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Core Stabilization Training and Fundamental Motor Skills in Children

Robabeh Rostami,[1,*] and Meysam Ghaedi[1]

[1]Shiraz University, Shiraz, IR Iran

[*] *Corresponding author*: Robabeh Rostami, Shiraz University, Shiraz, IR Iran. Tel: +98-71136134625; Fax: +98-7116486441, E-mail: rostami@shirazu.ac.ir

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Abstract

Background: The right establishment of specialized and sports movements results from proper motor development in childhood.
Objectives: The current study aimed to evaluate the effect of a period of core stabilization training on the fundamental motor skills in children aged four to six.
Methods: From the kindergartens of Shiraz, Iran, 31 children aged four to six were selected using purposive sampling method, and randomly divided into two groups: 16 children in the control and 15 children in the core stabilization training groups. After implementation of the test of gross motor development-2 (TGMD-2) as pre-test, the experimental group performed core stabilization training for six weeks (four sessions per week) and overall for 24 sessions of 45 minutes; in the same period, the control group did the normal activities of kindergartens. When the experimental group had finished its training, both groups were evaluated again in the post-test stage by TGMD-2. It is a process-oriented test that measures the development of the fundamental motor skills of 3 - 10-year-old children in locomotor skills and object control categories and its results can be interpreted by both norm- and criterion-referenced methods. To describe the biographical characteristics of the participants, and the resultant data of the test, mean and standard deviation statistics were used and Kolmogorov-Smirnov test was employed to evaluate the normal distribution of data. At the level of statistical inference, univariate analysis of covariance was used. Data analysis was performed using SPSS statistical software, version 21. The significance level was $P \leq 0.5$.
Results: Regarding pre-test scores as covariate variable, the intervention of core stabilization training in locomotor skills and object control skills indicated a significant difference between the experimental and control groups ($P = 0.006$ and $P = 0.011$, respectively).
Conclusions: It was concluded that the core stabilization training can be used as a valuable intervention leading to the development of fundamental motor skills. Furthermore, such training has more effects on object control skills than locomotor skills.

Keywords: Core Stabilization, Fundamental Motor Skills, Children

1. Background

Changes in lifestyles and the invention of equipment, tools, and machines, and in short, paying less attention to movement and sports in today's mechanical life has doubled the expectations and commitments of physical education objectives. Therefore, physical education experts believe that by identifying and setting physical education objectives, a great favor is done to humanity since modern man needs movement and activity, especially at early ages. Inactivity and lack of movement stunt growth, and cause depression, abnormalities and loss of vitality and joy of life (1). Childhood, by including important periods of motor development, plays an important role in maintaining an active lifestyle. Fundamental motor skills, one of the important periods of children's motor development, are a basic prerequisite for more complex sport movements and daily activities. These activities fall into three main groups: stability skills, locomotion skills and object control skills (2). Fundamental skills are mastered during the growth period, especially early childhood; therefore, special attention should be paid to pre-school and school periods. Without considering this stage of skill development, individuals have problems in doing sport and daily activities (3). Developing these skills allows children to independently communicate with their environment (4, 5). Evidence suggests that fundamental skill development in childhood may play an important role in the prevention of physical activity in adulthood (6). An important point about the maturation of fundamental movements is that these skills are not merely age dependent, but they should be practiced. That is why providing educational opportunities and incentives are stressed to develop these skills during childhood.

Poor fundamental motor skills of individuals and lack of public attention to this important issue has seriously concerned physical activity and sport experts since fundamental motor skills such as running, jumping, throwing and hitting are the skills used in everyone's daily life, and they are basic requirements for man's survival. Complex skills of adulthood that lead to success in sports and professions are in fact the complex form of the fundamental motor skills that should be developed in childhood. In fact, the process of learning and motor development is a series

of successive chains linked together and continually follow each other to reach complex skills. The first chains are related to learning fundamental motor skills.

The term Core exercises is unfamiliar in the world of fitness and rehabilitation which is not properly understood yet (7). Core stability is a vital and essential component of performance. The purpose of the core is to create the necessary strength to access the existing motor task. Core stability and the performance of motor chain are necessary for the stability and functionality of all movements (8). The focus of studies such as those of Clark et al. (9), Piegaro Jr (10), Leetun et al. (11), Samson (12), Petrofsky et al. (13), Kahle (14) and Sarvestani et al. (15) were on the role that core stability exercises play to improve factors such as accomplishment, sports performance, injury prevention and balance in adults' communities. Core stability studies in Iran are limited to the studies by Bahmani et al. (16) and Habibian Dehkordi et al. (17) that did not consider the present research population.

2. Objectives

Thus, according to the importance of learning fundamental movements in people lives and its central role as one of the strongest predictors of future physical activities (18), also because of the importance of the core as a missing link in training programs (7) and due to the importance of pre-school age as a very important period in the development of motor behavior, the current study aimed to evaluate the effect of a period of core stability training on fundamental motor skills in children aged four to six.

3. Methods

Due to the nature and aims of the study, the experimental design was employed with pre-test post-test and the control group.

3.1. Population, Sample and Selected Methods

The statistical population of the study included all four to six-year-old children in the nursery schools and preschools of Shiraz, Iran, in the 2014 - 2015 academic year selected by purposive sampling method. Since this study was an impact assessment survey, 31 children aged four to six were selected and randomly divided into the control and experimental groups (16 children in the control group and 15 children in the core stabilization training group). The study process consisted of pre-test, core stabilization training and post-test. First, the children were evaluated in the pre-test stage using test of gross motor development 2 (TGMD-2). Then, they were randomly divided into control and experimental groups. The experimental group performed core stabilization training for 24 sessions of 45 minutes, and in the same period, the control group did the normal activities of the nursery school. It is noteworthy that the studies mentioned in the literature of the current study evaluated the effect of intervention program on fundamental motor skills; the number of training sessions was 18 to 36. As the US national research council in planning the intervention declares, in optimal conditions, intervention should be provided five days per week, but with regard to the nursey school schedule, this research was conducted for six weeks, four days per a week. After the training, both control and experimental groups were evaluated again in the post-test stage using TGMD-2.

3.2. Intervention

Experimental group conducted core stabilization training for six weeks, four times a week. Each session lasted for about 45 minutes. Core stabilization training protocol was based on the trainings proposed by Jeffreys (19) and consisted of three levels of training, beginning with level one and gradually developing to level three. Level one included static contractions in a stable condition. Level two included dynamic movements in a stable environment and level three trainings included dynamic movements in an unstable environment and gradually resistance movements were used in this environment. Swiss balls were used to create an unstable environment.

3.3. Tools and Methods of Data Collection

3.3.1. Personal Information Form

Subjects' demographic data including date of birth, weight and height were registered in the confidential forms with the assistance of the nursery school officials and the children's parents.

3.3.2. Test of Gross Motor Development 2

Test of gross motor development 2 (TGMD-2) was the data gathering tool for motor skill competency variable. TGMD-2 is a process-oriented test that measures the development of the fundamental motor skills of 3 - 10-year-old children in locomotor skills and object control categories, and its results can be interpreted in both norm- and criterion-referenced methods (20). This test, based on motor development measurement resources, is one of the most common tests of measurement in the field of physical education. The validity and reliability of this test is approved in Iran by Zarezadeh (2009). Based on her studies, internal consistency reliability coefficients for locomotor skills and object control scores and also for composite score were 0.87, 0.74 and 0.80, respectively. The range

of test-retest reliability coefficient was from 0.65 to 0.81 and the grading internal validity was more than 0.95. Construct validity was proved by factor analysis.

3.4. Statistical Method

To describe the demographic data of the participants and the resultant data of the test; the mean and standard deviation were used and Kolmogorov-Smirnov test was employed to evaluate the normal distribution of data. At the level of statistical inference, univariate analysis of covariance was used. Data analysis was performed using SPSS statistical software, version 21. The significance level was $\alpha \leq 0.05$.

4. Results

To quantitatively describe the demographic variables of the participants, the mean and standard deviation of height, weight and body mass index (BMI) relating to the subjects in the control and experimental groups were measured. The results are presented in Table 1.

As indicated in the above and the the means of movement and object control skills related to the control and experimental groups were almost equal in the pre-test stage, but after conducting intervention, the mean of experimental group increased both in terms of locomotor skills and object control skills are presented in Table 2 and Figure 1.

As shown in the following table, after controlling intervention variable, statistical test of covariance analysis with a significance level of ($P \leq 0.05$) was used (the pre-test scores of locomotor and object control skills were considered as covariance variable). The results of covariance analysis for control and experimental groups in the object control and locomotor motor are presented in Table 3.

Based on the results drawn from Table 3, by considering pre-test scores as covariate variable (query), the intervention of core stabilization training in object control and locomotor skills led to a significant difference between the control and experimental groups ($P \leq 0.05$). As indicated, the difference between the experimental group, with an average of 31.46 and the control group with an average of 27.87, in terms of performing locomotor skills ($F = 44.825$ and $P = 0.006$) was significant. Accordingly, it can be stated that core stabilization training improved the locomotor skills of four to six-year-old children in post-test stage. According to ETA separation factor, influence rate was 0.62 which means that 62% of post-test variance was due to the intervention of core stabilization training. In other words, 62% of the difference between the control and experimental groups in the post-test was due to applying independent variable. Furthermore, concerning object control skills, the difference between the experimental group, with an average of 29.00 and the control group with an average of 22.50, in terms of performing object control motor skills ($F = 132.729$ and $P = 0.011$) was significant. Accordingly, it can be stated that core stabilization training improved the object control skills of four to six-year-old children in the post-test stage. According to ETA separation factor, influence rate was 0.83 which means that 83% of the post-test variance was due to the intervention of core stabilization training. In other words, 83% of the difference between the control and experimental groups in the post-test was due to applying independent variable.

5. Discussion

Due to the reduction of physical activity and as a result the decline in the performance of special and fundamental motor skills, it seems necessary to perform motor interventions from childhood. Children's participation in various dynamic programs leads to the development of various movement schemata.

It also increases the capability of performing motor skills during life. Therefore, with regard to the issues raised above, the current study aimed to evaluate the effect of core stabilization training on the fundamental skills of four to six-year-old children. Based on the obtained results, core stabilization training improved object control and locomotor skills of the children. The results of the study were in line with the findings of Bahmani (16), Habibian Dehkordi (17), Shinkle et al. (21) Saeterbakken et al. (22) and Seiler et al. (23) which all had reported the improvement of motor function after the core stabilization training. Bahmani (16) examined the effects of a period of core stabilization training on the performance of locomotor and object control skills of 7 - 10-year-old male students with delay in fundamental motor skills development. His study results showed a significant improvement in performing fundamental skills in both subscales of locomotor and object control using TGMD-2.

On the other hand, the results of the current study were inconsistent with those of Schilling et al. (24). One reason for this inconsistency may be the limited number of subjects used in their research. Probably, small sample size (five subjects in each group) failed to fully show the effect of core stabilization training on performance. Although their subjects were untrained students, the important factor in the lack of significant improvement in performance scores, according to the researchers own beliefs, was small sample size and high-variability of the subjects. Another reason is using different criteria to measure the performance.

In terms of motor development, in the current study, the existing difference in the scores of gross motor test

Table 1. Mean and Standard Deviation of Height, Weight and Body Mass Index in the Study Groups[a]

Groups[b,c]	Number	Height, cm	Weight, kg	Body Mass Index
Group1	16	115.45 ± 4.79	20.01 ± 3.08	14.95 ± 1.61
Group2	15	116.63 ± 4.13	21.44 ± 3.74	15.71 ± 2.38

[a]Values are expressed as mean ± SD.
[b]Group 1, the intervention group; group 2, the control group.
[c]The mean and standard deviation of the subjects in both control and experimental groups in pre-test and posttest are presented.

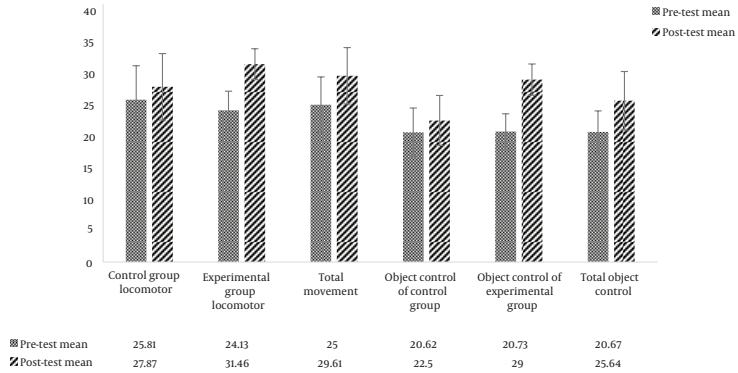

Figure 1. Scores of Pre-Test and Post-Test in the Control and Experimental Groups

Table 2. Mean and Standard Deviation of the Study groups by Pre-Test and Post-Test[a]

Statistical Index of Skill	Pre-Test	Post-Test
Control group locomotor	25.81 ± 5.40	27.87 ± 5.28
Experimental group locomotor	24.13 ± 3.02	31.46 ± 2.46
Total locomotor	25.00 ± 4.42	29.61 ± 4.47
Object control of the control group	20.62 ± 3.86	22.50 ± 3.98
Object control of the experimental group	20.73 ± 2.84	29.00 ± 2.50
Total object control	20.67 ± 3.35	25.64 ± 4.66

[a]Values are expressed as mean ± SD.

between the control and experimental groups may be explained with respect to dynamic systems perspective (25). Newell proposed that motor skills development takes place based on the interaction between task constraints, organism and environment. It means that fundamental motor skills emerge in a dynamic system that contains a certain task done by a learner with specific features in the environment. In this approach, known as dynamic systems, factors (subsystems) of an organism (inclusive) are among the factors that affect the development of motor skills. An increase in some of the organism factors such as maximum balance, maximum power, maximum strength and a more efficient power transfer by the core to upper and lower extremities as a result of core stabilization training can be an important factor in improving performance and performing the fundamental motor skills of those children that, in the current study, were under the intervention of core stabilization training.

In total, core stabilization training enhances the fundamental skills performance of the children with little expertise in these skills. Strength, stamina and a high coordination in the core may be considered as central factors to improve children's motor skills. However, the results of the current study require further research in terms of evaluating the effect of core stabilization training on performance. Future research should seek the best training methods to influence the motor function by examining various protocols of core stabilization.

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Table 3. Covariance Analysis of the Groups Regarding the Locomotor and Object Control Skills

Source of Change	F	Level of Significance	Standard Error	ETA Separation Factor
Covariance (locomotor)	66.598	0.008	0.094	0.71
Covariance (object control)	71.169	0.010	0.096	0.72
Group				
Locomotor	44.825	0.006	0.278	0.62
Object control	132.729	0.011	0.354	0.83

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