IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

EFFECT OF A MULTIMODAL BALANCE ENHANCING GROUP EXERCISE PROGRAM ON ELDERLY

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Abstract:

Background: The rate of falls and severity of the resulting complications increases dramatically with age. When it comes to fall prevention in elderly population, it is very important to collectively work on postural control, Lower limb strength along with balance training. When all this training is given in group and under observation, it helps to improve performance, willingness and promotes motivation to complete the exercise protocol. Hence the need of the study is to find the effect of a multimodal group balance enhancing exercise program on elderly.

Aim: To find the effect of a multimodal group balance enhancing exercise program on elderly.

Methodology: It is an experimental study, having sample size of 20 of age between 65-75 years. The data was collected from the locality and the training took place under supervision. TUG, BBS, One Leg Standing Time were assessed. After exercise protocol, statistical analysis was done, and the result were obtained.

Result: Significant improvements were observed by paired T-test after multimodal balance enhancing group exercises with p-value less than 0.0001.

Conclusion: Study concludes that this multimodal group balance exercise protocol can significantly improve balance in elderly.

Keywords: Balance, multimodal, stability.

INTRODUCTION

Aging is a fundamental process that affects all our systems and tissues. The rate and magnitude of change in each system may differ person to person, but total body decline is an inevitable part of life for everyone. Ironically, we spend about 75% of our entire life span undergoing the process of decline[2]. Balance is a critical component of most activities of daily living among older adults. Good balance reach in older adults living independently, productively, and proactively is important in housework, cooking, shopping, and travel. Maintenance of a balanced independence is essential for staying healthy and for wellbeing[3.] Balance training of any type reduced falls by 17%, and the multimodal intervention that trained balance, strength, corrected environment, and medications was the most effective FICSIT intervention Increasing evidence suggests that an exercise intervention program that includes strengthening of the lower extremities and functional training such as balance training would improve the physical function and reduce risks of falling of older Adult[3.] Several factors contribute to an adequate balance confidence and control, and consequently promote mobility and prevent falls. Essential factors are reliable sensory information from the visual, vestibular, and proprioceptive and mechanoreceptive systems; a well functioning central nervous system (CNS) with feedback and feed forward loops able to withstand external and internal volitions; as well as adequate musculoskeletal strength and sufficient range of motion in the joints for adequate movement. Factors that can impair balance control are, for example, pain, cognitive impairment, and fear of

falling. Moreover, age-related degeneration and a variety of diseases, more common with older age, can afflict all functions and systems involved in balance control[1].

Falls and resulting injuries in the aging population are common. Falls and injuries are also among the top geriatric and costly. About one third of elderly more than 65 years old experience at least one fall accident per year. The rate of falls and severity of the resulting complications increases dramatically with age. The majority of falls occur due to multiple interacting factors. For community-dwelling elderly, the two most important intrinsic predictors for a fall accident are taking medications and having a poor balance[1]. Evidence clearly suggests that falls and the fear of falling in the older persons are not associated with a singular cause or risk factors. Falls is a uncontrolled accidental drop or descent of body to the floor or a lower level. One study reported that approximately 18% of individuals younger than 45 years fall each year compared to 25% of those between ages 45 to 65 years, and 35% of those older than age 65 years, falling increases in frequency and can result in catastrophic loss of functions. Another study indicated that 30% of adults older than age 65 years and 40% older than age 75 years fall each year[2]. Falls prevention exercise is currently considered the best approach for primary and secondary fall prevention at a population level, and well-designed exercise programs have been evidenced to prevent falls and injuries for community-dwelling elderly[1]. fall-preventive interventions are delivered by health care professionals either individually at home or in group sessions or with a mixed approach a few times a week, targeting strength and balance exercises, sometimes complemented by endurance exercise such as walking[1]. However, these earlier training programs do not specifically focus on exercises stimulating sensory reweighting, nor do they emphasize exercises improving gaze stabilization by challenging vestibulo-ocular and vestibulocervical interactions. These functions are crucial for a well functioning postural control system, especially considering that degeneration and disease often afflict these systems with aging[1]. Falls, the leading cause of accidental death among older adults, are a serious clinical problem among adults over 65 years of age.1–6 Falls are costly and have potentially devastating physical, psychological, and social consequences. Nonfatal falls often lead to physical injury (eg, fractures), reduced levels of activity, loss of confidence, and altered life style in elderly people[5]. Although most falls involve multiple factors, causes of falling are often categorized into intrinsic (personal) and extrinsic (environmental) factors.9,10 Some examples of intrinsic factors include balance impairment, neurological disorders, sensory deterioration, musculoskeletal disorders, postural hypotension, and medication use. Examples of extrinsic factors include ill fitting footwear, poor lighting, slippery surfaces, and inappropriate furniture. Research shows that balance impairment is a major contributor to falling in elderly people[5]. A growing body of research supports the link between exercise and fall prevention. A systematic review of this literature (Gregg et al 2000), found consistent evidence from a series of prospective and case-control studies linking physical activity with a 20%–40% reduced risk of hip fracture. Balance exercise programs can be effective in improving gait and balance, as well as reducing falls and fall-related injuries[4].

METHODOLOGY

1) **Study Design**: pre and post experimental study.
2) **Sample Size**: 20

20 (minimum sample size to estimate population mean)

$$n = \frac{4\delta^2}{E^2}$$

3) **Study Population**: 65-75 years
4) **Study Duration**: 6 Months
5) **Sampling Method**: convenient sampling.
6) **Study Setting**: Jalgaon
7) **Criteria Of Selection:**
   (A) Inclusion Criteria**:**
      1) Mild to moderate risk of fall (according to BBS score)
      2) Both male and female of age- 65 to 75
      3) Functionally independent (according to Barthel index)

(B) Exclusion Criteria:

1) Any severe joint related pain
2) Any neurological impairment
3) H/O CVD
4) Use of any walking aids.

8) **Materials**

Pen, Paper, Chair, Stop watch, exercise mat

OUTCOME MEASURES

1. Time up and go(TUG) test
2. Berg Balance Scale (BBS)
3. One-leg standing time (OLST)

PROCEDURE

The study is conducted on 20 subjects who fits in the inclusion criteria. The intervention will be explained in the language understood by the subjects.
Subjects included in the study will be given the treatment protocol will be given with proper warm-up and cool down period. Pre and post assessment will be done with using outcome measures, time up and go test and one-leg standing time. Exercise in the treatment protocol includes,

Warm up: wrist roll, ankle roll, spot marching for 5 minutes

WEEK 1-

1- Knee squats (15 reps)
2- Heel/calf raising (15 reps)
3- Practice ankle sways (15 reps)
4- One leg standing with eye open (up to 1 min)

WEEK 2

1-Knee squats (15 reps)
2-Heel/calf raising (15 reps)
3-Practice ankle sways (15 reps)
4-One leg standing with eye open up to 1 min then one leg with eye close for at least 30 sec.

WEEK 3

Repeat all above (remove one leg standing) on compliant surface
1-Walk heel touching to toe on firm surface
2-Head rotations (15 reps)
3-Practice walking 5 steps and turning 180º (Lt and Rt)

WEEK4

Continue above all
1-standing, head and shoulder movements
2-Walk and move the head side to side, up and down.

WEEK5 and 6

Continue all above exercises.

Knee squats. Stand with feet shoulder width apart, eyes open, hands at your hips, and bend your knees and imagine that you are sitting down on a stool or chair. Then straighten your knees again. Repeat 10 times in an even pace. Go as deep as you manage - but no further than until your thighs are parallel to the floor. Keep in mind to put your weight on your heels (keep the contact between your heels and the floor) and to have your knees above or behind your toes. You should not feel any pain in your lower back from this exercise.

Heel /calf raising. Stand with your arms crossed over your chest, eyes open, and raise your heels and come up on your toes. Keep standing on your toes for as long as you can (or up to about 10 seconds) and then lower your heels again. If needed hold on for support with your hands on a door frame, chest, or table. Repeat three times with five seconds apart.

One leg standing. Try to balance on one leg, eyes open, for as long as you can or up to 1 minute Have your hands at the hips and the other foot about 15 cm over the floor. Keep your eyes on a point about 1.5 meters in front of you. Then do the same thing on the other leg.

Head rotations. Stand with feet shoulder width apart, hands clasped behind your back, and look straight forward. Turn your head and look as far as you can over your right shoulder. Keep this position for a few seconds. Then turn your head quickly and smoothly to your left. Look over your left shoulder and keep this position for a few seconds. Then, quickly turn your head again to your right. Look as far as you can over your right shoulder and keep this position for a few seconds. Remember to keep your trunk as still as you can. Repeat the head rotations (one rotation = from right to left or left to right) for a total of 10 times.

STATISTICAL ANALYSIS

Data was analyzed using the statistical package SPSS19.0 (SPSS Inc., Chicago, IL) and level of significance was set at $p<0.05$.

1- Descriptive statistics was performed to find out the mean and standard deviation.

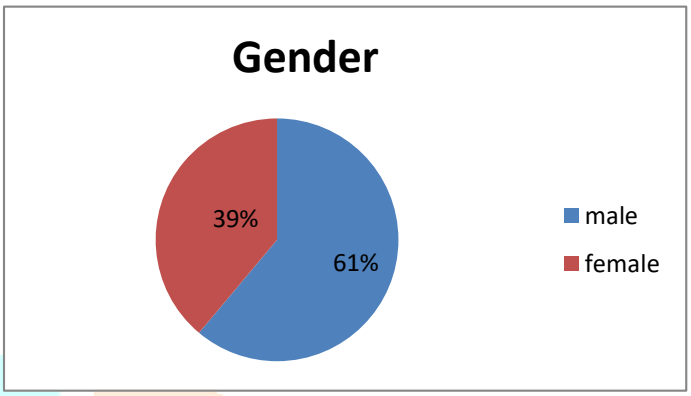
2-To assess the effectiveness of balance, confidence and stability paired t test was used.

RESULT

Table No. 1- Gender Distribution

Gender	Frequency	Percentage
M	11	61%
F	7	39%

Fig.no.1 –Graphic representation of gender of participant



Graph no.1

Table no. 1 and graph no.1 shows distribution according to gender. In that total male participants are 11 i.e. 61% and total no. of female participants are 7 i.e. 39%.

Table 2- Comparison of Pre and Post TUG

TUG	Mean	SD
PRE	23.4933	4.746
POST	19.8938	4.763

Fig.no.2- Graphic representation of pre and post Time Up And Go Test

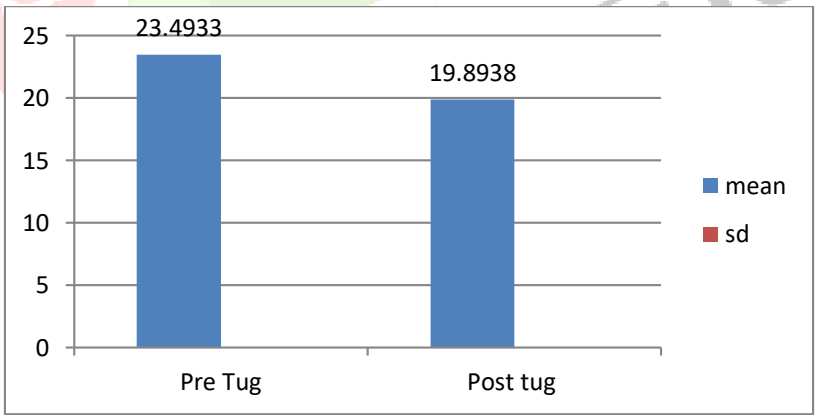


Table no. 2 and graph no. 2 shows the mean value of TUG test with standard deviation. P value is less than 0.0001.

The result showed that there is significant difference present in pre (23.4933) and post (19.8938) TUG

Table no. 3- comparison of Pre and Post BBS

BBS	Mean	SD
Pre	46.1	1.76
Post	47.6	2.00

Fig.no.3- Graphic representation of Pre and Post BBS

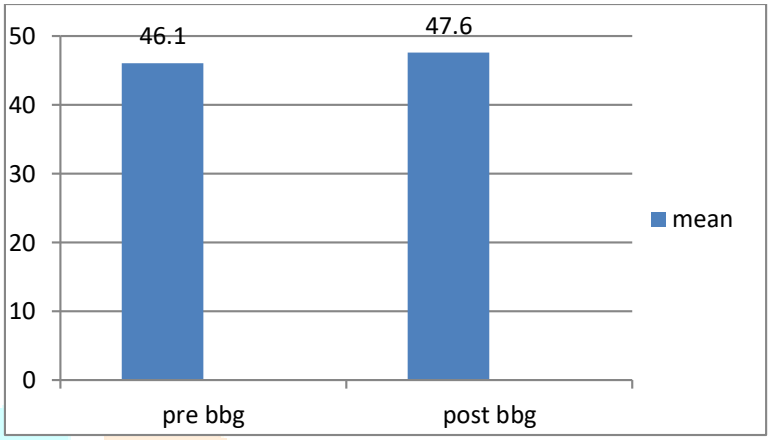


Table no. 3 and Graph no. 3 shows the mean value with standard deviation in Pre and post BBS. P value is less than 0.0001.
The result showed that there is a significant difference present in pre (46.1) and post (47.6) BBS.

Table no. 4- Comparison of pre and post one leg standing

One Leg Standing	Mean	SD
Pre	3.2	1.71
Post	5.7	2.52

Fig.no.4- Graphic representation of Pre and Post One Leg Standing

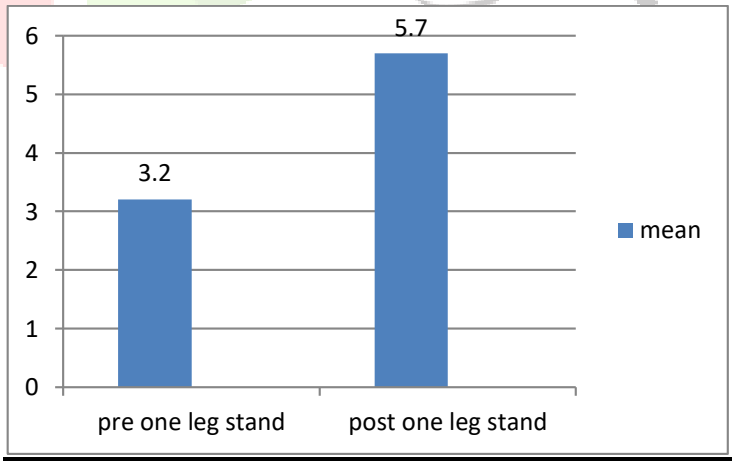


Table no.4 and Graph no. 4 shows mean value with standard deviation in Pre and Post One Leg Standing. P value is less than 0.0001.
The result showed that there is a significant difference present in pre (3.2) and post (5.7) one leg standing.

DISCUSSION

The intention was to administer group exercises that would enhance balance skills, and could be performed safely and efficiently in a group by community-dwelling elderly, consuming little time and effort that it would be acceptable for senior citizens.

This study was conducted to improve balance for elderly people. In this study 20 subjects with mild to moderate balance impairment who fulfilled the inclusion criteria were selected with age range from 65-75 years of both genders.

The gender distribution was analyzed as shown in table 1 and figure no. 1 . in which there are 11 male comprising 61% and 7 female comprising 39% of total analyzed as shown in table 2 and fig. 2. And the two people dropped out after 3 weeks of protocol due to health issues.

The peripheral musculoskeletal and central vestibular systems deteriorate with age, which may cause poor balance and dizziness in the elderly (Rosenhall, 1973). However, it seems likely that the CNS is capable of compensating for a certain degree of decline in function because not all elderly are impaired to the extent that the clinical signs of vestibular dysfunction are apparent (Matheson, Darlington, & Smith, 1999).

Strength training for individuals 60 years and older can induce large improvements in muscle strength as evidenced by both micro- and macroscopic muscle hypertrophy (Frontera, Meredith, O'Reilly, Knuttgen, & Evans, 1988). Accordingly, regular exercise has been recommended to improve balance, strength, and coordination in elderly, and exercise may also play a role in improving a number of sensorimotor systems that contribute to stability in elderly (Lord, Ward, Williams, & Anstey, 1994). considering this, we have administered body weight strength training for our subjects focusing on lower limbs, which includes two leg supported squats, heel/calf raise.

Postural control is needed to both maintain static posture and ensure body stability during movement. Thus, exercises controlling stability during various biomechanical challenging conditions were included in the multimodal balance enhancing group exercises. **one-leg standing** exercises on a firm as well as compliant surface with EC And EO was included in this study. Pre and post comparison in one leg standing time has shown statistically significant difference with p value less than 0.0001.The improvements might be due to the multimodal balance enhancing group exercises included exercises (e.g., one-leg standing and knee squats) with both EO and EC, first on solid surfaces, and, with increasing balance proficiency, progressing to completing the exercises on compliant surfaces. This facilitates the sensory reweighting process that is indeed necessary when one tries to balance without visual information when vibrations are causing perturbations or even more so when standing on compliant surfaces.

In the present study, when compared Pre and post **BBS score**, did not show much difference (Mean pre: 46.17 post: 47.67 and SD pre: 1.76, post: 2.00) but still is statistically significant with p value less than 0.0001.

It was important to involve participants who were relatively healthy to check whether such multimodal exercise produce any significant effect on balance and fall prevention. According to inclusion criteria, as indicated by the score in BBS, our participants had mild risk of fall and relatively high functioning and mobile Seniors. The study can be highly relevant to the increasingly aging population. Hence, the multimodal balance enhancing group exercises can be potentially applied before balance dysfunction becomes too advanced.

Thus, the multimodal balance enhancing group exercises is intended to be used as a complement to other physical activities focusing on balance improvement.

Aspects of gait such as mean step length, mean stride length, and mean average speed serve as good predictors for balance. Based on these, the Timed Up and Go Test is a valid predictor of balance in senior citizens.

The study shows significant improvement in **TUG score** post intervention with p value less than 0.0001 (pre mean 23.4933 and post 19.8938) .

Hopefully, the intervention has the potential to prevent fall accidents in the long term by successfully improving balance and promoting health. The program may assist and help maintain the functional capability and mobility performance of community-dwelling older adults with relatively low risk for falls.

CONCLUSION

Study concludes that this multimodal group balance exercise protocol can significantly improve balance in elderly. So such exercise program may help to prevent fall in elderly population which may assist to maintain the functional capability and mobility performance for longer period of time.

LIMITATIONS:

1) In this study we have not assessed the pre and post strength in lower limb. As the lower limb strength is potential factor in maintaining good balance.
2) Six weeks exercise program was not made tailored and individualised. As every single individual in a group may respond differently to the exercises.
3) Subjective assessment is lacking.
4) Repeated periodic assessment has not been taken.

SUGGESTIONS:

1) Individualised tailored exercise program with respect to strength, postural control and balance can be given as it can make more marked difference in result.
2) Long term follow up after 6 week intervention program may give the definite result if protocol has long term effect or not.

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