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The Effectiveness of Functional Training on Agility and Body Mass Index of Females with Intellectual Disability

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Abstract: *The aim of this study was to determine the effectiveness of functional training (FT) on agility and body mass index (BMI) of females with intellectual disability. The research method was pretest- posttest- with a control group. The statistical population consisted of all females students with ID in elementary school of Shiraz studying under the auspices of the Special Education Organization in 2018-2019. The participants included 30 females students with ID selected through convenience sampling and randomly assigned to the experimental (n = 15) and control (n = 15) groups. The experimental group received the functional training for 15 sessions, while the control group did not receive any intervention. The T test was used to assess agility and the height and weight of the subjects were measured first and their BMI was calculated using the formula "* $mass(kg)/(height\ (m))^2$*. The collected data were analysed using ANCOVA. The results showed that FT had a significant effect on Agility females students with ID (p<0.05) but FT had not a significant effect on BMI of females students with ID (p<0.05). Therefore, Deciding on the effectiveness of FT on agility and BMI in people with ID requires further research.*

Keyword*: Functional Training, Agility, Body Mass Index, Females, Intellectual Disability*

I. Introduction

Intellectual Disability (ID) is associated with decreased motor activity that manifests itself as impaired motor coordination, limited motor accuracy, and difficulty learning new activities (1). People with ID are usually sedentary or have minimal mobility (2). These people have limited experience in physical activity (3). They have a lower level of motor skills than their typically developing peers (4). In general, people with ID are more sedentary than people without disability. This sedentary lifestyle, which results from poor physical fitness, can lead to countless health problems such as obesity, high blood pressure, coronary heart disease, osteoporosis, diabetes and premature death (5).

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Two of the most important factors effecting physical activity are agility and body mass index (BMI) (6, 7, 8). Agility is defined as the ability to change direction quickly and maintain balance without losing speed (9). In fact, agility is the ability to change direction effectively, which requires the integration of skill movements such as speed, balance, strength, and reaction time, and represents the ability of people to react to their surroundings (10).

BMI is one of the body measurement indicators whose main purpose is to discover the relationship between overweight and various diseases and due to the simplicity of measurement and calculation, it is used in research on obesity (11). This index is calculated in different ways, but it is mostly measured in terms of weight to height ratio in kilograms per square meter (12, 13). The World Health Organization (WHO) has proposed BMI as a criterion for weight classification that has been accepted internationally. BMI is a good criterion for evaluating body composition (11).

One of the functional problems of children with ID that continues into adulthood is slow movement (4). Speed is important in agility (9, 10). Also, most researchers believe that people with ID are more likely to be overweight and obese than their typically developing peers due to their high level of inactivity (6, 14, 15, 16). People with ID make up about 3% of the world's population and obesity exacerbates their limitations. As a result, they are not given the opportunity to participate in society (17). About the BMI it can be said that People with ID at any age are more prone to obesity and overweight than typically developing people (18). Their physical health may be affected by increased risk of high blood pressure and sedentary lifestyle (2). Some people with ID are at risk of obesity due to a genetic disorder, low mobility, or unhealthy eating habits or the use of drugs that effect their health (19, 20). Evidence shows that high BMI has a negative effect on motor function and physical fitness of people with ID (6, 21). Overweight and obesity lead to decreased motor function (19). Rimmer and Yamaki noted that being overweight exacerbates many secondary medical conditions, such as chronic pain, social isolation, depression, and fatigue, in children and adolescents with ID (18).

One of the effective intervention measures in improving agility and BMI is exercise and physical fitness. Physical fitness in most definitions includes the following components: Body composition, cardiorespiratory capacity, muscle strength and endurance, balance and flexibility. These components are essential for independent living and the development of functional skills (22). Studies have shown that by creating a suitable and rich environment and using physical exercises, you can provide the opportunity for normal and independent living for people with ID (23). Azmi and Kusnanik concluded that speed and agility training program can improve the speed, agility and acceleration of football players (24). Vurmaz and Bingul also reported a positive effect of physical activity on agility (25). jump rope improve students' agility (26). The results of Bhutkar et al. showed the positive effect of exercise on the BMI (27). The results of Smits-Engelsman, Jelsma and Ferguson showed the positive effect of exercise on agility (28). A study by Seron, Silva and Greguol found that 12 weeks of aerobic exercise significantly reduced BMI and waist circumference. They concluded that exercise prevented the increase in body fat in people with ID (29). Combined exercise training has a positive effect on indices of obesity, physical fitness and lipid profile in adolescents with ID (30).

One of the new sports approaches to improving agility and BMI is FT. The goal of FT is fitness and increased ability to perform daily activities. These exercises should be considered as general movements, not just one muscle. For example, when someone jumps, he/ she doesn't just use her leg muscles, rather it is the result of a collective effort between the nervous, cardiovascular, respiratory and musculoskeletal systems which allows the person to have a smooth movement (31). In FT, instead of practicing on the effective factors separately, the emphasis is on performing multi-joint, muscular and multiple activities (32). FT are a challenge for the sense of movement, movement control, and the central nervous system. During these exercises, the nervous system learns to control the whole movement and can have the best planning in performing the movements (33). FT puts less pressure on the muscles, no muscle is damaged or degraded, all the muscles in the body are coordinated and that's the basis of physical activity. These exercises focus on stabilizing the body. If an exercise can be performed without pain and discomfort and in the right form with the right movements and improve the quality of movement from one week to the next; It is a practical and effective exercise (31). FT are based on the four pillars of movement, level change, pushing and pulling and rotating. These four pillars describe the body's biomechanical function (33). Research has shown that functional exercise has significantly improved the physical health of children and adolescents (34). In the study presented by Bozdogan and Kizilet, it is observed that plyometric exercises improve jumping and agility (35).

On the one hand, people with ID have problems in physical fitness factors such as agility and BMI (1, 2, 17, 18, 21, 36). Overweight and agility problems in these people lead to a lack of participation in social activities and isolation (37), injury, chronic pain and fatigue and depression (18) and reduced motor function and reduced quality of life (12). On the other hand, exercise and physical activity, especially FT , have a positive effect on agility and BMI (18, 27, 28, 29). Despite the positive effects of FT on agility and BMI, according to studies, no research has been found on the effect of FT on agility and BMI in people with ID. Due to the low cultural and economic wealth of most children's families with ID and their inability to use costly educational and therapeutic methods such as medical, paramedical and psychological services, such research can help these families. In this regard, it is necessary to study the effect of FT as a simple educational and treatment method without side effects. This study introduces a method available to teachers, parents and educators to create and improve various skills in children with ID. Therefore, the aim of this study was to investigate the effectiveness of FT on agility and BMI in females with ID, which was performed in response to the following question:

Does FT have a significant impact on the agility of females students with ID?

Does FT have a significant impact on the BMI of females students with ID?

II. Materials and Methods

Population, sample, and sampling method

The research method was experimental with pre-test and post-test with control group. The statistical population consisted of all females students with ID in elementary school of Shiraz studying under the auspices of the Special Education Organization in 2018-2019. The participants included 30 females students with ID selected through convenience sampling and randomly assigned to the experimental (n = 15) and control (n = 15) groups. Both groups

had pre-test of agility and BMI before the intervention program. After the intervention program, both groups had post-test of agility and BMI.

Procedure for FT

FT were implemented in 15 sessions. Each session lasted from 45 to 60 minutes. These programs were run for five weeks and three sessions per week. Each exercise was repeated 3 set and 12 to 15 times per session. The movements were performed by the instructor and the children observed and performed it. The exercises are based on FT and include:

1) Squat overhead: Participants placed their hands above the head and held the ball with two hands. While the legs are open, be in squat mode and knees bent 90 degrees. Then stand with your hands in the same position.

2) Russian twist with ball: Sitting on the ground, knees bent, Legs together and slightly above ground level, Put the hands in front with a ball in hand, rotate the upper back straight without lowering the legs or bending and after a second pause, turn left and continue moving.

3) Lange: While holding two balls in the palm of their hand, they put one foot ahead of the other, bend one of the knees and they try to keep the pelvic girdle fixed. After the eight sets are over, they change their legs and continue with the other foot.

4) Landing on one leg from box: jumps down from the box with one foot and repeats again.

5) *Wall push up*: This modified Swedish type of Push up is the most comfortable type of Push up and is very convenient to start. The examiner stands in front of the wall, Hands on the wall and bends forward and returns to the first position.

6) Rotary Stability: The individual assumes the starting position in quadruped with their shoulders and hips at 90 degrees relative to the torso. The opposite elbow and knee touch each other in front of the abdomen, and then each moves upward on its side until it is fully extended.. The torso should, elbow, hand, and knee that are lifted should all remain in line with the middle sagittal plane of the body.

Instruments

Agility

The T test was used to assess agility. The subject begins the test by standing behind the starting line. The subject moves 10 yards straight forward and touches the tip of the cone with her right hand. Then the 5 yards go to the left and touch the tip of the cone with the left hand. Then, by changing the direction, 10 yards go to the right and touch the tip of the cone. Then goes 5 yards to the left and touches the tip of the cone. At the end, 10 yards running backwards and reach the starting point. Each participant tried 3 times and their best time (minimum time) was recorded as data. Three- to five-minute rest intervals were taken between trials to allow for full recovery (8, 38). The best of three maximal effort trials was used for analyses.

BMI

To evaluate the BMI, the height and weight of the subjects were measured first. The height is the distance between the soles of the feet and the top of the head in a standard position. The height of the subjects was measured by meters, the subjects were without shoes, and the heels, head areas, the shoulder, and back area were tangential with the wall. Their weight was measured with the least acceptable clothing, with a digital scale. Their BMI was calculated using the formula " $mass(kg)/(height\ (m))^2$".

Ethical Considerations

Parents gave consent for participation of their children in this study. The parents were aware of the purpose of the study and their children had the right to leave the study at any time. They were assured that all their information would remain confidential. The ethical review board of the regional Special Education Organization approved the study.

III. Results

Table 1 shows the mean values for agility and BMI for the experimental and control groups.

Table 1.

Mean and standard deviation of agility and BMI in the experimental, and control group

		Descriptive statistics	
		Pre-test	Post-test
	Groups	M (SD)	M (SD)
Agility	Experimental	17.60 (5.73)	14.27 (5.35)
	Control		
BMI	Experimental	18.00 (4.28)	17.93 (4.04)
	Control		
		22.98 (4.71)	22.67 (4.47)
		23.94 (3.74)	23.89 (3.74)

To determine whether changes in the mean values were statistically significant or not, analysis of covariance (ANCOVA) was run. It is worth noting that regression homogeneity and homogeneity of variance were investigated prior to the ANCOVA. The results showed that the use of ANCOVA test is possible. The results of an ANCOVA are presented in table 2 and 3.

Table 2.

Analysis of Covariance Results for Agility in Experimental Group and Control Group

Changes	Sum of squares	Degrees of freedom	M of sum of squared	F	significance level	Etta coefficient
Pre-test	618.959	1	618.959	309.625	0.01	0.920
Group	85.864	1	85.864	42.952	0.01	0.614
Error	53.975	27	1.999			
Total	9141	30				

According to the table 2, the difference between the students' performance in the experimental and control groups was statistically significant in the post-test of agility ($F=42.952$, $P<0.01$). The difference between the scores of the two groups of students indicated that the FT program had an effect on agility and the effect was 0.614.

Table 3.

Analysis of Covariance Results for BMI in Experimental Group and Control Group

Changes	Sum of squares	Degrees of freedom	M of sum of squared	F	significance level	Etta coefficient
Pre-test	469.986	1	469.986	2239.959	0.01	0.998
Group	0.593	1	0.593	2.826	0.10	0.095
Error	5.665	27	0.210			
Total	16740.910	30				

According to the table 3, the difference between the students' performance in the experimental and control groups was not statistically significant in the post-test of BMI ($F=2.826$, $P>0.05$). The difference between the scores of the two groups of students indicated that the FT program had not an effect on BMI.

IV. Discussion

The aim of the present study was to investigate the effectiveness of FT on agility and BMI in females with ID. The findings showed that FT has a positive effect on agility of females with ID and improves it. In other words, it reduces time during the T-test, but has not had a significant effect on BMI.

In relation to agility, the results of this study are indirectly consistent with the research of Sarika and Shenoy (39), Kang et al. (7), and Smith et al (27). The results of Sarika and Shenoy showed that plyometric exercises such as squats and box jumping have a positive effect on the agility of football players. These exercises were performed for 6 weeks and three days each week. They found that plyometric exercise increased speed and agility (39). In the study of Kang et al. game was designed according to the level of physical activity of students and the results showed that

exercise improved agility in students with ID (7). Smith et al. examined the effect of exercise programs on agility in children 6 to 10 years of age with and without motor coordination disorder. These activities were performed twice a week for a period of 5 weeks and improved children's agility (27). Research by Yilmaz et al. showed that 10 weeks (twice a week) of water exercise improves endurance, speed, agility and balance in children with ID (40).

Agility training requires strengthening the muscles involved in stabilizing the body and joints of the lower limbs. The mechanism of action of FT on agility is similar to the effect of plyometric exercises. and landing skills to beginner plyometric training is a program that first teaches jumping athletes (30). Jumping from the box in this study is a plyometric exercise. Among the mechanisms of FT, first mention nervous adaptation. This nervous adaptation usually happens when there is a coordination between the "central nervous system" signal. Second, this adaptation can be through the simultaneous recall of motor neurons or the better facilitation of nerve impulses to the spinal cord. In other words, improving neuromuscular coordination and recalling the nerve fibers that occur as a result of FT improves strength in the legs. It reduces the time it takes for feet to touch the ground and when doing agility activity and changing directions, it improves movement (39) Plyometric exercises enhance movement through neural and muscular ventilation, neural adaptation of muscle spindles, and joint continuity (41).

FT require stopping, starting, and changing direction during an explosive maneuver and all of these components are involved in agility (33), So they help improve agility. Research shows that plyometric exercises improve agility by increasing neuromuscular coordination, increasing the nervous adaptation of muscle spindles, golgi tendon organ, and deep joint sensation (42). The most important element of movement is rotation. A lot of physical activity in sports is explosive and involves the transverse plane (the motion plane in which rotational motions occur). Rotational exercises improve oscillations, change direction and generate rotational energy. Rotation is one of the most important motor skills and has a prominent role in all sports (33).

Azmi and Kusnanik Concluded that optimal physical condition and health play an important role in improving and developing speed, agility and acceleration (24). FT strengthen the muscles by simultaneously using different muscles in the upper and lower torso and strengthening them. These exercises emphasize a healthy lifestyle and they follow the principles of movement that can help improve the health of the body (31). Because the FT improves of the lower limbs and lower body strength, reduces foot contact time with ground and increases orientation speed (33). Agility requires rapid development of high strength and power, as well as the ability to make optimal use of the traction cycle in ballistic movements (43). FT and plyometric exercises develop strength and power (44). Power plays an important role in agility. In agility development, the increase in force to move the body faster is directly related to strength multi-purpose exercises such as squats, lunges and explosive plyometric exercises can improve strength (45). Therefore, it can be concluded that FT improve agility in children with ID.

The research findings also showed that FT did not have a significant effect on BMI in females with ID. Probably 5 weeks of exercise is not enough to lose weight and more time is needed. The results are inconsistent with those of Hinckson et al. (46), and Butkar et al. (27), and with the results, Ghasemi et al. (47), and González-Agüero et al. (48) are indirectly aligned. Hinkson et al. studied 24 weeks of exercise with nutritional control on fitness factors, eating habits and health of children and adolescents with ID with overweight and obesity in New Zealand. They

concluded that obesity and overweight could be controlled in these people through exercise and proper nutrition (46). Butkar et al. reported a positive effect of exercise on BMI. They exercised for 24 weeks, and 6 days each week. In the end, the BMI showed a significant decrease (27).

Ghasemi et al. examined the effect of rebound training on BMI for 8 weeks and the results did not show a significant effect. Combining exercise and proper diet can provide a supportive and preventative solution for people with ID, so that they can lead a healthy life by controlling their weight and eating a healthy diet and encouraging more physical activity (47). González-Agüero et al. conducted a study on young people with Down syndrome. Subjects performed a 21-week polymetric jump training program. The results showed that plyometric jumping exercises were an effective way to decreasing weight in young people with Down syndrome (48). A study by Seron, Silva and Greguol found that 12 weeks of aerobic exercise significantly reduced BMI and waist circumference, while the percentage of fat in non-participants increased (29). In a 2010 study, Wu et al. examined physical activity in adolescents with ID for 6 months. The results showed a significant decrease in weight and BMI of individuals with ID (49).

Probably the short duration of the exercises in this study compared to other studies is one of the factors that have contributed to the ineffectiveness of FT in BMI. Longer workouts are needed to lose weight. Also, in this study, there was no control over the type and amount of nutrition of the subjects. Exercises that lead to a change in BMI should be accompanied by calorie intake so that the volume of exercise reaches the threshold of calorie consumption effective in weight loss. Of course, due to the implementation of separate sets, these exercises did not provide the necessary continuity for the use of aerobic energy devices and most exercises were performed in the form of a phosphogenic system (50). The present study showed that FT improves agility in children with ID. Therefore, parents, psychologists, educators, teachers, and people who deal with students with ID can take an effective step toward reducing their children's mobility problems by using a FT approach.

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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