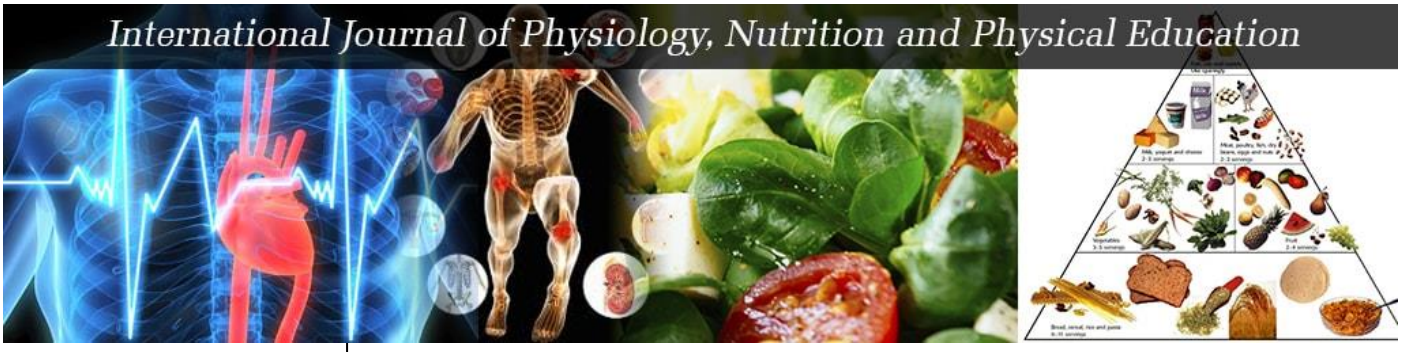

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Effectiveness of a balance exercise program to improve postural control in older adults

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Abstract
Background: Balance is a fundamental ability of human movement. Aging and all neuromusculoskeletal disorders result in decreased postural control and falls. Therapeutic exercise is an effective tool to improve postural control. Balance exercise programs have proved to be helpful for older adults. This study is to measure the level of physical activity in older adults and determine the effect of a balance exercise program to improve on postural control in older adults.
Objective: The objective of the study is to measure the level of physical activity in older adults and determine the effect of a balance exercise program to improve on postural control in older adults.
Methodology: An interventional study was conducted to find the effectiveness of balance exercise in older adults to improve postural control. Convenient samples of 30 older adults < 50 years with normal BMI were assessed and underwent intervention process based on inclusion criteria. International Physical Activity Questionnaire was used to assess level of physical activity in subjects and Tinetti Performance Oriented Mobility Assessment used before and after exercise program to assess balance &gait. The exercise was given of weekly thrice 1 hour session over a 4 week period.
Result: Statistical analysis was done using descriptive statistics and paired t tests. Mean and standard deviation of the collected data of POMA are 21.76 +3.69 in before and 26.86 +1.4 in after treatment. The results of IPAQ in collected data are high and moderate level of physical activity. The t tests show significant improvement in pre and post treatment (before and after balance exercise). i.e. POMA – T = 7.921(p=0.000), POMA – G = 4.527(p=0.000) and POMA – B = 9.279(p=0.000).
Conclusion: This study concludes that balance exercise program that improved postural control in older adults with normal BMI. And these interventions are help to reduce the risk of falls. The balance exercise program was given only for 4 week period.

Keywords: Aging, balance, postural control, falls, exercise program

Introduction
The aging process occurs around the world and is accompanied by changes in neuromuscular, somatosensory, vestibular, and visual systems associated with sedentary lifestyles or diseases, and results in decreased postural control and falls. Falls resulting in injuries such as fractures, psychological disorders, and increased use of health services (the leading cause of emergency department visits), generate costs for both the individual and for health services, and can result in not intentional death for older adults [1]. Injuries and loss of life due to falls in the elderly is a very major factor facing them [2].
Balance is a fundamental ability of human movement. Mechanically it can be defined as the ability to sustain center of body mass in limits of the support surface. Support surface can be defined by the area between the feet or with the area of the ground on which a person stands [3]. All neuromusculoskeletal disorders result in some degeneration in the balance control system. Three major sensory systems are involved in balance and posture. Vision is the system primarily involved in planning our locomotion and in avoiding obstacles along the way. The vestibular system is our 'gyro', which senses linear and angular accelerations. The somatosensory system is a multitude of sensors that sense the position and velocity of all body segments, their contact (impact) with external objects (including the ground), and the orientation of gravity [2].
Postural control is defined as the act of maintaining, achieving or restoring a state of balance during any posture or activity.

The posture is maintained by tonic muscle contractions against gravity and stabilizing the positions of body segments [4]. The many complex substrates of the postural control system subserve a common functional goal: regulation of the relationship between the center of mass and the base of support [5].

Falls are defined as accidental events in which a person falls when his/her center of gravity is lost and no effort is made to restore balance or when this effort is ineffective. Falls are considered as the most common cause of injuries in older population [6]. The most common fall-related consequences are pain, bruising, lacerations, fractures including upper extremity and hip fractures and intracranial bleeding in severe cases[7]. Risk factors for falls that have been identified include history of falling, use of assistive devices, environmental hazards such as poor lightening, and various health conditions including muscle weakness, vertigo, gait and balance impairments, visual and hearing disorders, cognitive and sensory impairments, orthostatic hypotension, diabetes mellitus, osteoporosis and some medications also increased risk of falls among older adults [6, 8].

Interventions those are effective for postural control in elderly people. Regular performance of exercises that improve postural control reduce the risk of falls is the most effective way to prevent them [9]. A variety of exercises involving gait, balance, coordination, functional tasks, strength training, stretching and multisensory exercises can enhance muscle strength, balance, and mobility in the elderly, reducing the risk of falls [10]. To assess the participants level of physical activity, a short form of the International Physical Activity Questionnaire (IPAQ) was applied. Postural control was evaluated using the Tinetti Performance Oriented Mobility Assessment (POMA). These evaluations were performed before and after the intervention program [1]. So, this study was done to ascertain the improvements of postural control in older adults.

Methodology

This interventional study was conducted in Dakshina Kannada Mangalore. Total of 30 subjects was collected with normal BMI and an age group above 50years including both genders. Subjects having any disease/clinical conditions; Instability, Urinary incontinence, Sensory deficit, Depression, Fear of falling, Hypertension, Osteoporosis, Osteoarthritis, Fracture related to falls, Arthropathy, fall within last year were included and any cognitive deficits were excluded. Subjects fulfilling the inclusion and exclusion criteria were enrolled for the study. Prior to beginning of testing, the purpose and procedure of the study was explained to all participants and provided written formed consent.

Procedure

Tools and apparatus required

- Chair
- Weight cuff (half kilogram/ one kilogram – depending on patient capacity)

The program consisted of weekly thrice 1 hour session over a 4 week period. The exercise program began with a warm up exercises for 5 minutes. For this the subjects perform exercises like lumbar flexion, extension and lateral flexion in right and left in standing position according to instruction. After that they perform stretching exercise for hip, knee and ankle muscles for 20 minutes. i.e. hamstring, Iliopsoas, hip adductors, quadriceps and gastrocnemius muscles. Stretching position is, supine for hamstring, Iliopsoas, hip adductors and gastrocnemius muscle, prone position for quadriceps muscles. Next, for 25 minutes, there were exercises for motor coordination and balance training associated with recreational activities like, unilateral knee flexion, extension and abduction with weight cuff in ankle of standing position with hands supported in a chair, calf raises and toe raises with same position, squatting, tandom position (keeping one foot in front of the other) and one – leg stand in standing position, and sideways walking. This was followed by a slowdown and relaxation period of five minutes, during which they performed breathing exercises associated with upper limbs. The progression of the exercises was tailored to each subjects, according to how easily each exercise could be performed, for example, by increasing the time a subject spend with his or her eyes closed while positioned with one foot in front of the other.

1. Stretching exercise: these can be performed for hamstring, Iliopsoas, hip adductors, quadriceps and gastrocnemius muscles. Stretching keeps the muscles flexible, strong and healthy and we need that flexibility to maintain a range of motion in the joints. Without it, the muscles shorten and become tight.
2. Balance training: this balance training program strengthens self-efficacy in balance control leading to improved postural control, fall – related self-efficacy, reduced fear of falling, increased walking speed and improved physical function. The exercises are; unilateral knee flexion, extension and abduction with weight cuff in ankle, calf raises and toe raises, squatting, tandom position, one – leg stand, and sideways walking.

Outcome Measure

International Physical Activity Questionnaire (IPAQ)

The international physical activity questionnaire (IPAQ) comprises a set of 4 questionnaires. Long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available. The purpose of questionnaires is to provide common instruments that can be used to obtain internationally comparable data on health – related physical activity.

Scoring of high level of physical activity IPAQ means your physical activity levels equate to approximately one hour of activity per day or more at least a moderate intensity activity level. Scoring a moderate level of physical activity on the IPAQ means you are doing some activity more than likely equivalent to half an hour of at least moderate physical activity on most days. Scoring a low level of physical activity on the IPAQ means that you are not meeting any of the criteria for ether moderate or high level of physical activity.

Tinetti Performance Oriented Mobility Assessment (POMA)

The Tinetti Assessment tool is a simple, easily administered test that measures a residence's gait and balance. The test scored residence ability to perform specific tasks. Purpose is to measure an older adult's gait and balance ability. Designed to measure balance (including fall risk) and gait function in elderly, but has also been used for patient with various other conditions.

Completion Time: 10 -15 minutes.

Scoring: the Tinetti Assessment Tool is done on a three- point Ordinal scale, ranging from 0-2. "0" indicates the highest level impairment and "2" indicates the individual's

independence. The individual scores are then combined to form three measures;
Total gaits score = 12
Total balance score= 16
Total test score =28

Interpretation: In general, residents who score below 19 are at a high risk for falls. Residents who score in the range of 19-24 points indicate the moderate risk for falls. Residents who score in the range of 25-28 points indicate the low risk for falls.

Equipment's Required: Hard, armless chair**,** Stopwatch or wristwatch, 15 ft (4.57 meter) walkway.

Result

Data was analyzed using SPSS v.16. Descriptive statistical analysis and sample paired t test was used to find mean values for the variables included in the study.

Table 1: Participants' mean and standard deviation of demographic characteristics. BMI=body mass index; SD=standard deviation.

Characteristics	N	Mean(SD)
Age	30	59.03 ±6.71
Sex(male: female)	30	12:18
BMI	30	23.18 ±1.59

Table 2: Descriptive statistics of POMA. X=mean; SD=standard deviation; POMA= Performance oriented mobility assessment; POMA-T=total score; POMA-G=gait score; POMA-B=balance score; t value= paired t test (p value).

Parameter	N	Pre	Post	t value	sig. p value
		X (SD)	X (SD)		
POMA-T	30	21.76 ±3.69	26.86 ±1.4	7.921	0.000
POMA-G	30	10.5 ±1.73	11.9 ±0.3	4.527	0.000
POMA-B	30	11.26 ±2.31	15.03 ±1.26	9.279	0.000

Discussion

Balance is a fundamental ability of human movement. Aging and all neuromusculoskeletal disorders result in decreased postural control and falls. Therapeutic exercise is an effective tool in the prevention of falls. Especially if it is incorporated with a comprehensive strategy targeting health, environmental, and behavioral risk factors that contribute to falls[3]. The selection of exercises and activities for balance training should be based on two major factors: the person's fall risk and the setting in which the training will take place. The cerebellum, in the back of brain, controls balance coordination and fine muscle control. It also functions to maintain posture and equilibrium [12, 13].

Most common causes for impaired postural control in older adults that is; instability, urinary incontinence, sensory deficit, depression, fear of falling, hypertension, osteoporosis, osteoarthritis, fracture related to falls, arthropathy and fall within last year[14]. Patient's gluteus muscles, hip flexors and hamstrings muscles are involved in balance training exercise program. Before each session of exercise program warm up for 5 minutes, warm up includes; lumbar movements and sit – stand. Stretching and balance training for 30 minutes, stretching for hamstring, Iliopsoas, quadriceps and gastrocnemius muscles. In balance training, unilateral knee extension and flexion, calf raises, toe raises, squatting, one leg stand, sideways walking and tandem position [1].

Researchers have found that stretching and balance exercises are effective for postural control in older adults. Thus by also improving a strength and endurance of muscles and reduces the risk of falls[2&5]. All the 30 subjects included in this study have completed the weekly thrice 1 hour session over a 4 week period of their respective treatment under supervision. The patients have shown significant improvement in postural control after 1 month of exercise training protocol. The improvement was measured by using Tinetti Performance Oriented Mobility Assessment (POMA). These evaluations were performed before and after the exercise program on first and last day of treatment[1].

The demographic characteristics of all the participants such as age, gender and BMI, is shown in Table 1. Mean (SD) of the demographic characteristic are; age = 59.03±6.71, gender = 12:18 and BMI = 23.18±1.59.

The descriptive statistics of POMA scores are calculated first and last day of before and after treatment. Scores of first day of treatment; POMA – T = 21.76±3.69, POMA – G = 10.5±1.73, POMA – B = 11.26±2.31. Scores of last day of treatment; POMA – T = 26.86±1.4, POMA – G = 11.9±0.3 and POMA – B = 15.03±1.26. t values of POMA - T = 7.921(p=0.000), POMA – G = 4.527(p=0.000) and POMA – B= 9.279(p=0.000). All the values are significant in this study.

Study by Fábio Marcon Alfieri *et al.* (2012) revealed that the program used in this study was safe and was able to promote some improvement in postural control, especially in the anteroposterior direction and in the base of support. However, it is noteworthy that further improvements could be obtained from a program of longer duration and greater frequency. In this study, volunteers' postural control was evaluated using the Timed Up and Go test (TUG) and the Guralnik test battery, and their static and dynamic posturography were evaluated using the Synapsys Posturography System. These evaluations were performed before and after the intervention program, which included an educational session and two weekly 1-hour sessions over an 8-week period of stretching exercises, proprioception, balance, and motor coordination[1].

Marcelo Riberto et.al. Found that, although the group that performed multisensory exercises presented with a significant reduction of body oscillation and expressive improvement in isokinetic parameters on the heels after training, we cannot state that any of the exercise programs was superior for postural control. A computer-generated list randomly allocated the subjects to one of two training programs: strength training (GS) or multisensory training (GM). Both groups were subjected to one hour of training sessions on two different days a week. Subjects in both programs. We performed isokinetic evaluations of muscle groups in the ankle and foot including dorsiflexors, plantar flexors, inversion, and eversion. The oscillation of the center of pressure was assessed with a force platform [11].

The present study also found that balance exercise program such as stretching and balance training helps in improving postural control in older adults. The study was measured using Tinetti Performance Oriented Mobility Assessment (POMA). This can be shows that reduced risk of fall and improvement in postural control.

Conclusion

The present study concludes that balance exercise program improved postural control in older adults with normal BMI and also help to reduce the risk of falls.

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