

Effect of Ankle Exercise Program and Proprioceptive Training on Stability, Functional Activity Performance in Elderly Population

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Abstract

Background: Balance is defined as the ability to maintain the centre of gravity within the base of support during human daily life activities'. Due to physiological process of ageing, there's decreased ability to generate force in the lower extremity muscles resulting in falls which have a deep impact on functional activity performance. The purpose of this study is to see the improvement in stability and performance of ADL's in response to ankle exercise program and proprioceptive training in community-dwelling elderly population and to compare the effect of both.

Method: This comparative experimental study included 40 ambulatory elderly individuals, both male and female of the age group of >65 years. The individuals with known neurological or cardiac condition were excluded. Then the subjects were recruited in 2 groups, 20 each. Group 1: Ankle exercise program (strengthening and stretching exercise for ankle musculature). Group 2: Proprioceptive training (proprioceptive exercise of the foot). The intervention period was for four weeks (5 sessions per week).

Result: On the statistical analysis of data by using SPSS v16, level of significance kept at <0.005 it was found that on Wilcoxon test the difference was significant post-intervention (p= 0.000) for both groups. On Mann Whitney U test, the change wasn't significant (p = 0.069 for POMA and 0.3 for ABC).

Conclusion: The study concludes that there's a significant improvement in stability and functional activity for the performance of ADL's after the ankle exercise program and proprioceptive training.

Keywords: Ankle exercise program, Proprioceptive training, POMA, ABC Scale, Balance, Geriatric.

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Introduction

Balance or postural control is defined as an ability to maintain the centre of gravity (COG) within the base of support (BOS) during daily human life and sports activities. Balance is a coordinated work of vision, vestibular apparatus and motor response (muscular activity). Postural

control can be divided into static balance and dynamic balance.¹ Static is one which helps to maintain erect human posture whereas dynamic deals with the control of body during movement.² Alteration of balance may lead to falls. Falls can be defined as 'an unexpected event in which the participants come to rest on the ground, floor, or lower level' or 'an unintentional loss of balance that leads to failure of postural stability.'³ The frequency of falls is more common in the elderly population due to the natural process of ageing. Physiological changes of ageing include changes in the central nervous system, cardiorespiratory system, renal system, endocrine system, gastrointestinal and

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musculoskeletal system.⁴ Previous study by Shehab Mahmoud El-Kader suggested that a decrease in the ability to generate force in the lower extremity muscles contribute to balance impairment and falling. According to the study by Vadhaiya Ashwin, there is a correlation between the ankle range of movement (ROM) and balance in elderly population.⁵ Study by Vipra P Dalal showed that home-based ankle exercise program shows improvement in balance performance.⁶ A study by Gauchard GC proves that proprioceptive training improves balance in elderly population.⁷ Due to fear of fall, a decrease in quality of functional activity performance is also seen in the elderly population. Falls are the most common and serious problem faced by older persons due to stability impairment. Thus the purpose of this study was to compare the effect of ankle exercise program and proprioceptive balance training on balance and functional activity performance in the elderly population.

Methodology

This comparative experimental study involved sample size of about 40 participants in total. The sampling technique used was computer generated randomised table. Community-dwelling elderly individuals both male and female of more than 65 years of age were included. There were 23 females and 17 males with ten males and females in group 1 and seven males and 13 females in group 2. Individuals with a known neurological condition, with recent lower limb fracture or replacement surgery, with amputation, serious cardiovascular impairment and recent vision impairment were excluded.

After approval from the ethical committee, the participants were then explained about the research protocol and purpose of the study. Written consent was taken from the participants. Pre-assessment of participants was done by using Tinetti Performance Oriented Mobility Assessment (POMA) scale⁸ for Balance and Activities-specific Balance Confidence scale (ABC) scale⁹ for the functional activity performance measure. They were then randomised into two groups with 20 participants in each group. Group 1: Ankle exercise program and Group 2: Proprioceptive training.

In POMA, eight dynamic balance tasks and nine characteristics of the walking pattern are scored on 2-or 3-point scales. The balance tasks are sitting balance, rising from a chair and sitting down again, standing balance (eyes open, eyes closed), and turning balance. Walking characteristics are gait initiation, step length, height, step length symmetry and continuity, path direction, and trunk

sway. Scores on this assessment categorize individuals as having a low risk of falling, higher chance of falling or high risk for falling.

In ABC scale, questions are asked for their level of confidence in doing the particular activity without losing balance or becoming unsteady and are scored on a percentile scale from 0% to 100%. The components include functional activities such as walk around house, walk up and down stairs, bend over and pick up slipper from closet, reach for small object on a shelf at eye level, stand up on tip toes to reach for an object above the head, stand on a chair and reach for something, sweep the floor, walk outside the house up to car parking, get in or out of car, walk across a parking lot to the mall, walk up or down a ramp, walk in a crowded mall, step on and off escalator with and without railings and walk outside on icy sideways.

After recruitment, the subjects were taught the exercises included according to the group as shown in Table 1 and 2 for Group 1 and Table 3 and 4 for Group 2.

Table 1. Group 1 exercises - for 1st and 3rd week

EXERCISES	DOSAGE
Active ankle movements (dorsiflexion, plantar flexion)	Ten repetitions
Stretching of plantar flexors (with use of towel)	Three repetitions with 30 seconds hold
Double toe raise with hand support	Ten repetitions
Double heel raise with hand support	Ten repetitions

Table 2. Group 1 exercises -For 2nd and 4th week

EXERCISES	DOSAGE
Active ankle movements	Ten repetitions
Stretching of plantar flexors	Three repetitions with 30 seconds hold
Single toe rise with hand support	Ten repetitions
Single heel rise with hand support	Ten repetitions
Forward Lunges	Ten repetitions

The intervention exercises were done respectively by the participants for five sessions per week for four weeks. Out of the five sessions, three sessions per week were supervised. On completion of 4 weeks, post assessment of POMA and ABC Scale was done.

Table 3. Group 2 exercises – for 1st and 3rd week

EXERCISES	DOSAGE
One leg stance	For 10 seconds 3 repetitions
Stepping forward, backward, sideways	Ten steps in each direction
Crossover walking	Ten steps and back
Step up and down the stairs	Ten steps and back

Table 4: Group 2 exercises – for 2nd and 4th week

EXERCISES	DOSAGE
One leg stance with arm variation as much possible	10 seconds 3 repetitions
Tandem walking	Ten steps and back for three repetitions
Toe walking	Ten steps and back for three repetitions
Heel walking	Ten steps and back for three repetitions
Step up and down on foam piece	Ten steps and back

Result

The baseline characteristics between the groups were compared to maintain uniformity between the groups and homogeneity was maintained with p-value 0.04 and 0.02 for POMA and ABC respectively. On completion of the intervention, the statistical analysis of data was done by using SPSS version 16 by Mann Whitney U test for intergroup analysis and Wilcoxon test for intragroup analysis with a level of significance at <0.005.

As mentioned in Table 5 and 6, on intragroup analysis, the results were statistically significant with p-value = 0.000 for both group 1 and 2 respectively.

Table 5: Comparison of Group 1 - Pre-exercise and Postexercise

PARAMETERS	PRE (Mean)	POST (Mean)	p-value
POMA	8.94	13.83	0.000
ABC Scale	20.16	31.22	0.000

As mentioned in Table 7, on intergroup analysis, the results were found to be statistically insignificant with p-value = 0.3 for ABC scale and 0.06 for POMA.

Table 6: Comparison of Group 2 - Pre-exercise and Postexercise

PARAMETERS	PRE (Mean)	POST (Mean)	p-value
POMA	10.78	16.42	0.000
ABC Scale	26.3	38.6	0.000

Table 7: Comparison of mean difference between Pre-exercise and Postexercise results between the two groups

PARAMETERS	GROUP 1	GROUP 2	p-value
POMA	4.88	5.5	0.06
ABC Scale	11.05	12.31	0.3

Discussion

Balance is the ability to maintain equilibrium and orientation in a gravitational environment. The maintenance of balance is influenced by multifactorial sensorimotor factors, including visual acuity, vestibular function, peripheral sensation, cerebellar function, and muscle strength of both lower extremities. Postural control is supported by kinesthetic sense, i.e. proprioception.¹⁰ Proprioception is defined as the sense of the relative position of one's parts of body and strength of effort being employed in movement.¹¹ Kinesthetic sense information intends joint position and motion, such as tension or pressure of muscle and ligament, for keeping joint position and velocity or acceleration during joint movement. This kinesthetic information integrates with visual and vestibular sensation to maintain balance.

The present study shows that there is a statistically significant improvement in the balance and functional activity performance following the intervention training with either Ankle exercise program or Proprioceptive training. Ankle musculature strength is an important component for maintaining static and dynamic balance. Thus the strengthening the ankle musculature leads to improvement in postural control and balance. Strength training induces muscular and neural adaptations that promote the ability of older adults to generate force and control falls.⁶ The proprioceptive exercises have shown to have an impact on balance as they improve kinaesthetic control and thus prevent falls in the elderly population.⁷

POMA measurement includes Total Balance score and Total Gait Score. In the present study, group 1 participant showed more improvement in Total Balance score than that of Total Gait Score when compared to group 2. This difference noted

may be due to the type of exercises included in the intervention of both groups. Group 1 exercises included ankle toe movements, plantar flexor, double toe raise and double heel raise with hand support, single toe raise and single heel raise with hand support. These exercises facilitated ankle musculature strength and flexibility thus improving balance. On the other hand, group 2 showed maximum improvement in Total Gait score when compared to group 1 as the intervention of 2nd group included more of weight-bearing exercises such as one leg stance, stepping forward, backward, sideways, crossover walking, step up and down, toe walking, heel walking with support, tandem walking. Weight-bearing activities provide kinesthetic stimulation thus improving postural control. A similar amount of improvement was seen on ABC Scale measurement.

This intervention training involved group therapy. The group exercises prevent falls and maintain physical functioning, as the group involvement promotes self-motivation thus improving confidence in performing functional activities.¹²

On intergroup analysis, the results were statistically insignificant. This supports the null hypothesis of the study that ankle exercise program and proprioceptive training doesn't vary significantly in their effect. This suggests that the cumulative effect of the exercises is same, even if they showed differences on POMA measurement. Thus the study concludes that there is a significant improvement in stability and functional activity performance in both groups after the intervention but no significant difference between the comparative groups. This study shows that both the interventions, i.e. Ankle exercise program and Proprioceptive training improve stability in the elderly population, thus providing an alternative therapeutic approach to be used for balance training in the elderly population.

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