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The Effect of Eight-week Yoga Exercise on Balance and Gait in Girls with Intellectual Disability

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ABSTRACT: Scientific evidence suggests that the individuals with intellectual disability are less physically active compared with healthy subjects. The former may be at risk of physical and motor disabilities. the present study aimed to evaluate the effect of eight-week yoga exercise on balance and gait of girls with intellectual disability. This was a quasi-experimental study with pre-test and post-test. For this purpose, 30 mentally retarded girls were randomly divided into experimental and control groups. The experimental group experienced yoga exercise with respect to the training program presented in this study. The subjects participated in eight weeks of training, three sessions per week and each session lasted for an hour with ten replications for each exercise. Stork test was used to assess static balance, the test of getting up and walking was used to assess dynamic balance. The number of steps per minute was calculated in order to assess gait. Kolmogorov Smirnov test and analysis of covariance were used to analyze the collected data. The results showed that variables of static balance, dynamic balance and gait significantly increased in the experimental group (P> 0.05). All variables in the control group remained unchanged. Yoga exercise with its special characteristics is a perfect exercise for both body and mind. Thus, yoga engages both body and mind in the exercise in order to increase strength and endurance of all body organs, trigger the deepest part of muscles, and improve balance and gait in the individuals with intellectual disability.

Keywords: intellectual disability, yoga, static balance, dynamic balance, walking

INTRODUCTION

Most research in relation to the effect of physical activity on physical fitness and motor abilities was conducted on healthy subjects and physically disabled individuals were less considered in this field (Lapier et al., 1997). Therefore, it is necessary to bestow physically healthy bodies to physically disabled individuals for daily activities by applying proper and timely exercise and strengthening physical forces and enhancing dynamic abilities. The individuals with intellectual disability are weak in terms of sensory - motor capacities, physical awareness, static and dynamic balance and coordination between general and delicate movements. The children with intellectual disability react slower to stimuli than normal children (Attix and Welsh Bohmer 2006, Woollacott, 2000). Therefore, participation in sports activities helps to improve physical, mental and social states. Intellectual disability is a widespread disorder and chronic disease throughout life. The factors underlying this disease affect brain structure, function, or both with a broad range of symptoms from mild to severe. The affected individuals tend to sit in one place for long and less participate in training programs, which puts them at risk of many chronic diseases. More than 400 factors cause intellectual disability (ID) as follows: genetics, nutritional disorders, traumatic pain and hip injuries at birth or childhood, communicable diseases (infectious) and poisoning such as fetal alcohol syndrome, maternal drug use during pregnancy, swallowing the object containing lead element, poverty, malnutrition, lack of knowledge-centered support that enhances intellectual development and adjustment skills.

The individuals with intellectual disability refer to those individuals with significantly lower than average overall mental performance. They also suffer from delay and weakness in adaptive behaviors during childhood development (Cabeza - Ruiz *et al.*, 2011). Scholars have defined growth as development up to age of 18.

The intellectually disabled individuals were classified as follows in one typical classification: educable group with an intelligence quotient from 50 to 79, trainable group with an intelligence quotient from 30 to 54, and dependent group with an intelligence quotient less than 29 (Ahmadi *et al.,* 2012). Most research has shown that children with intellectual disability have a low level of physical fitness compared with their normal peers.

Gait skill seems simple at first look but it consists of multiple movements. In other words, gait is a complex skill according to kinematics analysis. Coordinated movements of the muscles and synchronized movements of the joints display a beautiful teamwork skill (Carmeli et al., 2002). Prior to walking, the individual should be able to balance the head, upper body members and body altogether in a standing posture. He should also be able to transfer the strength from one upper organ to one other lower limb and lifting one organ from the ground and placing the lifted organ in front of the other lower limb in alternative pattern. These activities require coordination, balance, healthy kinesthetic sense and proprioception as well as healthy joints and muscles. Thereby, it should be noted that the seemingly simple gait skill requires a very complex coordination between neural, muscular and joints systems (Sokhangouei and Afsharmand 2013). The lower limb of the human body may lose its function due to involvement with various diseases. As a result, gait abnormalities may be caused. Such abnormalities as intoeing and out-toeing can be cited in this regard. These abnormalities may be caused due to various reasons such as altered hamstring length or changes in movement of the lower limb joints, which may be due to abnormalities in the ligaments and lower limbs. Therefore, gait abnormalities may cause problems in the balance as one essential component required to perform all daily physical and key individual activities (Shumm and Woolacott 2001, Wollcott and Shimway-Cook 2005). Balance is a complex motor skill, which describes the dynamics of body posture to prevent falling. Balance is divided into two types of dynamic balance and static balance. Imbalance increases the likelihood of falls, which can cause various injuries. The individuals with intellectual disability are less balanced than healthy individuals. Decreased muscular tonicity and hypermobility of the joints are common in people with intellectual disability. This may cause various disabilities such as motor fractures and disabilities, social and psychological disorders such as uncertainty, decreased self-confidence, restricted mobility, and fear of falling, depression, and loss of independence in activities (Cremers *et al.,* 1993). Due to low mobility of people with intellectual disability and imbalance and walking, yoga has lasting benefits for the individual by strengthening and making flexible the interior muscles. This exercise can help prevent injuries and postural problems. Yoga as a teamwork exercise is accessible, relaxing and healing with no side effects. Yoga was approved as a physical and mental exercise. Yoga as an exercise has a significant effect on the health of various groups and segments of society, including men and women in different age groups (Leininger, 2006). Yoga is implemented with minimal cost and accurately in multiple cases. The people with intellectual disability can benefit from this exercise without any concern. Thus, due to importance of balance and musculoskeletal structure in daily activities and participating in sports programs and improving balance skills to control and acquire motor skills, the present study investigated the effect of eight-week yoga exercise on balance and gait of girls with intellectual disability.

In a previous study, researchers investigated the effect of 8-week yoga exercise and meditation on static and dynamic balances in women with multiple sclerosis with an emphasis on body type. Berg Test and T. J. U. G Test were respectively used to assess static balance and dynamic balance. The results showed that eight-week yoga exercise and meditation affect the balance in women with multiple sclerosis (Luskin *et al.,* 2000).

Parisa Najaf Abadi (2013) investigated the effect of eight-week selected motor and physical fitness exercises on static and dynamic balances in secondary school girls with intellectual disability. The effect of physical and motor fitness exercises on dynamic balances was significant while the above selected exercises had no significant influence on static balance of the students with intellectual disability (Benjuya et al., 2004).

Looper *et al.* (2008) investigated the effects of treadmill exercise intensity and its consequences on gait in children with Down syndrome. The result suggested that the number of steps was higher in children with intensive training and they attained most of the motor milestones at an earlier mean age.

MATERIALS AND METHODS

This was a quasi-experimental study. The subjects consisted of mentally retarded female students in school for exceptional students in the first district in Karaj in Alborz province in 2014-2015. Among 200 students in this school, 30 students were randomly selected into two groups: control group (n = 15, mean and standard deviation of height was equal to 145.4 ± 8.8 cm, mean and standard deviation of weight was equal to 50.9 ± 16.1 kg; mean and standard deviation of age was equal to 15.3 ± 2.9 years old) and experimental group (n = 15, mean and standard deviation of height was equal to 150.06 ± 9.8; mean and standard deviation of weight was equal to 50.4 ± 13.3; mean and standard deviation of age was equal to 15.6 ± 2.4). The students with a history of lower extremity injury and disability were excluded from the statistical population.

All parents filled out informed consent and form of personal characteristics of the students. At beginning of the study, the research variables of stork test get up and walking and the number of steps per minute were measured as pre-test in both experimental and control groups. Then, the control group were excluded any training program. The experimental group received yoga exercise program for 8 weeks, 3 sessions per week, each session lasted for 60 minutes. At the beginning, the training program lasted for 15 minutes. By the end of the second month, the training lasted for 60 minutes. At the beginning, each movement was repeated three times. At the end, each movement was repeated ten times. Each session began with a warm up and ended with cooling exercises in a teamwork manner.

The day after the last day of exercise, the post-test was performed. The period and procedures of pre-test and post-test were identical to each other. In other words, pre-tests and post-tests were performed at a certain time. Soehnle Scale made by Germany was used to weight the subjects. A meter tape was used to measure heights of the subjects. A flat surface and a Q & Q stopwatch made by Germany were used to measure the stork test. A chair, one cone and one Q&Q stopwatch were used to measure the test of getting up and walking. Four cones and one Q&Q stopwatch were used to measure the number of steps per minute.

Statistical analysis: The descriptive statistics of mean and standard deviation, inferential statistics, assumptions testing (Kolmogorov Smirnoff) and hypotheses testing (analysis of covariance) were used. All operations were performed using SPSS version 20. EXCEL was used for drawing the charts.

RESULTS

The descriptive statistics of mean and standard deviation, inferential statistics, assumptions testing (Kolmogorov Smirnoff) and hypotheses testing (analysis of covariance) were used. Tables show the subject's physical characteristics. The results showed that variables of static balance, dynamic balance and the number of steps per minute were normally distributed in terms of independent variable. Data of Kolmogorov Smirnoff test results relevant to variables of static balance, dynamic balance and number of steps per minute, which were normally distributed in terms of independent variable ($P>0.05$). Data of results of analysis of covariance, which showed significant difference in static balance between girls with intellectual disability in experimental group (25.37) and control group (10.67) ($p = 0.006$, $F (1, 27) = 8.888$. The results of analysis of covariance showed a significant difference in dynamic balance between girls with intellectual disability in experimental group (10.39) and control group (13.42) ($p = 0.000$, $F (1, 27) = 8.83$. The results of analysis of covariance showed a significant difference in number of steps per minute between girls with intellectual disability in experimental group (130.7) and control group (109.03) ($p = 0.000$, $F (1, 27) = 89.3$. (See Fig. 1 and 2).

Table 1: Mean and SD of individual's properties of studied groups.

Group	**Height** (cm)	**Weight** (kg)	**Age** (year)
Exercise	150 ± 9.8	50.4 ± 13.3	15.6 ± 2.4
Control	145 ± 8.8	50.9 ± 16.1	15.3 ± 2.9

Table 2: Description of independent variables in studied groups.

Variable	**Exercise group**		**Control**	
	Pre test	**Post test**	**Pre test**	**Post test**
Static balance	17.9 ± 16.2	23.6 ± 16.7	11.6 ± 9.3	9.71 ± 9.1
Dynamic balance	11.07 ± 1.03	9.81 ± 0.83	13.35 ± 2.2	14.10 ± 1.4
walking per minute	119 ± 10	133 ± 5.6	111 ± 7	107 ± 6.5

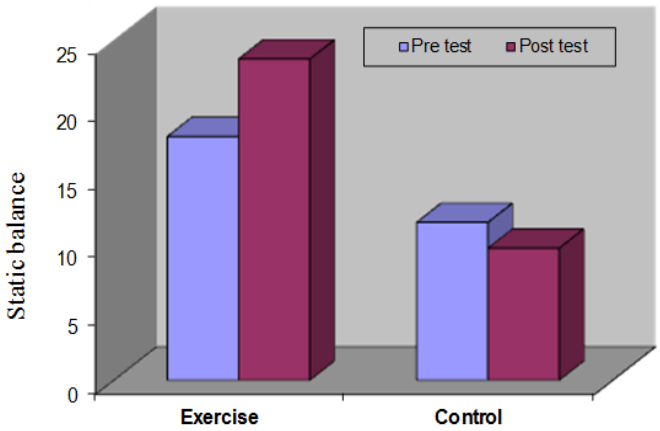

Fig. 1. Pre and post training of static balance of two groups.

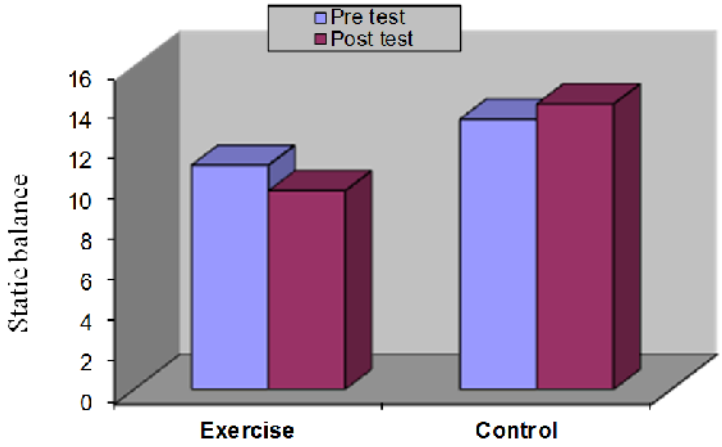

Fig. 2. Pre and post training of dynamic balance of two groups.

DISCUSSION AND CONCLUSION

Deficiency or excess of flexibility affect stiffness and instability of moving organs and maintaining proper posture (Schieppati *et al.*, 1994, Woollacott *et al.*, 1986, Melzer *et al.*, 2000, Wipple *et al.*, 1987). Weak or poor posture, poor relative arrangement of different body parts in relation to each other increase stress on the body support structures and reduce function of balance on support (Kendall *et al.*, 2005). Finally, these changes will affect the ability of people to undertake their tasks and affect physical efficiency (Houglum, 2000). Yoga coordinates various human body systems and engage body and mind in the exercises in order to increase strength and endurance of all organs and target the deepest part of the body Thereby, yoga can improve balance. The findings revealed that yoga exercises affect static balance in girls with intellectual disability.

These findings are not consistent with those obtained by This difference is due to type of exercise and age of the subjects.

Balance operates as a feedback circuit between the brain and musculoskeletal system. Dynamic balance can be observed in normal individual movements in daily activities, which play an important role in human life. The importance of dynamic balance is more considered in lives of mentally retarded individuals since they are less physically active than healthy people. Imbalance increases the likelihood of falls, which can cause various injuries (Ulrich *et al.*, 2011, Ordonez *et al.*, 2010). The findings showed that yoga exercises affect dynamic balance of mentally retarded girls. Muscular tonicity and hypermobility of the joints are common in people with intellectual disability. Weakness in lower limbs and poor balance in standing posture increase the possibility of falling.

Improved strength and balance after walking program positively increase self-confidence and reduce or decelerate age-related diseases, reduce the risk of falling and encourage people with intellectual disability to participate in social and recreational activities (Wipple *et al.*, 1987). The findings revealed that yoga affect the number of steps per minute in mentally retarded girls.

Walking requires coordination, balance, healthy proprioceptive and mobility sense as well as healthy joints and muscles. The present study compared the static balance after a period of yoga exercise between the experimental group and the control group in mentally retarded girls. The results showed a significant difference in static balance after a period of yoga exercise between the experimental group and the control group in mentally retarded girls. They suggested that balance increases after a period of yoga exercise program in people with intellectual disability.

Cui (1970) and Molnar (1978) argued that imbalance in people with intellectual disability refers to controlling muscular patterns before coordination between them and integration of central movement patterns caused by poor myelination, descending brainstem and cerebral nerves and reducing the number of nerve connections in higher nerve centers such as motor cortex, basal ganglia, cerebellum and brain stem through the spinal cord.

Neuromuscular abnormalities in people with intellectual disability include muscular tonicity, durability of earlier reflections after their disappearance as they grow older and slow response during voluntary movements, which delay growth in these people (Davis and Kelso 1982). Hypermobility of the joints and muscular tonicity are the main cause of weakness in balance. Previous studies showed reduced and slackened motor activities from childhood to adulthood in people with intellectual disability, which is probably due to delay in development of basic skills (Rigoldi *et al.*, 2011).

The present study compared dynamic balance after a period of yoga exercise between the experimental group and the control group in mentally retarded girls. The results showed that dynamic balance increased after a period of yoga exercise in the experimental group in mentally retarded girls. They suggested that dynamic balance increased after a period of yoga exercise in people with intellectual disability.

Some researchers argued that balance increase as the subjects grow older since visual, vestibular and somato sensory systems have developed (Nolon *et al.*, 2005). The study compared the number of steps per minute between the experimental group and the control group in mentally retarded girls. The results showed that the number of steps per minute increased after a period of yoga exercise in mentally retarded girls. They suggested that the number of steps per minute increased after a period of yoga exercise in mentally retarded individuals.

Thus, Yoga is a traditional sport exercises, which meet individual physiological needs for muscular stretch and increasing mobility of joints and muscular tonicity for harmony between body and soul. The stretching helps to reduce cerebral excitements and muscular contraction, which improves physical and mental alertness, social adaptability, reduces depression and anxiety, improves concentration, and improves the balance. Thus, necessary measures should be adopted to remedy difficulty in balance in these subjects due to importance of balance in daily activities and acquiring other skills and positive impact of various physical exercises in improving the balance (Tsimaras and Fotiadou 2004).

In summary, people with intellectual disability are less physically active than normal subjects. Improvement in the present study may be attributed to the exercise protocol. Thus, yoga exercise can be used as a method to improve balance and gait in people with intellectual disability. On the other hand, it seems that changes in training methods effectively improve balance and gait according to the findings of other studies. Additional studies are needed in this area.

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