental group outperformed the control group, suggesting the effectiveness of the Spark physical activity program on the locomotor and manipulative variables.

Table 1: Mean±standard deviation and independent t-test for investigating the demographic characteristics of the subjects

Variable	Group		F	t	sig
	Experimental Mean±SD	Control Mean±SD			
Age (years)	7.8±0.77	7.73±0.70	0.153	0.256	0.793
Height (cm)	125.6±3.75	124.86±2.66	1.86	0.616	0.543
Weight (kg)	21.80±1/56	22.46±1.88	0.74	1.05	0.301

Table 2: The mean and standard deviation of the scores related to the locomotor and manipulative variables of the two groups

Variable		Group	Pre-test Mean±SD	Post-test Mean±SD
Locomotion	Running	Experimental	0.96±0.54	1.76±0.53
		Control	1.23±0.53	1.26±0.59
	Hopping	Experimental	1.53±0.44	1.80±0.41
		Control	1.30±0.56	1.26±0.65
	Long jump	Experimental	1.23±0.49	1.66±0.55
		Control	1.13±0.48	1.13±0.48
Manipulation	Kicking	Experimental	1.23±0.45	1.66±0.55
		Control	1.20±0.41	1.13±0.48
	Overhead throwing	Experimental	1.30±0.41	1.70±0.41
		Control	1.13±0.48	1.23±0.45
	catching	Experimental	1.40±0.50	1.90±0.54
		Control	1.16±0.49	1.23±0.59

Table 3: The results of covariance analysis between the experimental and control groups in the locomotor and manipulation skills

Variable	Source of change		Sum of third squared	Df	Mean of third squared	F	Significance level	η coefficient
Locomotion	Running	Pretest	2.85	1	2.85	2.19	0.001*	0.69
		Group	3.74	1	3.74	2.82	0.001*	0.57
	Hopping	Pretest	3.71	1	3.71	2.75	0.001*	0.44
		Group	0.94	1	0.94	5.52	0.026*	0.17
	Long jump	Pretest	4.47	1	4.47	3.41	0.001*	0.61
		Group	3.71	1	3.71	3.07	0.001*	0.57
Manipulation	Kicking	Pretest	4.71	1	4.71	4.73	0.001*	0.62
		Group	1.88	1	1.88	1.89	0.001*	0.39
	Overhead throwing	Pretest	1.30	1	1.30	1.75	0.001*	0.39
		Group	1.50	1	1.50	1.21	0.001*	0.43
	Catching	Pretest	0.96	1	0.96	6.22	0.02*	0.20
		Group	2.87	1	2.87	1.61	0.001*	0.47

Discussion

The aim of this research was to investigate the effect of a selected physical activity program on manipulative and locomotor skills in children with neuropsychological learning disorders. The results showed that a period of physical activity and exercise leads to improved manipulative and locomotor skills in children with neuropsychological learning disability. These results it is compatible in line with the findings of Jokar et al. [23], Joseph [15], Swanson [16], Homayounia et al. [11], Kosari et al. [24]

Motor development specialists believe that introducing physical activity-based interventions maintains children's health. They are also effective in improving the motor and fundamental skills of children. Physical activity and movement have a positive influence on all cognitive, emotional, and psychomotor areas [1]. In the present research, introduction of a physical activity-based intervention showed a positive influence on improving the locomotor and manipulative skills in children with neuropsychological learning disorders.

In line with the results of the present research, Godoy and Branta [25] also observed the positive impact of a motor intervention using the Olrich test on improving locomotor and manipulative skills. Tahmasbi Boroujeni et al [18] also found that 12 sessions using a selected physical activity program using balls and rackets can improve the hand-eye coordination of dysgraphic children. Also, Homayouni et al [11] in a research entitled; 'investigating the impact of physical activity and perceptual motor skills on learning mathematical concepts in children with developmental neuropsychological learning disabilities', found that introducing 15 sessions of educational intervention including selected physical exercise as well as perceptual motor skills lead to improved learning of mathematical concepts in children with neuropsychological learning disabilities.

The effectiveness of physical activity-based interventions suggests the influence of rich and stimulant environmental experiences on various areas of motor development. In exercise interventions, three factors of facilities, equipment, and time should be considered. Also, it can be stated that when exercise interventions are coupled with proper developmental programs, they can influence different motor and physical development dimensions [1]. In the interventional approach considered in the present research, attempts were made to mainly focus on improving the locomotor and manipulative skills within the timeframe considered. Also, proper facilities and equipment had been considered in line with the age and height of the participants. All these can further justify the effectiveness of the physical activity intervention on improving manipulative and locomotor skills in children with neuropsychological learning disorders.

One of the main reasons for the effectiveness of the

selected physical activity program in the experimental groups can be its unique features; diverse programs, creation of game and fun, sense of cooperation and development of motivation in children, and having the opportunity of longer duration of exercise. Indeed, introduction of a selected physical activity program can be useful since parents are not able to provide it themselves and the school activities fail to achieve the desired outcome as they are not purposeful. By creating the opportunity for repetition and exercise and acquisition of experience in a purposeful and regular way within a specific timeframe, this program can allow children to enrich their motor experiences and achieve a greater motor development [24, 26].

The programs designed for this research were not only accompanied by games and fun, they also had a wide variety of activities in comparison to the previous session, thus making it more attractive to children, and they consequently participated in the programs with greater motivation. The results of this research are in line with the theory of dynamic systems as well as Newell constraints model, which states that in the development of fundamental and motor skills of children, in addition to the factor of inheritance, the type of task and interventions used in the environment are also very effective [4].

The Spark motor program, which was considered in the present research, was designed such that the participants should follow the predetermined patterns and points designed for improving fundamental skills, and they are encouraged to improve these skills through repetition and endeavor. Regular practice and repetition in a selected movement enabled the subjects to predict the subsequent movements. Therefore, following a proper rhythm in the motor patterns caused the child to do the subsequent movements with better efficiency.

One of the limitations of the present research was inadequate control on the level of sleep and food of the subjects as well as their psychological states during the course of the research. Furthermore, the previous experiences of participants in programs based on improving fundamental skills were not fully known to the researchers. Finally, another major limitation was that only males were employed in the present study, and as such generalization of the results should be done with caution. Thus, it is suggested that further research be conducted using female subjects and in other geographical regions.

Conclusion

Overall, a 12-session exercise program based on a selected physical activity can cause improved locomotor and manipulative skills in children with neuropsychological learning disorders. To conclude, it is recommended that parents, teachers and the related authorities who are involved with this group of society employ this exercise protocol to improve the fundamental locomotor and manipulative skills in children with a neuropsychological learning disorder.

Conflict of Interest: None declared.

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