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

Amir Dana1*, PhD; Efstathios Christodoulides2, PhD

1Department of Physical Education, Gonbad Kavoos Branch, Islamic Azad University, Gonbad Kavoos, Iran
2Lecturer in Sport and Exercise Science, University of Central Lancashire, Cyprus

ARTICLE INFO

Article History:
Received: 14/05/2019
Revised: 11/11/2019
Accepted: 16/12/2019

Keywords:
Motor skills
Locomotor
Manipulation
Physical activity
Learning disability

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.

2020© The Authors. Published by JRSR. All rights reserved.

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].
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 leg,*************** 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% (=n^2/0.001=sig 01/37= 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>
<thead>
<tr>
<th>Variable</th>
<th>Mean±SD Experimental Group</th>
<th>Mean±SD Control Group</th>
<th>F</th>
<th>t</th>
<th>sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>7.8±0.77</td>
<td>7.73±0.70</td>
<td>0.153</td>
<td>0.256</td>
<td>0.793</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>125.6±3.75</td>
<td>124.86±2.66</td>
<td>1.86</td>
<td>0.616</td>
<td>0.543</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>21.80±1.56</td>
<td>22.46±1.88</td>
<td>0.74</td>
<td>1.05</td>
<td>0.301</td>
</tr>
</tbody>
</table>
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 are 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.

Discussion

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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group</th>
<th>Pre-test</th>
<th>Post-test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locomotion</td>
<td>Experimental</td>
<td>0.96±0.54</td>
<td>1.76±0.53</td>
</tr>
<tr>
<td>Running</td>
<td>Control</td>
<td>1.23±0.53</td>
<td>1.26±0.59</td>
</tr>
<tr>
<td>Hopping</td>
<td>Experimental</td>
<td>1.53±0.44</td>
<td>1.80±0.41</td>
</tr>
<tr>
<td>Control</td>
<td>1.30±0.56</td>
<td>1.26±0.65</td>
<td></td>
</tr>
<tr>
<td>Long jump</td>
<td>Experimental</td>
<td>1.23±0.49</td>
<td>1.66±0.55</td>
</tr>
<tr>
<td>Control</td>
<td>1.13±0.48</td>
<td>1.13±0.48</td>
<td></td>
</tr>
<tr>
<td>Manipulation</td>
<td>Kicking</td>
<td>1.23±0.45</td>
<td>1.66±0.55</td>
</tr>
<tr>
<td>Control</td>
<td>1.20±0.41</td>
<td>1.13±0.48</td>
<td></td>
</tr>
<tr>
<td>Overhead throwing</td>
<td>Experimental</td>
<td>1.30±0.41</td>
<td>1.70±0.41</td>
</tr>
<tr>
<td>Control</td>
<td>1.13±0.48</td>
<td>1.23±0.45</td>
<td></td>
</tr>
<tr>
<td>Catching</td>
<td>Experimental</td>
<td>1.40±0.50</td>
<td>1.90±0.54</td>
</tr>
<tr>
<td>Control</td>
<td>1.16±0.49</td>
<td>1.23±0.59</td>
<td></td>
</tr>
</tbody>
</table>

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

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

References

1. Goodway JD, Ozmun JC GD. Understanding motor development:
2019.
3. Iivonen S, Sääkslahti A NK. The development of fundamental
motor skills of four-to-five-year-old preschool children and the
effects of a preschool physical education curriculum. Early Child
5. Safavi Homami. Sh, Ghazinoor. N AA. The Effects of a Training
Course with an Emphasis on Fine Motor Skills on Executive
Functions of Children with Learning Disorder. Mot Behav.
2010;
7. Marita S HC. Review of mathematics interventions for secondary
students with learning disabilities. Learn Disabl Quarterly.
practice with transgender and gender nonconforming people. Am
Psychol. 2015;16(70):832–64.
9. Jalilabkenar SS AM. The applications for teaching students with
learning disabilities (impairments in reading, writing and spelling.
10. Kirk S, Gallagher JJ, Coleman MR AN. Educating exceptional
11. Homayouni A, Homayounnia M, Abazari A AFZ. Physical
activities and perceptual motor ability effect on learning math
concepts in children with neuropsychological learning disabilities.
12. Giordà D, Toffalini E, Altò G CC. Intelligence measures as
diagnostic tools for children with specific learning disabilities.
skills and sports participation related in children with intellectual
14. Gholami A, Abani M, Ghasemi AGB et al., The Effect of Selected
Rainbow Parachute Games on Motor and Social Development of
15. Joseph J GH. Implications of Physical Education Programs
2013;24(3):219-228.
16. Swanson LH JO. The influence of sport on reading growth in
subgroups of children with reading disabilities. J Except Child
17. Fragala-Pinkham M, Haley SM OM. Group aquatic aerobic
18. Tahmasebi, B.S., M. Shadmehri AFP. The Effect of Selected
Physical Activity on Eye-hand Coordination of Students with
19. Abedi A, Kazemi F, Shooshhari M, Golshani Monazzah F. The
effect of aerobic exercises on the visual and auditory attention
of pre-school boys with ADHD in Isfahan in 2009-2010. Psychol
20. Bortnohn EE, Reichow B, Schnitz A, Smith IC SD. A systematic
review of sensory-based treatments for children with disabilities.
21. Zarezadeh M. Normalization and Determining the Reliability
and Validity of the Ulrich 2000 Exercise Test for 3-11 Years Old
22. Fu Y, Gao Z, Hannon JC, Burns RD BT. Effect of the SPARK
program on physical activity, cardiorespiratory endurance, and
23. Jokartangkarami s, Sheikh M BF. The Effect of a Period of
Selected Physical Activity on Improving Gross Motor Skills in
Children with Developmental Coordination Disorder (DCD). J
24. Kosari S, Keyhani F, Hamayyetalab R AA. Effect of a selected
physical activity program on the development of motor skills
