



## The Effect of Core Stability Training on Fundamental Motor Skills in Over-weight and Obese Girls



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### ABSTRACT

**Background:** Childhood is the most important stage in development, and overweight and obesity during this period can affect the development of fundamental motor skills that are the basis of more complex sports skills and performances. The purpose of the present research is to investigate the effect of core stability training on fundamental motor skills on over-weight and obese girls. **Methods:** This research is of quasi-experimental type. After school selection randomly and after initial screening, 30 girl's student of 7 years (15 in the experimental group and 15 in the control group) were selected who were in the obese and overweight categories based on body mass index. Students' Object Control and locomotor skills in pre-test and post-test were assessed using Gross Motor Development Test 2 (TGMD2). The method of the present study was experimental and its design was pretest-posttest with a control group. **Results:** One-way analysis of covariance showed that core stability exercises can improve the fundamental motor skills of overweight and obese students. **Conclusions:** According to the findings of this study, by designing and implementing core stability exercises in primary schools, it is possible to help improve the fundamental motor skills (locomotor and ball skills) of children, especially children with motor deficits due to overweight and obesity.

### 1. Introduction

In recent years, the epidemic of obesity and overweight in children and adolescents has been one of the major health problems in developed and developing countries. According to international definitions, at least 10% of children worldwide are obese or overweight (Han, Fu, Cogley, & Sanders, 2018). In general, it can be said that the source of this great problem of the century dates back to childhood. In addition, research shows an increasing prevalence of obesity and overweight among children (Daniels, 2006; Organization, 2000). This increase is dangerous because obesity causes physical and mental illness that continues into adulthood (Bryant, Duncan, & Birch, 2014). Research shows that overweight and obesity have a negative effect on children's ability to perform fundamental motor skills (Hayes, Balantekin, Epstein, & Wilfley, 2019). Also, overweight children with lower levels of fundamental motor skills have less participation in physical activity (Zhang, Gu, Zhang, Caçola, & Wang, 2020). Childhood is the most important stage in development and overweight or obesity during this period can affect a child's motor development (Wick et al., 2017).

Fundamental motor skills have been discussed by researchers as a very important stage of a child's motor development. Among these skills, three categories of stability, manipulation and locomotor can

be mentioned. These skills are gradually refined and combined to be used in daily life, recreational and sports activities (Hulteen, Morgan, Barnett, Stodden, & Lubans, 2018). The development of these skills depends not only on maturation and age but also the environment is another factor that plays a key role in the development of such skills (Butterfield, Lehnhard, & Coladarci, 2002). Fundamental motor skills are enhanced if the learning environment is rich and there are opportunities for motor experiences (Robinson & Goodway, 2009). An important point from the perspective of experts, in addition to improving these skills, is to study the factors affecting their growth (Apache, 2005) factors such as age and gender, body composition, the three main factors of training opportunity (facilities, equipment and time to engage in activity) and enrichment of motor experiences (use of intervention programs) (Fisher et al., 2005). Yu et al (2016) examined the duration of activity in the group of children with developmental delays as well as healthy children. Among the factors affecting the development of fundamental motor skills, providing an appropriate training program can be considered the most important factor in the development of basic skills (Yu et al., 2016). Much research has been done in this field, and according to the results, various educational programs have been proposed for the development of these skills in childhood, the main purpose of all of which is to acquire and refine fundamental motor skills (Webster, Martin, & Staiano, 2019). Goodoy & Branta (2003) evaluated the effect of motor skills interventions on fundamental motor skills and evaluated

the effect of interventions positively. Fundamental movement patterns are also refined with practice and integrated with more complex movement sequences, such as the skills required in special games and sports (Goodway & Branta, 2003). In recent years, the core area of the body and exercises related to strengthening and stabilizing this area, have found many enthusiasts in various fields. The lumbar-pelvic-thigh area, along with the surrounding muscles, is referred to as the central area of the body, and given the anatomical position of the center of gravity in this area and the resulting human movements, the stability of this area is very important (Alsakhawi & Elshafey, 2019), and is a necessary and vital component of performance. Activation of the various parts of the body that surround the motor chain produces function. For optimal motion chain performance, it is the center that must position the lower parts in optimal position, timing and speed. In order to do this, strength and balance must be used. The goal of the central area of the body is to create the necessary strength to achieve the desired motor task. Core stability and movement chain performance are essential for the stability and performance of all movements (Cabanas-Valdés et al., 2016). Providing appropriate training and exercise programs to enrich the environment can be considered the most important factor in the development of basic skills. Since the pre-school and school years are the most important period in the development of basic movements, the rich environment in this period can play a significant role in reaching the level of proficic (Szafraniec, Barañska, & Kuczyński, 2018). In this regard, (Rostami, Habibian Dehkordi, & Chardah Cherik, 2016) studied the effects of core stability training on children's fundamental motor skills. The results of their study indicated the improvement of these exercises on the desired skills (Rostami, Habibian Dehkordi, & Chardah Cherik, 2016). Sajedi, Parsai, Biglari & Sattarzade (2022) studied the permanent effects of core stability exercises on static and dynamic balance of blind children. In their study on 30 boys and girls with an average age of 9 years, they examined the effect of the exercise program on balance tests. The result of the study indicated that core stability exercises have an immediate effect on improving static and dynamic balance performance. Also, after two months without training, significant and lasting positive effects were obtained on static and dynamic balance score (Sajedi, Parsaie, Biglari, & Sattarzade, 2022).

Although previous studies have supported the idea that obesity and overweight can affect children's fundamental motor skills, but no effort has been made to improve these skills with regard to core stability exercises. Given the interrelationship between fundamental motor skills and participation in physical activity, improving these skills in these children is likely to increase their participation in physical activity. Therefore, the purpose of the present research was to investigate the effect of core stability training on fundamental motor skills on over-weight and obese girls.

## **2. Materials and Methods**

### *2.1. Subjects*

From all girls' students in the first grade of primary school in the second district of Shiraz at 2017, 30 girls were selected. For this purpose, after determining the school and during the initial screening of students' height and weight, 30 students who were classified as obese and overweight based on the body mass index of the standard reference curves of the Center for Disease Control and Prevention, were selected. The overweight group means that their body mass index is between 0/85 and 0/95 percent based on the standard body mass index curves for age and gender according to the Center for Disease Prevention and Control, and the obese group means girls whose body mass index is higher than 0/95 be a percentage.

### *2.2. Apparatus and Task*

The gross motor development test with the abbreviation TGMD-2 will be the tool for collecting the motor skill competence variable of this study. TGMD-2 is a process-oriented test that measures the development of fundamental motor skills of children aged 3 to 11 years, and its results can be interpreted in two normative and standard ways. This test consists of two parts and each part includes six basic movement skills. Locomotor skills include run, gallop, hop, leap, horizontal jump, slide and object control skills include: striking a stationary ball, stationary dribble, kick, catch, overhand throw and underhand roll. The validity and reliability of this test has been confirmed by Zare-Zadeh (2009) inside the country. Based on his study, the similarity reliability coefficient for object handling and control score as well as composite score was reported as 0.87, 0.74 and 0.80 respectively. The range of the test-retest reliability coefficient is from 0.65 to 0.81 and the internal reliability of the scorer is above 0.95, and the construct validity has been confirmed through factor analysis (Zare-Zadeh, 2009)

### *2.3. Procedure*

The method of the present study was quiz- experimental with pre-test-post-test design; in which the effect of the independent variable (core stability t) on the dependent variable in which Object Control and locomotor skills of overweight and obese children were examined. Both groups were evaluated in the pre-test stage through gross motor skill test 2. The experimental group did core stability training during 24 sessions of 45 minutes. After completing the training period, the groups were re-evaluated with the TGMD-2 test in the post-test phase.

Necessary permits were obtained from the university and the Department of Education to conduct the research. Subjects, school management and their families also agreed to have students participate in the study.

**Table 1.**  
Core stability training program

Weeks	Type of Activity	Period of time
First	Abdominal contraction and trunk maintenance activity in supine position.	3 rounds and each 8 to 10 seconds
	Abdominal contraction and trunk maintenance activity in prone position.	
Second	Lying in supine position and moving the legs parallel.	3 rounds and each 8 to 10 seconds
	Contraction of the trunk in the supine and prone in a static position.	
	Contraction of the trunk in the form of an arch and palmar in a dynamic position. Bridge to the side.	
Third	Bridging the stomach with the support of the knees.	3 rounds and each 8 to 10 seconds
	A two-person game with fixed hand pressure.	
	Spinning the ball up and down and sideways.	
Forth	Getting into a squatting position with one leg open.	3 rounds and each 8 to 10 seconds
	Launch movement in an inclined path with an angle of 45 degrees to the left and right.	
	Double squat movements.	
Fifth	Lying down on the Swiss ball.	3 rounds and each 8 to 10 seconds
	The upward movement along with raising one leg is similar to the cart game.	
Sixth	Bridging so that the feet are on the Swiss ball.	3 rounds and each 8 to 10 seconds
	Bridging with the help of hands along with raising one leg. Pushing the plates game.	

#### 2.4. Data analysis

After checking the normality distribution of the data by the ShapiroWilk test, in order to analyze them the Levene's test was used for the assumption of equality of variances. By observing the normality distribution of the data, Covariance analysis was used. Data analysis was done with SPSS version 26 software at a significance level of  $p \leq 0.05$ .

### 3. Results

To eliminate the effect of possible differences in the pre-test, one-way analysis of covariance was used. The mean scores and standard deviation of object control skills in the control and experimental groups were  $12.8 \pm 1.9$  and  $10.13 \pm 1.77$  respectively.

As it can be deduced from table 2, the difference between the experimental group with an average of (12.80) and the control group with an average of (10.13) in terms of the implementation of motor skill of object control with  $F=371.23$  and ( $P \leq 0.05$ ) is significant. Based on this, it can be said that 8 weeks of core stability training has improved the movement skill of object control in overweight/obese girls in the post-test phase.

As can be deduced from Table 3, the difference between the experimental group with an average of (13.40) and the control group with an average of (10.80), in terms of the implementation of movement skills with  $F=504.061$  and ( $P \leq 0.05$ ) is significant. Based on this, it can be said that 6 weeks of core stability training has improved the movement skills of overweight/obese girls in the post-test phase.

**Table 2.**  
Findings of one-way analysis of covariance in object control skills of overweight / obese girls

Source of Change	Sum of Squares	Df	Mean of Squares	F	Sig	Partial Eta Squared
<b>Covariate variable</b>	84.84	1	84.84	246.47	0.0001	0.90
<b>Group</b>	127.78	1	127.78	371.23	*0.0001	0.93
<b>Error</b>	9.29	27	9.29	-	-	-
<b>total</b>	4092.00	30	-	-	-	-

Table 3.

*Findings of one-way analysis of covariance in locomotor skills of overweight / obese girls*

Source of Change	Sum of Squares	Df	Mean of Squares	F	Sig	Partial Eta Squared
<b>Covariate variable</b>	35.46	1	35.46	211.00	0.0001	0.89
<b>Group</b>	84.72	1	84.72	504.06	0.0001*	0.95
<b>Error</b>	4.54	27	0.17	-	-	-
<b>Total</b>	4483.00	30	-	-	-	-

#### 4. Discussion and Conclusion

The aim of this study was to compare the effect of core stability training on fundamental motor skills (Object Control and locomotor skills) of girls who were overweight and obese, respectively. The results of the present study show that 18 sessions of core stability training program can be considered as a useful way to improve movement and object control skills of overweight and obese girls. The results of this study regarding the effect of exercise on fundamental motor skills in obese children were similar to the study (Murano et al., 2014) who reported the improvement of fundamental motor skills of overweight and obese children after exercise. Murano et al. examined an eight-month multi-component exercise program focusing on health-related physical activity, exercise training, and behavioral changes in 41 obese children with a BMI greater than 95%. Health-related physical activities included basic motor skills, muscle strength, power, aerobic fitness, speed, and flexibility, and the exercise program was practiced by increasing the volume of activities. Behavioral changes were made by encouraging children to work outside of the research program. Body composition was assessed by measuring body mass index, fundamental motor skills were assessed by the Ulrich-2 test, and a person's perception of their physical abilities was assessed by the Children's Physical Ability Scale. The results showed a significant difference in body composition, level of physical fitness, fundamental motor skills and perceived competence in overweight and obese children (Morano et al., 2014).

More specifically, the results of the study regarding the effects of core stability exercises on the fundamental motor skills of children were similar to the studies of (Ghaedy, Rostami, Chahardah Cherik, & Khoshbakht, 2021; Rostami et al., 2016). Rostami et al., (2016) investigated the effect and short-term a core stability training on static and dynamic balance of children with delayed balance development. In this study, 30 boys with an average age of 8.5 years out of 162 students were placed in two control and experimental groups according to the results of the BOT2 test. For 8 weeks, the control group participated in regular physical education programs, and the experimental group participated in core stability exercises designed for 4-6 children. Subjects performed Romberg's static balance test and Y dynamic balance test in pre and posttests. The results indicated that core stability exercises have significant effects on children's balance scores. The researchers suggested that this type of exercise program should be included in children's movement activities. Ghayedi et al (2021) investigated the comparison of the effect of one period of selected practice and core stability on the object control skills of children aged 4 to 6 years. 45 children were placed in three groups (control, central stability and object control) and they were tested for object control skills from the Ulrich II test series. The results indicated that selected exercises and core stability both lead to the improvement of object control skills in children aged 4 to 6 years. In comparing the effect of selected exercises with central stability, the results indicated the

superiority of specially selected exercises over core stability exercises on improving object control skills. These results lead to the conclusion that it is better to consider the characteristics of the exercises in the early stages of the exercises, because the characteristics of the exercises are more influential on the process of performing basic motor skills (Ghaedy et al., 2021; Rostami et al., 2016).

Butcher, Handrigan, Mackrous, & Hue (2015) & Steinberg et al (2013) in their research showed that the control of height and balance of overweight and obese children is lower than their normal weight counterparts. Since posture control is generally considered a prerequisite for the development of motor skills, imbalance is likely to lead to delayed motor development (Boucher, Handrigan, Mackrous, & Hue, 2015; Steinberg et al., 2013). Carmeli, Zinger-Vaknin, Morad & Merrick (2005), it is likely that one of the reasons for the significant effect of core stability training on fundamental motor skills of overweight and obese girls, increasing height control and balance of these children as a result of core stability training. As to how core stability exercises can affect balance and height control, it should be explained that contraction of the central region muscles before limb movement is a postural prediction reaction of the central nervous system that prevents postural differences and plays a role in organizing dynamic balance (Carmeli, Zinger-Vaknin, Morad, & Merrick, 2005). Therefore, the core stability training program leads to improved activity prediction and thus reduces the disturbance in the displacement and fluctuation of the center of gravity (Panjabi, 1992). Core stability exercises also increase strength, endurance and nerve control in this area, and through these exercises, control of the inner part of the spine, internal control of the abdomen and muscular control of trunk movements can be improved and the body's ability to maintain balance in different movements can be improved (28). Although the children's body mass index did not change at the end of the exercises, but the development of motivation and self-concept of the child and improving their attitude towards physical activity can be considered as another reason for the significant effect of exercise. Self-concept and body image is a kind of mental attitude that each person has towards the appearance and dimensions of his body and his motor and physical abilities. Overweight and obese children have less physical self-concept than normal weight children and it can be said that obesity is one of the factors that is effective in negative self-assessment of these people (Marsh, Hau, Sung, & Yu, 2007). From this perspective, it is not surprising that the findings of this study improved in almost all post-test study variables. Therefore, encouraging and increasing the self-confidence of overweight and obese children by engaging in fun physical activities may benefit the development of basic motor skills. From the point of view of motor development, the difference in gross motor test scores in this study between the control and experimental groups may be explained by the perspective of

dynamic systems. (Newell,1986) suggested that the development of motor skills occurs based on the interaction between task constraints, organism, and environment. That is, fundamental motor skills emerge within a dynamic system, which includes a specific task, which is performed by a learner with specific characteristics and in a specific environment. In this approach known as dynamic systems, factors within the organism (pervasive) are among the factors that will affect the development of motor skills (Newell, 1986). Increasing some within the organism factors such as maximal balance, maximal power, and more efficient transfer of force from the central body to the upper and lower limbs as a result of core stability exercises may be an important factor in improving performance and performance of children's fundamental motor skills. Considering the above and confirming the effect of the exercise program and the results obtained in this study, it can be concluded that core stability exercises due to increased height control and balance as well as creating favorable conditions for self-concept development and motivation of obese and overweight children, can be used to develop the fundamental motor skills of these children. In addition, performing the mentioned exercises in the form of games may have led to the improvement of children's basic movement skills. This study was performed only on girl's subjects, so in subsequent studies it should be performed on boy's subjects and for longer periods. In addition to examining the effect of core stability exercises on motor skills, the effect of this type of exercise on weight changes should also be considered by researchers.

According to the results of this study, we can point to the effect of the environment on the development of fundamental motor skills of children, especially overweight and obese children, and this result can be explained based on the perspective of dynamic systems. Overall, the Central Stability Exercise Program can improve movement skills and object control in children with motor disabilities. Also, due to the significant effect that the central stability training program has on the fundamental motor skills of overweight and obese children, this method can be considered as part of educational methods and teachers and educators, in addition to other educational methods, also teach this method to children.

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#### Conflict of Interests

The authors have no conflict of interests.

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