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Effect of core stability exercises using swiss ball on balance performance and quality of life in elderly

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Abstract
Background: Balance is an integral component of most of the daily activities. As a complex sensorimotor function balance control requires the integration of multiple systems such as vestibular, visual, and somaesthetic information into the central nervous system (pyramidal, extrapyramidal and cerebellar systems) in order to maintain antigravity postures and to produce a suitable response to any perturbation. In elderly, impairments of balance have serious health implications. Poor balance is associated with an increased risk of falling, and fall related injuries have significant individual and societal costs. Balance impairments are also associated with poorer mobility measures in elderly population.
Aim: To find out effect of core stability exercises using swiss ball on balance performance and quality of life in elderly.
Methods: 30 Normal healthy community dwelling elderly were selected. Their baseline assessment was done by performing the Time-up-and-go test (TUG), the one-legged-stance test (OLST) and by filling up the SF-36 form. These subjects were then, via multiple block randomization, divided into two groups i.e. exercises performed on swiss ball (Group A) and exercises performed on floor (Group B). After performing the pre test, the training procedures were elaborated for the subjects and were performed under the supervision for 5 weeks, 3sessions per week. The training routine consisted of 2 sets of 8 repetitions of each exercise. Rest periods was given between all sets of program according to need of subject.
Results and Discussion: The data was analysed using Paired t-test, Mann-Whittney U-test and Wilcoxon test. It was seen that both the balance protocols i.e. with or without swiss ball have been effective in improving balance of older adults. Since core stabilization training adds on much stress on lumbar and abdominal muscles, these training sessions have improved balance, since the postural muscles in this area play the most important role in balance and orientation. Here, Abdominal Crunch exercise recruits the trunk flexors (Rectus Abdominis), the back extensor exercise recruits all the back extensors, the bird dog exercise recruits the back extensors (mainly multifidus) and pelvic bridging exercise recruits the paraspinal muscles of the body. In this study, Group A showed more significant values in terms of Timed-up-and-go test and One-legged-stance test as compared to Group B.
Conclusion: It was concluded that core stability exercises using swiss ball are more effective than floor exercises in elderly for improving balance performance. Considering the results of present study, it seems that developing and administering physical fitness programs for the elderly is effective for increasing their balance and as a result their quality of life. Considering their special conditions, both training types can be used and can be recommended to the geriatric society.

Keywords: balance performance, quality of life in elderly, swiss ball

Introduction

Balance is an integral component of most of the daily activities. As a complex sensorimotor function balance control requires the integration of multiple systems such as vestibular, visual, and somaesthetic information into the central nervous system (pyramidal, extrapyramidal and cerebellar systems) in order to maintain antigravity postures and to produce a suitable response to any perturbation [1].

Balance is defined as a complex process involving the reception and integration of sensory inputs, and the planning and execution of movement; to achieve a goal requiring upright posture; it is the ability to control the centre of gravity (COG) over the base of support in a given sensory environment [2].

Normal aging is associated with a decline in the integrity of the physiological systems that contribute to the control of balance [3]. In elderly, impairments of balance have serious health implications [4]. Poor balance is associated with an increased risk of falling, and fall related injuries have significant individual and societal costs. Balance impairments are also associated with poorer mobility measures in elderly population. Increase in age is associated with impaired performance in vestibular, visual and somaesthetic systems, a decline in the speed of information transmission and changes in the mode of information processing in the brain, all of which lead to balance and postural disorders [5-8].

The process of aging results in a deficiency or lack of physical activity which further results in decreased independence, necessity to rely on other persons, and consequently, reduced quality of life [9].

As the body ages, the changes in the musculoskeletal, sensory and neural systems (motor control) begin to affect mobility. The muscular system also plays a role in balance as all body movements are affected by skeletal muscles. Muscular strength is needed to maintain postural stability during walking.

Balance improvement has resulted in a number of balance intervention studies, which initially focused on task specific exercises and every day activities such as getting in out of chair, or stepping up and down from one level to another. These studies demonstrated that balance can be improved. Researchers then began to examine the effect of task specific exercises in combination with strength training. They found that not only did the combination of the two exercises improve balance, but strength training alone also improved balance [10].

Recent advances in balance training include aerobic exercises, Tai chi, alone or in combination with weight training. On the other hand, core stabilization as a modern training procedure highly affect abdominal and lumbar muscles and the results of various studies signify that conducting these training decreases back pain. Nonetheless, the effect of these training on balance, especially in elderly adults, has not yet been analyzed and since performing these training do not cost much, they can be substituted with traditional training providing that they are effective in improving balance and quality of life of elderly of the elderly, so that elderly adults will perform training in a safe environment which will increase their life independence as well as providing them with a variety of training levels [11].

Another recent advance in core stabilization training is use of the swiss ball. These exercises are used to strengthen the core abdominal muscles [10]. Abdominal muscular endurance and strength are important for trunk stability, appropriate posture and body movements. The core is important because it provides proximal stability for distal mobility [12].

The central nervous system and body proprioceptors work together to refine patterns of movement. Performing exercises on swiss ball may increase proprioceptive demands and stress the core muscles that are important for balance and stability[13].There is a need for more research to examine if exercises that focus on core strength training through swiss ball, can be effective as other balance programs.

Effects of physical exercises in elderly are equivocally beneficial. Their positive effects do not decrease with age. For persons at older age, it is recommended to participate in an appropriate physical training. Physical activity programmes adjusted to the needs of elderly persons that would allow them to maintain physical fitness and thus better quality of life for a possibly long period of time [9]. Therefore the purpose of this study was to investigate the effect of core stability exercises using swiss ball on balance performance and quality of life in elderly.

Aim

To find out effect of core stability exercises using swiss ball on balance performance and quality of life in elderly.

Objectives

- To find out effect of core stability exercises using swiss ball on balance performance
- To find out effect of core stability exercises using swiss ball on quality of life.
- To find out effect of core stability exercises on floor on balance performance
- To find out effect of core stability exercises on floor on quality of life.

Hypothesis

Core stability exercises using Swiss ball are more effective than core stability exercises on floor in elderly for improving balance and quality of life. *Alternative Hypothesis*: Core stability exercises on floor are more effective than core stability exercises using swiss ball in elderly for improving balance and quality of life. *Null Hypothesis*: Core stability exercises using Swiss ball and exercises on floor are equally effective in elderly for improving balance and quality of life.

Significance

If proved effective core stability training using swiss ball can be used as an adjunct to currently used rehabilitation protocol for improving balance performance in elderly which further can lead to improvement in function and quality of life.

Procedure

A sample of 30 elderly subjects were selected based on the inclusion and exclusion criteria. The participants were explained about the purpose and nature of the study followed by signing of the informed consent form (Appendix A). The general assessment regarding the demographic data (name, age, gender and address), health-related information (any past medical history problem) was gathered in an assessment performa (Appendix B). The various measurements were taken like age, height, weight, Mini Mental State Examination, Geriatric Depression Scale, Barthel Index (Appendix D). One Legged Stance Test, Time Up and Go Test and Short Form-36 Questionnaire survey were performed to measure score for balance performance and quality of life before training. The instructions regarding the test were given to the subjects. One legged Stance Test was tested on preferred leg indicated by each subject. The subject was asked to stand erect on firm surface with arms folded across chest and head facing straight ahead, then to raise one leg based on preference and kept the leg raised as long as possible. The number of seconds the subject was able to maintain balance without touching the other leg, without uncrossing arms, or using any support, was recorded by stop watch. The Time Up and Go test measured (in seconds) the time taken by individual to stand up from a standard arm chair, walk a distance of 3 meters, turn, walk back to the chair and sit down. No physical assistance was given. They started with their back against the chair, their arms resting on the armrests. They were instructed that, on the word "go" they had to get up and walk at a comfortable and safe pace to a line on the floor 3 meters away, turn, return to the chair and then sit down again. The subject walked through the test once before being timed in order to become familiar with the test. Three trials were recorded and the best score was recorded. After measuring scores for balance performance, the Short form 36 was used to measure quality of life. Short Form-36 Questionnaire survey was given to the subject and instructed to answer every question by marking the answers as indicated. If they were unsure about how to answer the question, they were advised to give the best answer they could.

Subjects were divided into 2 groups for study i.e. Group A performed core stability exercises using swiss ball and Group B performed core stability exercises on floor. Same exercises were given to both the groups i.e. abdominal crunches, back

extension exercise, pelvic bridging and bird dog exercises. After performing the pre test, the training procedures were elaborated for the subjects and were performed under the supervision for 5 weeks, 3sessions per week. The training routine consisted of 2 sets of 8 repetitions of each exercise. Rest periods was given between all sets of program according to need of subject.

Protocol

Table 1

Exercises	Week 1	Week 2	Week 3	Week 4	Week 5
Abdominal Crunches	Sets -2, Rep.-8 /set, Hold-2 sec	Sets -2, Rep.-8 /set, Hold-3sec	Sets -2, Rep.-8 /set, Hold-4sec	Sets -2, Rep.-8 /set, Hold-5sec	Sets -2, Rep.-8 /set, Hold-6 sec
Back extension	Sets -2, Rep.-8 /set, Hold-2 sec	Sets -2, Rep.-8 /set, Hold-3 sec	Sets -2, Rep.-8 /set, Hold-4 sec	Sets -2, Rep.-8 /set, Hold-5 sec	Sets -2, Rep.-8 /set, Hold-6 sec
Pelvic bridging	Sets -2, Rep.-8 /set, Hold-2 sec	Sets -2, Rep.-8 /set, Hold- 3sec	Sets -2, Rep.-8 /set, Hold-4 sec	Sets -2, Rep.-8 /set, Hold-5 sec	Sets -2, Rep.-8 /set, Hold-6 sec
Bird dog	Sets -2, Rep.-8 /set, Hold-2 sec	Sets -2, Rep.-8 /set, Hold-3 sec	Sets -2, Rep.-8 /set, Hold-4 sec	Sets -2, Rep.-8 /set, Hold-5sec	Sets -2, Rep.-8 /set, Hold-6sec

Results

Data was collected for Timed-up and Go Test, One Legged Stance Test and Short form-36 health questionnaire. The number of males and females in each group was 12 and 3 respectively.

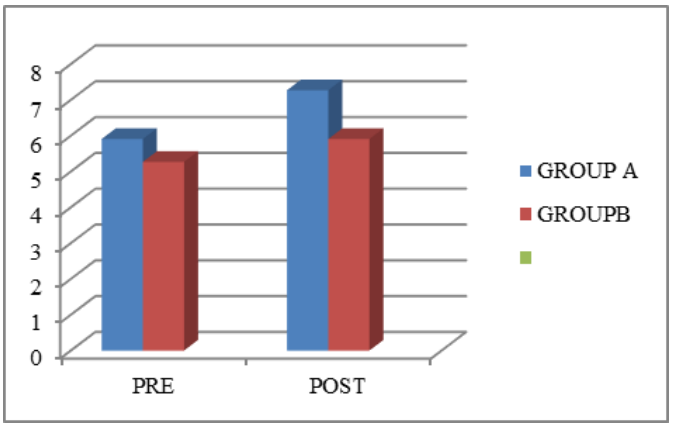

Fig 1: Comparison of mean score of One legged stance test (OLST) of Group A and B

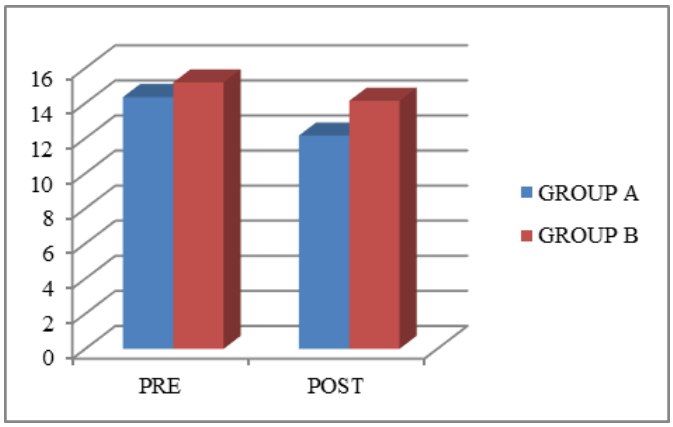

Fig 2: Comparison of mean score of Timed-up and Go Test (TUG) of Group A and B

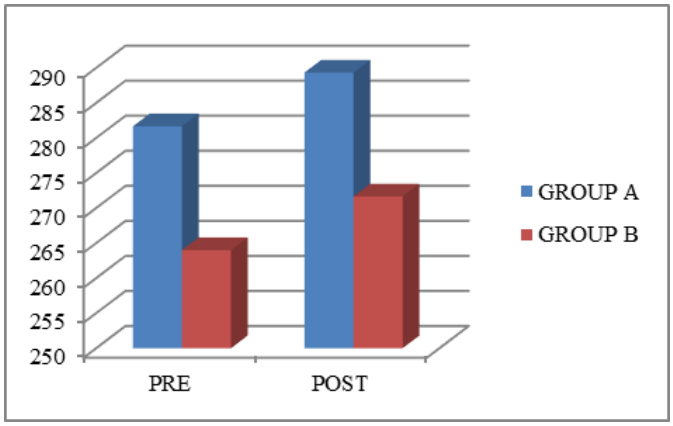

Fig 3: Comparison of mean score of Short Form-36 of Group A and B

Discussion

Confirming our hypothesis, the core stability exercises on swiss ball are more effective than core stability exercises on floor in elderly for improving balance.

It was seen that both the balance protocols i.e. with or without swiss ball have been effective in improving balance of older adults. Since core stabilization training adds on much stress on lumbar and abdominal muscles, these training sessions have improved balance, since the postural muscles in this area play the most important role in balance and orientation. Here,

Abdominal Crunch exercise recruits the trunk flexors (Rectus Abdominis), the back extensor exercise recruits all the back extensors, the bird dog exercise recruits the back extensors (mainly multifidus) and pelvic bridging exercise recruits the paraspinal muscles of the body.

Comparison of the groups revealed significant difference in terms of Timed-up-and-go test and One-legged-stance test predicting static and dynamic balance.

In this study, Group A showed more significant values in terms of Timed-up-and-go test and One-legged-stance test as compared to Group B. This is because performing the abdominal and back exercises on unstable surfaces stressed the musculature and activated the neuro-adaptive mechanisms that led to gain in the stability and proprioceptor activity. Similarly, in a study conducted by *Ludmila M. et.al. (2003*) [13] to compare the effect of 5 weeks of physio ball core stability and balance exercises with conventional floor exercises in women, It was found that physio (swiss) ball group had significantly greater balance scores than the floor exercises. They concluded significant increases in abdominal and erector spinae muscle Electromyographic (EMG) activity and duration of static balance times when compared to floor exercises [13].

According to *Kibler et al (2006)* [65] who studied the role of core stability in athletic function, the body uses core muscle activation to generate the necessary rotational torque around the body and produce extremity motion. Based upon this suggestion, we theorized that in One Legged Stance Test and Time Up and Go test, as the subject stands on the stance leg and uses the opposite limb to reach, the rectus abdominus and oblique muscle would fire before the movement occurs to perform trunk motion, allowing the subject to maintain balance [65].

The multifundi and transverse abdominus muscles would help to maintain dynamic balance during lower extremity movement by providing support to the lumbar spine. Similarly, in a study conducted by *Marshall and Murphy et al. (2005*) [15] the effect of core stability exercises on and off a swiss ball was studied. They found that exercising on Swiss ball lead to greater activation levels of the muscle of the lumbopelvic region during performance tasks. Exercising on the swiss ball increased activity for the rectus abdominus, transverse abdominus and obliques during press up exercise when compared with exercise on a stable surface. In the present study the subjects in core stability group performed exercises on Swiss ball, which may have created similar improvement reported by *Marshall and Murphy* [15].

This is supported by *Behn et.al. (2002*) who studied the differences in isometric force output, muscle activation (interpolated twitch technique), and electromyographic activity of the quadriceps, plantar flexors (PF), and their antagonists under stable and unstable conditions. They concluded that primary purpose of training program with physio (swiss) ball should not be only to gain strength but also to gain stability, improve balance and proprioceptive capabilities [71]. So, this could be the reason for more improvement in group A those performing exercises on swiss ball as compared to group B those performing exercises on floor.

Hajar Jahadian et al (2012) studied the effect of eight weeks aquatic balance training and core stabilization training on dynamic balance in inactive elderly males. They found that the effect of both training types on balance was equal and no significant difference was observed between them.[89]

Shriharsh et al (2010) who investigated the efficacy of sensory EMG biofeedback and swiss ball exercises in geriatric training program for improving strength and balance and their influence on subjective functional well being. They concluded that comprehensive preventing program with inclusion of sensory EMG biofeedback and ball exercises to improve strength and balance for geriatric population is beneficial for improving their functional well being. They also stated that use of air-filled ball in conjugation with functional tasks was effective in increasing strength in anti-gravity trunk musculature in turn to improve postural awareness and maintain good balance [70].

Mohammad M. et al (2004) found out the effect of combined sensory and muscular training on balance in older adults and they revealed that a combined sensory and muscular training on balance and strength in older adults has a marked improvement in balance measures like one leg stance balance, dynamic balance and lower limb strength after 12 weeks of supervised training that challenged the sensory and muscular system [57]. This suggests that if the somatosensory training is given for a long period, then it may affect the static as well as dynamic variables of balance [90].

This is further supported by *Jerrold et al. (2005*) [68] who evaluated the effect of exercise regime on strength training in the core muscles, balance and reach in geriatric population. They assessed balance and functional reach before and after the exercise program. They concluded that even if older individuals are engaged in a basic fitness program, training is very beneficial in increasing their independence and functional activities of daily living [68].

In the present study, it was seen that both the balance protocols i.e. with or without swiss ball have been equally effective in improving quality of life of older adults in terms of mean difference. Within group analysis of Short Form 36 revealed a non-significant result. This can be due to the fact that no training was given for upper and lower limbs individually instead stress was laid on core muscle training. Hence, the between group analysis also showed no significant difference.

This is supported by *Metel et al. (2006*) [9] who evaluated the effectiveness of physical exercises, particularly exercises on unstable surfaces in improving functional efficiency and self-evaluation of quality of life in elderly people. They concluded that applied physical exercise programme positively influences the results of tests describing physical performance of elderly people. Also, higher self-evaluation of quality of life was supported by these people in two physical categories and in two mental categories of Short-Form-36 test [9].

Though the experimental hypothesis of this study is supported by the results of statistical analysis of variables, we can conclude that balance training on swiss ball has beneficial effect on dynamic and static balance of elderly and can be effective in the quality of life if given for long duration.

Limitations

1. Time duration considered was less.

2. Follow –up of balance test was not considered.
3. More sophisticated instruments like force plate analysis, posturography, videography, etc. were not considered.
4. Sample size considered was small.
5. Strength of core muscles was not considered.

Conclusion

It was concluded that core stability exercises using swiss ball are more effective than floor exercises in elderly for improving balance performance. Considering the results of present study, it seems that developing and administering physical fitness programs for the elderly is effective for increasing their balance and as a result their quality of life. Considering their special conditions, both training types can be used and can be recommended to the geriatric society.

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