The effect of 6 weeks core stabilization training program on the balance in mentally retarded students

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Abstract. The purpose of this study was to examine the effect of core stabilization training program on the balance of mentally retarded students. Thirty one mentally retarded male students were selected. *Methods*. Subjects were divided randomly into two groups, training (TRN: n= 17) and control (CTL: n= 14). The dynamic balance was measured with the modified Star Excursion Balance Test (Y test). TRN group performed a core stabilization program for 6 weeks and three times per week. The pre-test and post-test of Y test was done for two groups afterward. Independent and dependent t-test used to analyze the data. *Results*. Results showed significant differences in mean posterolateral and Posteromedial in the experimental group in post test ($p \leq 0.05$) but insignificant on anterior direction ($p \leq 0.27$). *Conclusion*. Core stabilization training program may improve the dynamic balance and can be used with other training programs.
Key words: *mental retardation, core stability, dynamic balance, Y test*.

Introduction

Mental retardation (MR) causes important effects on children physical fitness, as well as cognitive activities during life span. Most research in the literature states that children with MR have poor level of physical fitness compared with their nondisabled peers. These studies found that children with MR have a low level of cardiovascular endurance, muscular strength, muscular endurance, running speed, balance and agility. It is well known that children with MR have isolation problems in society what leads to their physical inactivity. Some research reports indicate that children with
MR achieves very low scores in cardiovascular fitness tests. In addition; several studies reported a significantly positive correlation between inactive lifestyles and cardiovascular disease. Therefore, physical activities should be established for children with MR, to develop their cardiovascular fitness (1). According to the American Association of Mental Retard (2006), the motor development of those children’s can present functional incapacities, limiting the execution of activities and restricting the participation of several situations of the real life. Therefore it is important to analyze the individuals' motor aspects with ID. One of the variables to be analyzed is the balance. That requires inputs from visual, somatosensory and vestibular inputs as well as their integration to reference the self within the environment and deficits in balance may result in delayed motor development because as postural control is generally presumed to be a precondition for the development of motor skills (2). However, current data regarding the effects of intellectual disability on balance performance are limited. Balance is an important component of daily activity and athletic performance (3). Balance plays a curtail role in almost all sport events. Either in shooting which requires the least amount of movements or dynamic sports such as gymnastics and wrestling, which require agility in conjunction with maximum balance, balance plays a critical role in success and failure (4). Specialists believe in the important role of posture control and balance in doing tasks such sitting,

2004
standing and walking. The core encompasses the lumbopelvic-hip complex (with 29 muscles of insertion) in which the center of gravity is located and where all movements begin (5).
Core stability is the motor control and muscular capacity of the lumbopelvic-hip complex. Normal function of the stabilizing system is to provide sufficient stability to the spine to match the instantaneously varying stability demands due to changes in spinal posture and static and dynamic loads.
Panjabi proposes that spinal stabilization is dependent on the interplay between passive, active and neural control systems so that if deficit occurs in one of the systems, other systems will try to compensate with prevention of injury (6).
Clark stated that the core function to maintain postural alignment and dynamic postural equilibrium during functional activities, which helps to avoid serial distortion patterns, thus improving athletic performance (7).
Leetun (8) suggests that core stability is one of the factors related to lower extremity injury. Also core stabilization training is a main portion of rehabilitation programs in people with low back pain (9).
There is experimental evidence from studies that core stabilization exercise has beneficial effects on balance control (4). These studies are done on athletes so that core stabilization training program is included in athletic movement. Also, there are different reports about type and time of training protocol. In this study we attempt to investigate the effect of core stabilization training on balance in people with imbalance problems.
Regarding the role of vestibular system in maintaining balance, ears are taken in to account as the sensory-balance limbs. Some studies reported that compared to healthy people, deaf ones have less skills in balance and they rely on sight outputs in balanced tasks (4).
Therefore, the aim of this study is to assess the outcome of six weeks core stabilization training program on the dynamic balance in mentally retarded students.

Material and Method

Our subjects included 31 students boys mentally retarded in the two groups (control, 14 patients with a mean age of 11.07±3.02, height 152±7.86, weight 44.07 ± 8.08) and (17experimental group with a mean age 11.23 ± 1.95, height 147±7.07, weighing 38.11±4.85) of the random pare selected. The two groups were with 50-70 IQ level. Subjects signed an informed consent form and answered a demographic.
Injury history questionnaire, which was used to obtain background information from each subject. Any they were free of lower and upper extremity pathology, neurological and visual disorders, and none of them used medication and did not perform any core stabilization, strengthening and balance program within the past six months and they were matched in age and physical activity level.
Core Strength Training Protocol. The control group did not receive the CST protocol; they were instructed to maintain their training routines and to report any alterations to the investigator. The CST group received the CST program that consists of 5 core-related exercises performed 4 times per week for 6 weeks.
The following 5 exercises were visually demonstrated and verbally instructed by the investigator after the pre training test: a) abdominal crunch on a stability ball to target abdominal muscles, b) back extension on a stability ball to target back extensor muscles, c) supine opposite 1-arm.1-leg raise to target back hip extensor muscles, d) hip raise on a stability ball to target back hip extensor muscles, and e) Russian twist on a stability ball to target abdominal muscles. The exercises are relatively well balanced, targeting core muscles (abdominal, hip flexor & extensor and back extensor muscles).
All exercises were fully instructed and demonstrated by a certified strength and conditioning specialist to ensure the understanding of the proper mechanics after the pre training laboratory test. In addition, the CST group received a hard copy of exercise instructions including pictures and training logs. Stability balls were provided to the experimental group because the treatment is intended for home training. They were instructed to fill out the training log after each session, and they also were contacted by the investigator at the end of each week to ensure adherence or to answer any concerns. Table 2 lists the volume of the training for the 6 weeks. According to Casio Lima et al, the total session volume should increase to challenge strength improvement rather than performing the same volume throughout the treatment. Therefore, this study was designed to increase the volume of exercise sessions every 2 weeks (10).
Y Balance Test Protocol. The Y TEST involved a taped star pattern with three excursions each at

135 degrees from each other, on an even floor surface.

Subjects placed their non-dominant foot on the middle of the star pattern, while their dominant foot reached as far as possible to each of the three excursions (anterior excursion, posteromedial excursion, posterolateral excursion) while maintaining a single leg stance while reaching with the opposite leg to touch as far as possible along a chosen excursion.

They touched the farthest point possible, and as light as possible, along a chosen excursion with the most distal part of their reach foot. Subjects were then instructed to return to a bilateral stance while maintaining their balance.

A practice session of 6 times in each excursion followed by a one minute rest and then the measured average of three trials for each excursion was recorded as the subject's dynamic balance scores.

Trials were discarded and repeated if the reach foot was used to provide considerable support when touching the ground, the stance foot was lifted from the center of the star grid or if the subject was unable to maintain balance throughout each excursion (Fig. 2).

Additionally, the leg length of the subject's dominant extremity was used to normalize their dynamic balance scores (excursion length.leg length x 100) for a percentage of an excursion distance in relation to the subject's leg length) and used for data analysis (11, 12).

*Lower Limb Length***.** On a mat table with the subject supine, the subject lifted the hips off the table and returned them to starting position. Then, the examiner passively straightened the legs to equalize the pelvis. The subject's right limb length was then measured in centimeters from the anterior superior iliac spine to the most distal portion of the medial malleolus with a cloth tape measure (3).

Procedure. At the orientation meeting, subjects were explained the purpose of this study, training protocol and balance test.

The participant's dominant leg was noted and measured, as determined as the leg that would normally be used to kick a soccer ball (11). Subjects were categorized randomly into two groups, training (TRN: n=17) and control (CTL: n=14).

Training group performed a core stabilization training program for eight weeks. The control group did not perform any of the training exercises. Subjects did balance tests one week prior to the beginning of the core stabilization training program (pre-test) and one week after the Conclusion of the core stabilization training program (post-test).

An independent t test was conducted to compare pretest and posttest between groups. In addition, a depended t test used to compare pretest and posttest in each group. The experiment wise alpha level was set at ($p<0.05$).

Results

Table I shows mean and standard deviation (SD) of the general characteristics of subjects in training and control groups.

Table II showed a significant difference between pretest and posttest of dynamic balance for training group ($p<0.005$) while in control group it was not significant ($p>0.005$).

Significant differences between groups (fig 1) was found in posterolateral excursion (t = 1.744, $p=0.007$) and posteromedial excursion (t=0.426, $p=0.001$).

Table I. General characteristics of subjects

Group	Age (years) Mean ± SD	Height (cm) Mean ± SD	Weight (kg) Mean ± SD
TRN	11.23±1.95	147±7.07	38.11±4.58
CTL	3.02±11.07	7.87±152	44.07±8.08

2006

Table II. Descriptive statistics for pre- and post-test data for the Y Test

excursion	group	pre-test (Mean ± SD)	post-test (Mean ± SD)	*t*	*p*-value
Anterior	CTL	65.57±7.57	72.07±8.98	1.802	0.082
	TRN	68.53±6.92	77.94±9.07	1.135	0.271
Posterolateral	CTL	70.79±12.10	58.00±12.75	5.967	0.688
	TRN	72.29±7.47	80.88±8.50	0.426	0.001*
Posteromedial	CTL	70.71±10.16	66.93±12.71	2.993	0.094
	TRN	64.47±9.71	79.06±9.86	1.744	0.007*

*$p<0.005$

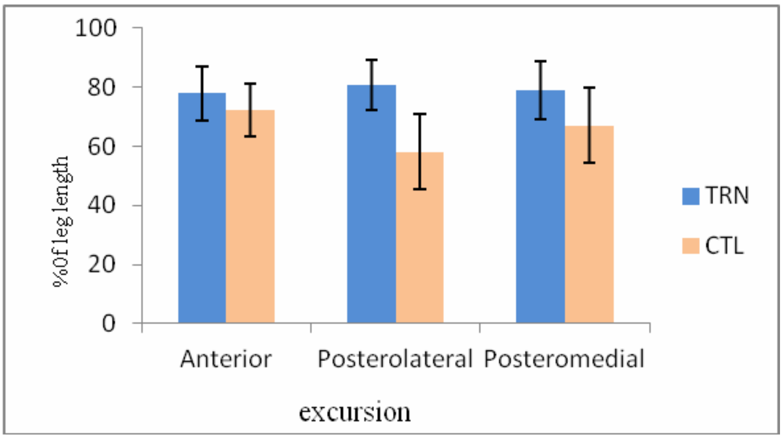

Figure 1. Y Test value.
* Indicates that there are significant different between training and control group

Discussion

The purpose of this study was to examine the effect of core stabilization training program on the dynamic balance in mentally retard students. It is well known that children with mental retardation have low physical fitness levels compared to children without disabilities (13).

Shepherd (1980) stated that this was highly related to low physical activity participation instead of physical disabilities (1).

In addition, Pitetti and Champell (1991) concluded that low physical fitness of mental retardation children was related to the combination of low motivation and insufficient physical activity (14). Furthermore, research showed that mentally retarded populations have lower motor performance standards compared to populations without disabilities (14).

Results showed that core stabilization training improved dynamic balance in mentally retarded students. There was significant difference in posteromedial, posterolateral but insignificant in anterior direction for training group.

The findings of this study was consistent with results of studies like Crapes et al. (15), Petrofsky et al. (16) and Casio-Lima et al. (17) who noted that core stabilization training results in improving the balance but was not consistent with Piegaro (18), Swaney & Hess (19) and Lewarchick et al. (20).

Although there were some basic similarities in their findings, the subject population and design of the studies were different. In the Piegaro's study (18) 39 healthy subjects were divided into four groups (core, core/balance, balance training, and a control group), whereas the present study worked on deaf students. Swaney and Hess (19) used healthy subjects for their control group and swimmers, while Lewarchick et al. (20) used healthy controls and football athletes. Since there is no universally accepted standard for core stabilization training program, it is not known what type, frequency or duration of exercises should be prescribed. Piegaro (18) conducted a four weeks program in which the specified training programs were conducted two times a week for four weeks, instead of three times a week for five weeks. Swaney and Hess (1) did a nine-week program, and Lewarchick did a seven weeks program.

Also, Piegaro, Lewarchick and Swaney used laboratory methods for assessing the balance such as Biodex Stability System while here the functional test was applied. Furthermore, in more previous studies was focused on contraction and strengthening of global muscles, but in this study was tried to strength deep and local muscles of core in training program. It is surprising that in this study, core stabilization training had the great test improvement for the easiest reach directions while had the least improvement for other directions. Hertel et al. (12) found the Y TEST requires neuromuscular control through proper joint positioning and strength from the surrounding musculature, throughout the test. Contraction of core stability muscles before initiation of limb movements, which is the feedforward posture reaction from neuromuscular system, shows that voluntary movement of the upper extremity is preceded by postural movements occurring in the lower extremity (pelvis, hips and trunk) that contributes to general dynamic organization of balance and inhibits postural disturbances. Core stabilization training program leads to sequencing the anticipatory activity and then reduces early perturbations of the center of gravity, which is a benefit for the individuals who need to remain in constant postural control (21). It is important to train movements and not muscles, so that everything works together. Training movements integrates and improves the function of the neuromuscular system in postural control (10). Furthermore the core is important because it is the anatomical location in the body where the center of gravity is located and movements stem from, therefore it seems strengthening of muscles of core causes the improvement of neuromuscular system and decrease of center of gravity displacement and sway (7). Core stabilization training improves neuromuscular system efficiency which leads to optimal arthrokinematics in the lumbopelvic-hip complex during functional kinetic chain movements, optimal acceleration, deceleration, optimal muscular balance and provides proximal stability for efficient lower extremity movements (21). This effects lead to optimal function and lower extremity muscles strength, that can eliminate produced torque during reaching in Y test. Consequently, subjects can obtain more reach distance in Y TEST. In this study, the applied training protocol was so that subjects performed their task on unstable surface such as Swiss ball, and this challenged their balance.

Results of our study showed no significant difference in anterior. It seems that core stabilization training had fewer effects on neuromuscular system control and muscles strengthening in this direction. One reason for this may be that these directions appeared to be the most difficult ones.

Hodges and Richardson (22) suggested making sure that the proper contractions occurred during the core stabilization training program which was paramount for determining the amount of neuromuscular controls that would be contributing to the Y TEST for optimum effects.

However, our study did not implement any invasive techniques for measuring muscle activation. Only subject feedback and visual observation by the principle investigator served as the assessment of core activation, it is possible that subjects during core stabilization training were not able to contract stability muscles well. In conclusion, core stabilization training may be used to enhance dynamic balance in mentally retarded students and is applied in the clinical setting.

Reference

1. Yılmaz I, Ergun N, Konukman F, Agbuğa B, Zorba E, Cimen Z (2009). The Effects of Water Exercises and Swimming on Physical Fitness of Children with Mental Retardation. *JOHK*; 21: 105-111.
2. Gorla J, Ferreira P, Trevizan L (2010). Performance of balance beam task of K.T.K. by people with intellectual disability. *J of Artigo*; pp101-111.
3. Hessari AF, Norrasteh AA, Daneshmandi H, Ortakand SM (2011). The Effect of 8 Weeks Core Stabilization Training Program on Balance in Deaf Students. *Med.Sport*; 15(2); 56-61.
4. Gary G, Gambetta V (2000). Functional balance. www.nationalthrowscoachesassociation.com at @EbookBrowse
5. Bergmark A (1989). Stability of the lumbar spine: a study in mechanical engineering. *Acta Orthop Scand*; Suppl 23: 1-54.

2008

6. Panjabi MM (1992). The stabilizing system of the spine. Part I: Function, dysfunction, adaptation and enhancement. *J Spinal Disord*; 5:38-39.
7. Clark MA, Fater D, Reuteman P (2000). Core (trunk) stabilization and its importance for closed kinetic chain rehabilitation. *Orthop Phys Ther Clin North Am*; 9: 119-35.
8. Leetun DT (2004). Core stability measures as risk factors for lower extremity injury in athletes. *Med Sci Sports Exerc*; 36: 926-34.
9. King MA (2000). Core stability: creating a foundation for functional rehabilitation. *Athl Ther Today*; 5: 6-13.
10. Kimitake S, Monique M (2009). Does core strength training influence running kinetics, lower-extremity stability and 5000-performance in runners? *Journal of Strength and Conditioning Research*; 23(1):133–140.
11. Plisky PJ, Gorman PP, Butler RJ, Kiesel KB, Underwood FB, Elkins B (2009). The reliability of an instrumented device for measuring components of the Star Excursion Balance Test. *North American Journal of Sports Physical Therapy*; 4(2); 92.
12. Hertel J, Miller SJ, Denegar CR (2000). Intratester and intertester reliability during Excursion Balance Test. *J.Sport.Reh*; 9:104-6.
13. Yıldırım Y, Kara B, Harutoğlu Akdur H (2011). Effect of balance training and posture exercises on functional level in mental retardation. *Fizyoter Rehabil*; 22(2): 55-64.
14. Vuijk PJ, Hartman E, Scherder LE, Visscher C (2007). Motor performance of children with mild intellectual disability and borderline intellectual functioning. Journal of Intellectual Disability Research;54(11): 955–965.
15. Carpes FP, Reinehr FB, Mota CB (2008). Effects of a program for trunk strength and stability on pain, low back and pelvis kinematics and body balance: A pilot study. *J Bodyw Mov Ther*; 12: 22-30.
16. Petrofsky J, Cuneo R, Ashley K, Hill J (2005). Core strengthening and balance in the geriatric population. *J Appl Res*; 5: 95-102.
17. Cosio Lima LM, Reynolds KL, Winter C (2003). Effects of physioball and conventional floor exercises on early phase adaptations in back and abdominal core stability and balance in women. *J Strength Condit Res*; 7: 41-52.
18. Piegaro AD (2003). The comparative effects of four-week core stabilization and balance-training programs in semidynamic and dynamic balance. Masters Thesis. Morgantown WV: West Virginia University.
19. Swaney MR, Hess RA (2003). The effects of core stabilization on balance and posture in female collegiate swimmers. *J Athl Train*; 38: S-95.
20. Lewarchik TM, Bechtel ME, Bradley DM (2003). The effects of a seven week core stabilization program on athletic performance in collegiate football players. *J Athl Train*; 38: S-81.
21. Norris CM (2001). Functional load abdominal training: part I. *Phys Ther Sport J*; 2: 29-39.
22. Hodges PW, Richardson CA (1997). Contraction of the abdominal muscles associated with movement of the lower limb. *Phys Ther J*; 77: 132-42.

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