Research Paper: The Effect of an 8-Week Pilates Program on Performance Test Scores of Adolescents With Intellectual Disability

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ABSTRACT

Purpose: This study aimed to investigate the effect of an 8-week program of selected Pilates exercises on the performance test scores of male adolescent students with mild (teachable) Intellectual Disability (ID).

Methods: This was a quasi-experimental study with a pretest-posttest and control group design. Study participants consisted of 30 individuals with ID. The study subjects were 10- to 15-year-old male students who were randomly selected by the convenience sampling method from the students of special schools in Parsabad City, Iran. The subjects were randomly assigned to the control (15 subjects) and experimental (15 subjects) groups. A set of tests were used as the performance test. The experimental group's exercise program included Pilates exercises. The subjects performed the exercises for 8 weeks (3 sessions per week). The Independent t test and Paired t test were used to analyze the data.

Results: In the experimental group, the results of this study revealed a significant difference in star excursion to extension (P=0.001), star excursion to abduction (P=0.004), vertical jump (P=0.001), 3 times single-leg jump (P=0.001), shuttle run (P=0.001), and stair sprints (P=0.003) after performing the exercises (P=0.05). However, there were no significant differences in star excursion to flexion (P=0.13) and single-leg jump (P=0.18) in the experimental group and the results of all tests in the control group (P≥0.05).

Conclusion: Pilates exercises seem to improve the balance and function of lower limbs in individuals of the ID group.

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Highlights

- Pilates method of exercises is suitable for all ages, all types of physical conditions, and at any region.
- In our study, the Pilates exercises group demonstrated a significant improvement in their lower extremities functions.
- Pilates exercises improved balance in extension and abduction directions as well as vertical jump, 3 times single-leg jump, shuttle running, and stair sprints in our study samples.

Plain Language Summary

Based on our study results, the Pilates method of exercises results in muscle strength, flexibility, etc. which in turn, significantly affect balance, walking, and lower limbs functions. The present study investigated the effect of Pilates exercises on the lower limb functions in individuals with intellectual disability. In general, the experimental group demonstrated a significant improvement in their lower extremities.

1. Introduction

Physical health is important in individuals' lives. Its positive and negative fluctuation may affect other aspects of human life, too. For example, a poor physical condition is associated with numerous important consequences. Thus, effective biopsychological and socioeconomic aspects must be assessed in this regard [1].

Despite advances in all aspects of today's world, Intellectual Disability (ID) has still remained a lifelong condition. About 3% of the people in the world have an Intelligence Quotient (IQ) score less than 68, and 80% to 90% of them range between mild or moderate ID [2]. The physical state is particularly important in life because the positive and negative changes in a physical aspect could affect other physical conditions. The chronic conditions of individuals with ID affect the financial, social, emotional, behavioral, and cognitive abilities of their families. Moreover, they are constantly faced with constraints [3].

The physical condition of children with ID is usually poor and associated with pain and abnormalities and poor physical fitness [4]. There is no method available to prevent this situation. ID has the potential to be minimized by training and providing suitable environments. Also, the affected population can live the normal life span; however, the critical role of the Ministry of Education is obvious in assisting such children to live a normal life. As far children are concerned, the physical aspect is clearly one of the main elements of education.

Most children with ID suffer from physical weakness due to immobility. Evidence suggests that, unlike past theories of education, children fail to develop their own basic skills while growing up. Therefore, the environment is another essential factor assisting to elaborate on these skills. Because of such poor approaches in the society, children with ID endure a lack of movements [5].

It is important to maintain strength and muscular endurance and balance to ensure the quality of life and functional autonomy in this population. Their physiological state usually aggravates with time, due to their immobile lifestyle or physical inactivity. Thus, they will get more dependent on others. It is important to be able to maintain an independent lifestyle for people with ID [6]. With an appropriate physical activity program, the adolescent would have the opportunity to be physically trained and live an active and healthy life in adulthood. This calls for encouraging physical activity and education among this group [7].

Individuals with ID suffer from biopsychological and social problems such as pain, cardiovascular malfunction, neurological disorders, spinal immobility, early fatigue, and so on. There are several methods to reduce the problems in these people [8, 9]. One of which is Pilates exercises. Pilates is accepted by physicians as a unique physical fitness preparation method, in which a combination of muscle strengthening, muscle stretching, and respiration pattern is used to develop trunk muscles and restore muscle balance [10, 11]. Unlike traditional resistance exercises in which the muscles are exercised separately, Pilates exercises with its holistic approach re-

quire the balance and coordination of several groups of muscles, simultaneously [12].

Several researchers have studied this field, including Nezakat Al-Husseini et al. who examined the effect of an 8-week Pilates program on motion function and depression in patients with multiple sclerosis. They concluded that Pilates exercises reduced depression and improved the motion function in the studied subjects [13]. Raj Kumar examined the effect of an 8-week Pilates program on speed and reported that these exercises improved the speed. Muscular strength and endurance in all areas have clearly increased which indicates that Pilates exercises can improve daily activities through greater strength and endurance [14].

Iriz et al. also investigated the effect of 12 weeks of Pilates exercises on women aged ≥65 years. The experimental group was trained for 12 weeks, consisting of 3 one-hour sessions, per week. They indicated that 12 weeks of Pilates training could be effective in preventing fallings, muscle strength enhancement, dynamic balance, time of reaction, decreasing depression, and improving the quality of life in women aged ≥65 years. [15]. There exists a considerable body of literature on the effects of exercise and physical practices on healthy individuals (without ID). Regular physical activity in adolescents promotes bone and muscle health, reduces depression and anxiety and improves mental health. On the other hand, many people become inactive as reaching the age of adolescence (followed by adulthood) [7].

Few studies are on children and adolescents with ID. Prior research investigated corrective exercises and athletic movements training, and the physical condition of ordinary students. However, few studies are available on the physical condition and its impact on performance during physical training in special students, and especially students with ID in Iran.This study was conducted using the Pilates exercise protocol, as a modern and practical exercise program. In addition to focusing on stretching and strengthening the muscles, it promotes the breathing function and leads to improvement in health and welfare.

Considering the importance and applicability of Pilates exercises, the present study aimed to improve and enhance the balance and function of the lower extremities in this population. Pilates exercises could improve these abilities and stimulate other motor and physiological functions. The present research aimed to discover whether individuals with ID can benefit from regular physical exercises and Pilates exercises, as much as the normal population. Thus, we investigated the effect of an 8-week Pilates program on the performance of lower extremities in adolescents with ID.

2. Materials and Methods

This was a quasi-experimental study with a pretest-posttest and control group design. Study participants consisted of 30 students aged between 10 and 15 years, who were randomly selected from the students of special schools in Parsabad City, Iran. The subjects were randomly assigned in the control (15 persons) and experimental (15 persons) groups. All subjects voluntarily participated in this study and with their parents' consent. The subjects were supported by cooperative managers, exercise trainers, and teachers. Also, all of them had an IQ of less than 70, which describes them as educable. Both study groups were matched on age and physical activity before conducting the evaluations. Thus, the study data were initially collected regarding the histories of diseases, cardiovascular disorders, orthopedic disabilities, surgeries, and medications. Some subjects were then excluded from the study on this basis.

We provided the test instructions to the subjects, prior to conducting the interventions. Then, the first practice was performed by the subjects, as the pretest. All tests were performed in one session, and they were given a 5-minute rest between the tests to avoid fatigue. After conducting the pretest, the experimental group received an 8-week Pilates program for three 45-minute sessions per week. During this period, the control group did not participate in any exercise. Finally, both experimental and control groups conducted lower limb function tests, as the posttest. The collected data from pretest and posttest were analyzed by Independent t test and Paired Sample t test (P≤05) in SPSS.

Research tools

To study the Star Excursion Balance Test (SEBT) toward flexion, the subject was requested to stand on one leg at the intersection of the lines and perpendicular to the frontal plane. Then the examiner requested the subject to stretch his other leg forward to keep balance. The distance between the toes of the moving foot and the intersection of the lines was measured. The test was performed for both lower extremities and the related mean score was calculated.

To study the SEBT toward extension, the subject was requested to stand on one leg at the intersection of the lines and perpendicular to the frontal plane. Then the examiner requested him to stretch his other leg backward

to keep the balance. The distance between the toes of the moving foot and the intersection of lines was measured. The test was performed for both lower extremities and the relevant mean score was calculated.

To study the SEBT toward abduction, the subject stood on one leg so that the inner edge of the foot was perpendicular to the frontal plane. The researcher instructed the subject to remove his other foot, to prevent imbalance. The distance between the toes of the moving foot and the intersection of the lines was measured. The test was performed for both lower extremities and the relevant mean score was calculated.

To examine the vertical jump distance, the subject stood on a flat floor in front of a wall, covered with reflective steps at intervals of 10 cm with a height of 150 to 200 cm. The subject took his upper limb to 180° abduction. Then, the finger length was highlighted. In the following step, with a swinging movement of the upper limb, he jumped his maximum range with both legs, leaving a mark with his toes. Then, the difference between the finger length in the standing position and the maximum jump was calculated. The test was performed 2 times to familiarize the subject and then 3 times for maximum jump recording. They could have a 3 to 5 minutes rest between each jump.

To examine the single-leg jump distance, the subject stood on the dominant foot, and his toe fingers were placed behind the zero-line, holding his hands behind his head to prevent the impact of the upper limb movement. He was asked to make a slow jump at the maximum distance he could go through. Then, the distance to the back of his heel was measured. The test was performed 2 times for familiarization and 3 times for maximum jump recording. The subjects had a 1-minute rest between each jump.

To examine the distance of 3 times single-leg jump, the subject stood on the dominant leg with his toe fingers placed behind the zero-line, holding his hands behind his head to prevent the impact of the upper limb movement. He was asked to perform 3 successive jumps so that in each leap on one side the longitudinal strip would descend to a width of 15 cm, the maximum distance that can pass, and then the distance to the back of the heel in the third jump is measured. The test was performed 2 times for familiarization and 3 times for maximum jump recording. The subjects had a 1-minute rest between each jump.

To examine the duration of stair sprints, the subject stood on the wall with a certain distance from the staircase. Then, the subject was requested to start running toward the staircase and step up 2 stairs in each move. The time was recorded from the moment he was detached from the wall until his foot touched the last step. To check the shuttle running time, the subject stood at a 5-m point in the middle of a 10-m course. He completed the 10-m course run. Then, returned and headed to the other end of the 10-m course and eventually ran back to the starting point (20 meters in total). Two stopwatches measured the start of the subject's run till final pass from the midline. The mean score was eventually calculated up to ±0.01 s precision. The test was done just once unless not performed properly. In this case, it was repeated after taking 3 to 5 minutes rest [16].

3. Results

This study was conducted on 30 male ID students divided into the experimental and control groups. The obtained data were compared using the Independent t test for the SEBT in flexion direction (P=0.23), SEBT in extension direction (P=0.31), SEBT in the abduction direction (P=0.17), vertical jump (P=0.47), single-leg jump (P=0.9), 3 times single-leg jump (P=0.09), shuttle

Table 1. Anthropometric and physiological characteristics of the subjects

Parameter	Group	Mean±SD
Age, y	Experimental	12.06±1.09
	Control	12.20±1.01
Weight, kg	Experimental	43.73±2.73
	Control	44.46±2.94
Height, cm	Experimental	150.73±2.68
	Control	151.26±3.49
IQ	Experimental	59.60±3.68
	Control	60.73±4.09

Table 2. The results of t-test for correlating pretest and posttest groups in lower limb function tests

Exercise Protocol	Group	Mean±SD		t	P
		Pre-test	Post-test		
Star excursion balance test in the direction of flexion (cm)	Experimental	60.80±0.94	61.33±0.97	-1.586	0.13
	Control	61.20±1.08	60.86±1.64	1.046	0.31
Star excursion balance test in the direction of extension (cm)	Experimental	70.66±1.17	72.06±1.22	-5.137	0.001*
	Control	71.00±1.19	71.33±1.23	-0.924	0.37
Star excursion balance test in the direction of abduction	Experimental	76.06±1.27	77.80±0.98	-3.440	0.004*
	Control	76.40±1.24	76.73±0.45	-1.524	0.15
Vertical jump	Experimental	15.2±1.21	19.3±1.37	-6.839	0.001*
	Control	15.8±1.08	15.6±1.02	-0.364	0.71
Single-leg jump	Experimental	92.06±0.96	92.53±0.83	-1.388	0.18
	Control	91.5±0.86	92.00±1.27	-1.562	0.13
Three times single-leg jump	Experimental	241.6±3.76	248.5±2.26	-4.973	0.001*
	Control	242.0±3.08	241.3±2.14	0.849	0.41
Shuttle running	Experimental	9.48±0.79	8.15±0.75	4.314	0.001*
	Control	9.56±0.88	9.43±0.88	1.493	0.16
Stair sprints	Experimental	8.32±0.51	7.23±0.65	3.757	0.003*
	Control	8.35±0.86	8.26±0.71	0.290	0.76

* Significance level: (P≤0.05)

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running (P=0.18) and stair sprints (P=0.78). The results indicated no significant differences (P≥0.05) (Table 1).

According to the Table 2, the results before and after the exercise protocol showed a significant difference with regard to the SEBT in the direction of extension, SEBT in the direction of abduction, vertical jump, single-leg jump, 3 times single-leg jump, stair sprints, and shuttle running (P≤0.05). However, there were no significant differences in SEBT in the direction of flexion and single-leg jump (P≥0.05). On the other hand, the results of none of the tests were significant in the control group (P≥0.05).

4. Discussion

Pilates helps with the establishment of a perfect harmony between the body, mind, and soul. In Pilates, the person first takes the complete control of his body through a targeted manner, then, achieves natural harmony through a complete gradual but progressive repetition of the movements [17].

Recent studies have argued that Pilates exercises are suitable for all ages, all types of physical conditions and physical fitness, and at any region [18, 19]. According to Cable (2009), exercising and participation in sports activities may facilitate muscular performance, which may increase the functional stability of individuals and trainees. Through learning and repeating these muscle activation patterns, athletes and participants in sports exercises can plan some muscle patterns in future which may potentially improve postural control and resistance against harmful forces. Pilates exercises result in muscle strength, flexibility, etc. which in turn, significantly affect balance, walking, and lower limbs functions.

The present study investigated the effect of Pilates exercises on the lower limb functions in individuals with ID. In general, the experimental group had a significant improvement in their lower extremities. The obtained results also suggested that the Pilates exercises improved balance in extension and abduction directions as well as vertical jump, 3 times single-leg jump, shuttle running,

and stair sprints. However, there were no significant differences in the direction of the flexion and single-leg jump (P≥0.05).

Panahi explored the effect of an 8-week Pilates program on the kinematic balance and parameters of walking among deaf students. Panahi stated that the Pilates exercises increased the static balance, dynamic balance, walking speed, and step length measurement in the deaf students [20]. Yukselen et al. (2008) also investigated the effect of exercises on the motor skills of children with ID. The skills of walking, running, jumping, squatting, playing with balls, balancing, cycling, climbing, stepping, trampolining, and jumping barriers and sub-sections of each have been surveyed in their research. Their study suggested a significant difference in these skills [21].

The results of the current research are in line with Bahiraei et al. (2017), Eric Johnson (2007), Eli Carmeli et al. (2005), Shahrjerdi et al. (2014), Shanazari et al. (2013), and Golpaygani et al. (2012) [22-27]. Although the obtained results may differ in terms of sample selection or other variables. However, the studies of Buchner et al. (1997), and Brown et al. (1993), were inconsistent with the results of this study; they did not report the performance of exercises on improving balance and walking and performance of lower limbs as significant [28, 29]. Such contradiction in the data may be due to ignoring factors such as physical fitness, activity, motivation, gender, age, height, weight, and leg length. The differences in the research studies may be related to methodology and other variables, too.

In comparison with normal people, individuals with ID have a delay in motor growth. This matter apparently negatively impacts balance, running speed, jumping, walking, etc. This study considered the weakness of the balance and functions of the lower extremities in persons with ID and the importance of these activities in daily life. The obtained results suggested that Pilates exercises improve balance and some functions of the lower limbs in this group. Coaches and teachers can also use Pilates exercises for people with ID and other disabled groups, especially at younger ages when their movement patterns are forming.

Ethical Considerations

Compliance with ethical guidelines

All subjects voluntarily participated in this study and with their parents' consent.

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Authors contributions

Conceptualization and methodology: All authors; Investigation: Rahman Amiri and Saeid Bahiraei; Writing original draft: Rahman Amiri; Writing-review and editing: Rahman Amiri and Hassan Daneshmandi; Funding acquisition: Rahman Amiri and Saeid Bahiraei; Resources: Rahman Amiri; Supervision: All authors.

Conflict of interest

The authors declared no conflict of interest.

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