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# The Effect of Pilates Exercises on Body Posture and Some Fitness Factors in Educable Mentally Retarded Subjects

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**ABSTRACT: Lack of exercise and physical activity worsened physical health of both intellectually and physically disabled subjects and caused abnormalities in these individuals. This also led to limited range of motion of the joints and limbs in these individuals. This may finally cause cardiovascular and respiratory diseases, diabetes, hypertension, obesity, etc. The present study aimed to examine the effect of Pilates exercises on body posture and fitness factors in educable mentally retarded subjects. This was an applied quasi-experimental study with pre-test, post-test and control group. The statistical sample consisted of 30 educable mentally retarded girls who were above 14 years old with an intelligence quotient between 50 and 70. These were divided into two control and experimental groups. Characteristics of the first group (control) consisting of 15 subjects were as follows: Height with 152.47 cm (mean), Weight with 63.62 ± 10.29 kg (mean and standard deviation), Age with 62.31 ± 1.46 years old (mean and standard deviation), Foot length with 28.72 ± 6.05 cm (mean and standard deviation). Characteristics of the second group (experimental) consisting of 15 subjects were as follows: Height with 851.35 ± 9.63 cm (mean and standard deviation), Weight with 76.84 ± 8.31 kg (mean and standard deviation), Age with 62.02 ± 1.69 years old (mean and standard deviation), Foot length with 58.68 ± 5.55 cm (mean and standard deviation). The subjects were selected using available (random) sampling method. The experimental group experienced Pilates exercise training program selected in this study. The subjects performed the exercises in eight weeks, three times a week and each session lasted for an hour and each exercise was repeated for ten times. Dynamic balance was assessed using Star Excursion Balance Test. The results showed a significant difference among the subjects before and after Pilates exercises (P <0.05). Pilates exercises maintain physical fitness and capability of mentally retarded individuals since these exercises resemble corrective exercises with specific characteristics. These exercises are used as a treatment option for abnormalities of these individuals. Pilates are included in Morning exercises of this group.**

**Keywords:** Pilates exercises, balance, mental retardation (intellectual disability

## INTRODUCTION

Physical health and status are important components of human life. Any positive and negative changes in these components can affect other aspects of human life. Pilates Exercise or Contrology was founded and developed by Joseph Pilates in 1920. This training exercise consists of such controlled exercises, which creates a physical harmony between body and the brain and enhances individual ability at any age range. People who do Pilates exercise sleep better, are less angry and stressed and fatigue. Pilates method led to the greatest satisfactory results in less possible time. Pilates Exercise alone is a perfect training method and is designed to achieve and maintain fitness and achieve higher standards of physical fitness. Pilates is a simply useful workout supplement to all sports, which integrate overall body strength and increase flexibility. Implementation of these exercises requires no special skills and equipment. It can be done on a mattress by any individual at any levels suitable for all age groups (Bernardo, 2007, Siqueira *et al.,* 2010, Cozen, 2004). Erik Johnson (2007) examined the effect of Pilates exercises on dynamic balance of healthy subjects with an emphasis on strengthening pelvic and back muscles.

The relevant results showed that these exercises increase dynamic balance, which was assessed using performance achievement test (Daneshmandi *et al.*, 2013, Kibler, 2006, Sato and Mokha 2009) Exercise is more important for people with disabilities. Exercises directly affect lives of disabled individuals. Intellectually and physically disabled individuals need special care. In some cases, these individuals cannot survive unless they receive special care. Disabled individuals as other segments of society often seek nonpharmacologic methods with less complications and cost among various therapeutic modes. Pilates can be done with accuracy and minimal cost in many cases. Disabled individuals can benefit from this exercise without any concern.

In one study, researchers reported that rhythmic movements have a positive effect on perceptual-motor skill development and social adaptation of mentally retarded children (Sato and Mokha 2009). Educable disabled individuals learn educational materials slower than healthy individuals. The former do not act in terms of learning as their peers but disabled individuals can learn some analytical skills. The majority of disabled individuals like those individuals with normal intelligence participate in similar motor activities; however, the former learn motor skills slower than the latter. Kibler *et al.* cited that core stabilization exercises and strength training considerably maximize the balance and performance of athletes in terms of upper and lower body movements. Muscular strength and dynamic balance considerably help intellectually disabled individuals to have a better life and achieve functional independence. The capability to maintain an independent living is an important factor for those people with intellectual disability. Imbalance and falling are considerably important in lives of majority of people from professional athletes to the elderly. Muscular weakness, proprioceptive problems and abnormalities in range of motion can endanger keeping the center of gravity within the base of support and may cause imbalance. Balance is a dynamic state, which requires a harmony between multiple neural paths in order to achieve and maintain balance. Maintaining static and dynamic balance lies on the reaction between body and the surrounding environment. This study assessed physical fitness and posture in the individuals with intellectual disability (mental retardation) and found a significant relationship between cardiovascular fitness, muscular strength, static and dynamic balance and their dorsal kyphosis (Khaliltahmasebi *et al.*, 2012). Kubilay studied the effect of balance training and status on performance of children with intellectual disability. The results showed that muscular endurance, muscular strength, coordination, harmony between balance and motor function had improved in the experimental group after 8 weeks (Kubilay *et al.*, 2007). In this study, the researcher used a functional test and examined the effect of Pilates exercise on body posture and some fitness factors in educable mentally retarded individuals.

## MATERIALS AND METHODS

This was an applied and quasi-experimental study with pre-test, post-test and control group. The subjects consisted of educable mentally retarded female subjects who were above 14 years old with an intelligent quotient between 50 and 70 at Rehabilitation Institute of Charitable Action in Tehran Province. The subjects were selected using available random sampling method. The sample consisted of 30 mentally retarded girls in two experimental and control groups with the following characteristics.

The control group consisted of 15 subjects with following characteristics: Age with 63.26 ± 1.46 years old (mean and standard deviation), Height with 251 ± 9.00 cm (mean and standard deviation), Weight with 36.26 ± 10.29 kg (mean and standard deviation), Foot length with 28.72 ± 6.05 cm (mean and standard deviation).

The experimental group consisted of 15 subjects with the following characteristics: Age with 62.02 ± 1.69 years old (mean and standard deviation), Height with 851.35 ± 9.63 cm (mean and standard deviation), Weight 76.84 ± 8.31 kg (mean and standard deviation), Foot length (58.68 ± 5.55 cm (mean and standard deviation). All subjects were matched with each other voluntarily in collaboration with the Institute. The superior foot was determined by questioning the subjects. After the test, normal distribution of the means and standard deviation were examined by Kolmogorov-Smirnov test. Shapiro and Wilk and Mann-Whitney U test were used to compare the control group with pre-test and post-test. The significance level for all subjects was considered as 0.05. All calculations were done using SPSS version 20. Excel software was also used to plot the graphs.

### *A. The method for measuring the dynamic balance*

Star Excursion Balance Test is a simple method for testing the dynamics of physical status of the subjects. Hertel reported reliability of SEBT between 0.78 and 0.96. Kinsi also showed that (SEBT) has an average reliability for assessment of dynamic balance (between 0.86 and 0.98 (9). The Star Excursion Balance Test (SEBT) is a network consisting of eight directions (anterior, anterior-interior, interior, interior-posterior, posterior, posterior-external, external and anterior-external) drawn at 45 degrees from each other.

Since this test has a statistically significant relationship with foot length, actual foot length from anterior superior iliac spines to the medial malleolus was measured in sleep mode in order to perform this test accurately and for data normality. Each subject practiced the exercises 1 to 2 times to learn the exercises. The subject should keep his balance on one foot regardless of support base and imbalance as maintaining the maximum distance from the eight directions at location of the test. The purpose of achievement in SEBT lies in keeping balance when maximum disruption is occurred in equilibrium mode and maintaining the ability to return to the equilibrium state (active cop movement). SEBT requires neuromuscular control for a proper position for the joint and the surrounding muscular skeleton strength around the joint during the test. The tools used in this test included eight tapes, adhesive tape and the conveyor. The measurements were in cm. The subject stands in the center of the network and moves his superior leg. Every effort will be measured from the central star. The test was repeated once for each subject. Mean of each direction was obtained and divided by foot length and multiplied by 100 to obtain achievement distance based on foot length percentage. The subject practiced to stand on one foot for 5 to 10 seconds after each attempt. If an error occurred, the subject was asked to repeat the test. The errors occurred when the foot in the center moved or in case of imbalance.

*B. Training program*

During the study, the control group did not have any training program. The experimental group performed the Pilates exercise program for eight weeks, three sessions a week and each session lasted for an hour. Each exercise can be repeated up to 10 times depending on physical condition of the subject. The subjects performed Pilates exercises in the first four weeks in 2 sets with 5 repeats and in the second four weeks in 2 sets with 10 repeats. The subjects had a 5 to 10 seconds break between each set. The exercises were conducted in sports hall of the institute. In the beginning, warm up workout was performed for 10 minutes before doing Pilates exercises selected in this study. The warm up workout was as follows: raising hands, neck stretching, bending upper body and back, bending the legs to the abdomen, bending and unbending the ankle). Pilates exercises were as follows: standing on the toe, standing on the heel, standing on toes in the balance, raising the hips, stretching the legs and tears). These exercises strengthen the abdominal muscles, hip extensor and flexor tendons, center of body strength, stretching and flexibility of the spine and back muscles and sciatic muscles and legs. After Pilates exercises, cooling exercises were performed for 10 minutes as follows: lifting the shoulder up to ears, lateral flexion of the head, back and upper body stretching.

## FINDINGS

The present study was conducted on 30 educable mentally retarded girls in two control and experimental groups. Table 1 shows Physical characteristics of the subjects. The results are indicated in Table 2 and 3. The balance score of the eight directions in SEBT significantly increased in the experimental compared to control group. In the control group, balance score declined in all eight directions.

**Table 1: Mean and SD of individual properties of two groups.**

| | **Experimental group** | **Control group** |
|---|---|---|
| **Age** (year) | 26.2 ± 1.69 | 26.13 ± 1.46 |
| **Height** (cm) | 158.5 ± 9.63 | 152.5 ± 9 |
| **Weight** (kg) **Pre test** | 67.5 ± 8.31 | 63.6 ± 10.2 |
| **Post test** | 65.4 ± 8.02 | 66 ± 9.8 |
| **Feet** (cm) | 85.86 ± 5.55 | 82.27 ± 6.05 |

**Table 2: Mean and SD of independent variables two groups.**

| **Variable** | **Experimental group** Pre test | Post test | **Experimental group** Pre test | Post test |
|---|---|---|---|---|
| **Anterior** | 46.67 ± 8.26 | 51.56 ± 8.45 | 48.8 ± 13.14 | 42.06 ± 7.28 |
| **Anterior-external** | 47.49 ± 7.78 | 50.92 ± 7.97 | 51.44 ± 14.13 | 46.68 ± 13.43 |
| **External** | 46.05 ± 6.97 | 49.49 ± 7.2 | 47.18 ± 5.42 | 43.18 ± 6.57 |
| **Posterior -external** | 35.56 ± 8.79 | 38.93 ± 8.82 | 34.07 ± 11.1 | 29.81 ± 9.09 |
| **posterior** | 29.75 ± 6.76 | 33.45 ± 6.67 | 29.73 ± 10.24 | 27.26 ± 12.69 |
| **Posterior-internal** | 24.73 ± 6.94 | 28.43 ± 7.19 | 26.03 ± 13.53 | 22.28 ± 11.51 |
| **Internal** | 8.48 ± 2.67 | 11.06 ± 2.66 | 11.73 ± 6.28 | 11.59 ± 16.51 |
| **Anterior-internal** | 41.90 ± 6.53 | 45.84 ± 6.24 | 41.3 ± 5.83 | 36.68 ± 6.84 |
| **Total (dynamic balance)** | 35.21 ± 5.26 | 38.71 ± 5.51 | 36.29 ± 8.57 | 32.44 ± 8.43 |

**Table 3: Results of U-man windy for comparison of the change of dynamic balance of two groups.**

| Balance status | **Changes** (M ± SD) | | **Changes** (middle) | | Sig |
|---|---|---|---|---|---|
| | Experimental | Control | Experimental | Control | |
| **Anterior** | 3.89 ± 0.86 | - 6.73 ± 10.7 | 3.57 | - 4.22 | 0.000 |
| **Anterior-external** | 3.42 ± 0.97 | - 4.76 ± 3.11 | 2.94 | - 5.36 | 0.000 |
| **External** | 3.43 ± 1.39 | - 4.00 ± 2.70 | 3.41 | - 4.37 | 0.000 |
| **Posterior -external** | 3.35 ± 1.19 | - 4.26 ± 3.65 | 3.33 | - 4.22 | 0.000 |
| **posterior** | 3.69 ± 2.17 | - 2.46 ± 3.96 | 3.33 | - 3.61 | 0.000 |
| **Posterior-internal** | 3.70 ± 2.66 | - 3.74 ± 3.40 | 2.94 | - 4.43 | 0.000 |
| **Internal** | 2.57 ± 1.34 | - 0.14 ± 10.7 | 2.35 | - 3.12 | 0.000 |
| **Anterior-internal** | 3.93 ± 1.85 | - 4.61 ± 3.45 | 3.57 | - 4.49 | 0.000 |

The difference between experimental and control groups was significant. The results showed that Pilates exercises can improve dynamic balance of educable mentally retarded girls in all directions.

## DISCUSSION

The present study aimed to investigate the effect of Pilates exercise on body posture and some fitness factors in educable mentally retarded individuals. The results showed that dynamic balance significantly improved in the experimental group. Pilates exercise improved balance in all direction in SEBT. Various factors are considered to design a training program in order to improve balance. Most training programs require a multidimensional approach in which stretching exercises are considered to improve range of motion of the joints and flexibility. Moreover, strength training is considered to increase muscular strength and improve balance training exercises to meet actual individual needs. Gaining enough muscular strength (especially in foots) is considerably important to keep balance and restore the lost stability (imbalance). Decreased muscle mass due to the aging process and the consequent reduction in strength may cause problems in keeping balance and preventing falls (Lange *et al.,* 2000).

Segen believed that physiological education method include correcting and strengthening the organs through development of reflective, motor and perceptual functions. The first step is the skeletal muscles training. He believed that the exercises should be simple and coordinated with motor and audio functions in order to develop any part of the body that has been weak or not developed properly (Johnson *et al.,* 2007). The individuals with intellectual disability can adapt to most living conditions. However, they cannot progress in all fields as normal children due to their limited intelligence and adjustment (Kubilay, 2007). Gambta and Gray 2000) stated that balance is the most important component of athletic capability. Balance is almost involved in any form of activities. Keeping balance is a complex motor skill, which describes dynamic body postures in prevention of falls (Lange *et al.,* 2000). Balance is an integral part of almost all daily activities and is the key to individual functions (Lange *et al.,* 2000). Abnormalities in motor components of balance control may be due to musculoskeletal system abnormalities (e.g. physical condition, limitation of range of motion of joints, muscular trauma) or neuromuscular system (such as poor neuromuscular coordination and pain). Weakness in muscle strength or range of motion of joints of the lower limbs can affect physical status of the individual or his balance. Pain can also change the correct pattern of movement and reduce individual stability. If the pain persists for a long time, muscular strength may decline and movement disorders may be caused (Bernardo, 2007). Wolff's law states that tissues adapt with respect to the pressure that is imposed on them. This law can be considered in both positive and negative perspectives. In positive perspective, load lifting and weight bearing help to increase bone density and prevent osteoporosis and other bone diseases. In negative perspective, gravity, weak body posture and improper habits can lead to structural weakness in tissues and pain, trauma, other weaknesses and most importantly muscular imbalance (Lange *et al.,* 2000). According to findings, Pilates exercises strengthen the immune system, develop flexibility, balance, strength, bulk up the lungs and increase respiratory function, strengthen the cardiovascular system, increase the range of motion of joints and muscles. Pilates due to resemblance to corrective exercises can correct physical symptoms and abnormal postures (Freeman *et al.,* 2012).

These findings are in line with those obtained by Kubilay *et al.* (2011). They studied the effect of postural and balance exercise on performance of children with intellectual disability (Kubilay *et al.,* 2007). The results showed that muscular endurance, muscular strength, coordination, balance and motor function had improved after eight weeks in the experimental group (Khaliltahmasebi *et al.,* 2012). Freeman *et al.* (2012) showed that Pilates improved the physical health of people with multiple sclerosis compared with the control group (Freeman *et al.,* 2012).

Some studies have emphasized that one of the most common problems with these programs is their short duration. Effectiveness of an intervention should be evaluated when enough conditions and opportunities are provided, so that children with intellectual disability can experience and learn various motor-perceptual behaviors (Sato and Mokha 2009, Khaliltahmasebi *et al.*, 2012).

In a study, the researcher examined the effect of specific motor program for six weeks on perceptual-motor capabilities of children with intellectual disability (Shedden and Kravitz 2006). He showed that this motor program had a significant effect on static balance of them; however, this program had not a significant effect on their dynamic balance. These results are inconsistent with those obtained in the present study. This may be due to the effect of exercise type on performance of dynamic balance and accuracy, strength and flexibility of the subjects.

Vearrier *et al.* (2005) studied the effects of intensive training and movement therapy exercises lasting for two weeks, each session lasting for six hours per day, on balance of 10 patients after a stroke. They found out that these exercises had not a satisfactory effect on balance. These results are inconsistent with those obtained in the present study (Vearrier *et al.*, 2005). This may be due to the very short-term exercise, long hours of practice and fatigue in the subjects.

Other studies assessed whether core stabilization exercises affect running and stability of lower limbs and performance of five thousand meters running. The Star Excursion Balance Test was used to assess the dynamic balance. The force platforms were used to assess gait kinetic measurement. The five-thousand running was used to measure running. The results indicated that the experimental group showed significant improvement in both five thousand running and kinetic gait. However, a significant improvement was not found for balance (Daneshmandi, 2013, Sato and Mokha 2009). These results were inconsistent with those obtained in the present study. This may be due to the effect of program type on performance of the subjects.

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