Original Article

Effectiveness of Multidirectional Stepping Training on Balance among Geriatric Population

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Abstract

Background: In order to perform an activity that requires an upright posture, balance is a complex process that involves receiving and integrating the sensory inputs as well as planning and carrying out movements. Falls are frequent among elderly people. An example of home based aerobic activity is multidirectional stepping training.

Purpose: To find out the effectiveness of multidirectional stepping training on balance among geriatric population.

Materials and Methods: From November 2022 to April 2023, 200 participants were recruited from the Sai Chai Physio Centre, with only 82 participants selected based on inclusion and exclusion criteria.The subjects were separated into two groups: Group A (n=41) and Group B (n=41).Group A received multidirectional stepping training, whereas Group B received conventional exercise.Both the interventions were given for four weeks, three times a week for 40 minutes.

Results: The findings indicated that both the groups showed statistically significant improvement after the interventions in scores of fall efficacy scale and Balance outcome measure for elderly rehabilitation($p<0.005$). Multidirectional stepping training showed statistically significant improvement in both the measures.

Conclusion: When compared to conventional exercise, multidirectional stepping training is more effective at improving balance.

Key Word: Balance, multidirectional stepping training, Geriatric, Fall, Fall efficacy scale.

Introduction

The phenomenon of aging, which is described as a dynamic, continuing, and irreversible flow of life linked to biological, psychological, and social elements, affects all people.[1] Additionally, according to the World Confederation for Physical Therapy (WCPT), Every year, one in three people over the age of 65 risk falling.[2] In order to perform an activity that requires an upright posture, receiving and integrating sensory information as well as planning and performing movements are all important parts of the complex process of balancing.[3] Falls are frequent

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among elderly people.[4] Older adults have less functional fitness, which affects their ability to balance, move with agility, and maintain muscle strength.[5] The senior population consequently develops a fear of falling and adopts an inactive lifestyle, which causes severe muscle atrophy and a reduction in lower extremity strength.[6] It has been recommended that for balancing exercises to be effective, the base of support should be reduced, upper limb support should be minimized, and weight shifting exercises like stepping should be included.[7]

An example of a home-based aerobic activity is Multidirectional stepping training.[8] This exercise was created in Japan by Shigematsu and Okura and was approved for use in homes.[9] Multi Directional stepping training involves walking from one side of the mat to the other while following the protocol's basic patterns. Multidirectional stepping training entails a variety of motions in several directions. It is done on a thin mat (100 × 250 cm) divided into 40 squares of 25 cm each. The Multidirectional stepping training exercise appears to be decreasing the chance of falling and enhancing balance. Square Stepping Exercise stimulates the sensorimotor system. The advantage of SSE goes beyond preventing falls, as it also enhances lower body fitness and functional ability.[10] Traditional balancing training exercise that emphasizes flexibility and postural control while building strength and endurance has been shown to be useful in enhancing functional capacity and lowering fall risk in elderly people.[11]

Aim

To find out the effectiveness of Multidirectional Stepping Training on balance among geriatric population.

Material and Method

This study was conducted with a total number of 200 subjects (geriatric population) were recruited out of which 82 subjects were chosen based on inclusion criteria and exclusion criteria. This study was conducted at Sai Charan Physio Centre. Activity Specific Balance Confidence Scale Questionnaire sheets were given to the elderly people and those who had moderate levels of physical functioning were included.The study period was performed from November 2022 to April 2023.

Materials Required:

Multidirectional Stepping Mats, Chalk, Stop Watch, Foot Stool, Chair.

Inclusion Criteria:

- Elderly persons over the age of 65 years who walk independently and without the use of walking aid.
- Activities Specific Balance Confidence scoring 50%-80%.
- Those who are leading sedentary lifestyle
- Both male and female are included.

Exclusion Criteria:

- Patients having a history of any neurological condition, musculoskeletal dysfunction, or other disorders that could impair balance (such as CVA, Parkinson's disease, or vestibular disorder), as well as joint replacements.
- Patients with unstable cardio respiratory conditions that may interfere with training.
- Patients who have been diagnosed with vision or hearing loss.
- Patients with recent surgeries or fractures.

Outcome Measure:

Evaluation of balance and fall prevention before and after the treatment protocol is done by using Fall Efficacy Scale International assess fear of fall in the elderly. Individuals are asked to rate their concern about when undertaking 16 tasks, there is a chance of falling.Balance Outcome for Elderly Rehabilitation evaluates elderly people's functional ability and standing balance. It includes four assessment that is timed up and go test, functional reach test, step test, test of static standing with feet together and eyes closed.

Procedure

All the subjects were informed about the terms of the experimental protocol and procedures before giving their consent. The subjects were divided into two groups, Group A (n=41) performed multidirectional stepping training and Group B (n=41) performed conventional exercise. All the subjects were assessed with fall efficacy scale and

Balance Outcome measure for Elderly Rehabilitation as a pre test and post test at the 4 weeks of the following intervention

Group A: Multidirectional Stepping Training:

- Subjects performed the exercise for a duration of 40 minutes which included 5 minutes of warm up, 30 minutes of multidirectional stepping exercise, 5 minutes of cool down activity for three sessions a week for four weeks. It included elementary pattern, intermediate pattern, advanced pattern.
- Practice for multidirectional stepping using a thin felt pad that has been divided into 40 squares of 25 cm each, measuring 100 x 250 cm.
- The subjects had to make their way from one end of the mat to the other by going through the prescribed steps.
- After completing the training mat, subjects were encouraged to exit normally and return to their starting locations, where they would line up for the following step.
- The forward, backward, lateral, and oblique step patterns were all incorporated in the multidirectional stepping training pattern.
- After being acquainted with each of these step patterns, the subjects were taught to walk with their heels lifted, that is, on their toes, rather than on the square frames.
- Every step pattern was repeated four to ten times. Initially, each step pattern took 15-20 seconds to complete, although each pattern took only 15 seconds.
- Warm-up before performing joint motions in all planes, warm-up exercises have been given for the biceps, triceps, flexors of the forearm, wrist, and fingers as well as lower limb hamstrings, quadriceps, and gastroc soleus muscles.

The execution rhythm slows down as you cool down. Slowly moving, swinging the legs while standing, extending the trunk and lower limbs, and relaxation exercises are performed.

Group B: Conventional Exercise:

Subjects performed conventional exercise for a duration of 40 minutes which includes 5 minutes of warm up and 30 minutes of specific exercises and 5 minutes of cool down activities.

Sideways Walking:

- Place the feet together and hold a small bend in your knees. Move one foot to the side initially and take a slow, controlled step in the opposite direction.
- Join it by moving the other step from one side of the room to the other or take 10 steps in each direction.

Step Up and Step Down:

- Hovering over hurdles (10 reps/two sets)
- Rise the right leg and join it by lifting the left leg. Retrace the steps to the starting location.

Heel To Toe Walk:

- Right heel should be squarely in front of the toe while standing erect. Continue the same with the left heel after that.
- Always maintain a forward-facing posture. Put fingertips up against a wall if need be for stability. Use your left foot to complete the movement again. Walk 20 steps in this direction.

Toe Lifts:

- This senior strength training exercise promotes balance as well. Place arms out in front of the therapist while standing upright.
- Lift up on the toes, then, slowly descend. Twenty times, raise and lower down.

Single Limb Stance:

- Hold the back of the chair with both hands. Slowly raise one leg off the ground. Maintain the balance for 5 seconds while standing on one leg.
- Return to the starting location and repeat 5 times more, increase the amount of time spent standing on one leg. Repeat with the opposite leg.

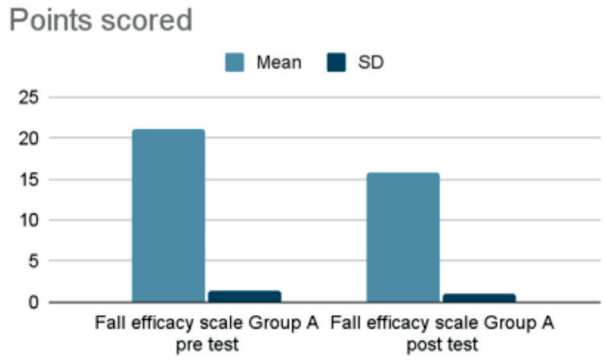
Marching in a place:

- For seniors, marching is a terrific exercise for improving balance

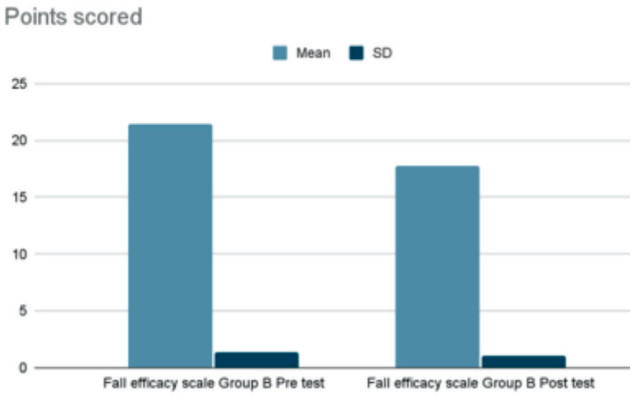
- Exercise in front of a counter, if you need to hold onto something. Keeping your right knee as high as possible, stand straight. Lift the leg after lowering it.
- Elevate and descend the legs 20 times.

Data Analysis

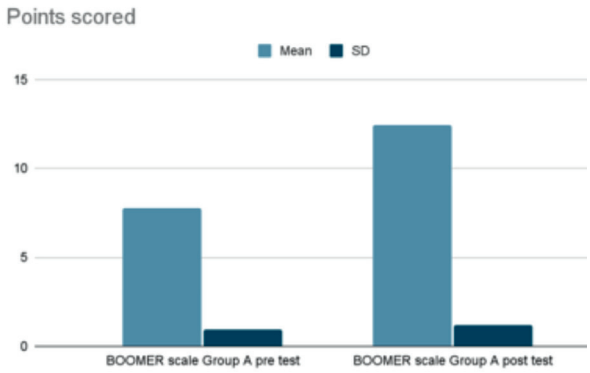
Using descriptive and inferential statistics, the collected data was evaluated. The mean and standard deviation were applied to all parameters. The Statistical Package for Social Sciences was used for statistical analysis. The non parametric test was done to compare groups. To compare the intergroup, the Mann –Whitney U test was utilized. To compare the within groups, the Wilcoxon Signed Rank test utilized $p<0.005$ was considered to be statistically significant.



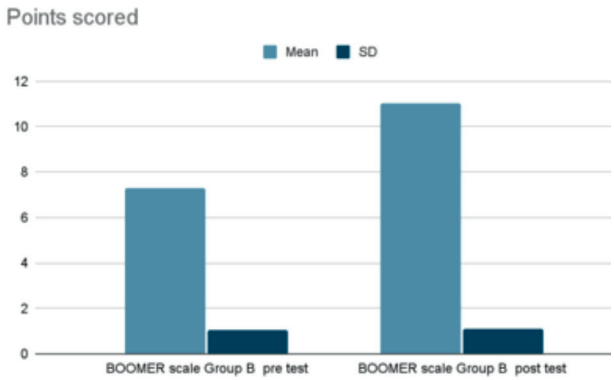
Graph 1- Comparison of pre test and post test values Group A with fall efficacy scale.



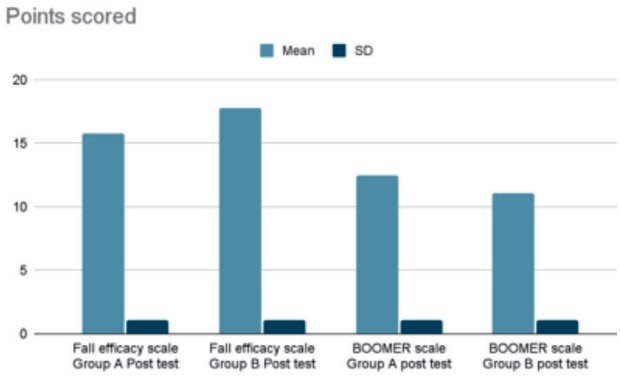
Graph 2- Comparison of pre test and post test values of Group B with Fall Efficacy Scale.



Graph 3- Comparison of pre test and post test values of Group A with Balance Outcome Measure for Elderly Rehabilitation Scale.



Graph 4- Comparison of pre test and post test values of Group B with Balance Outcome Measure for Elderly Rehabilitation



Graph 5- Comparison of pre test and post test values of Group A and Group B with Balance Outcome Measure for Elderly Rehabilitation and Fall Efficacy Scale.

Result

A quantitative data statistical analysis found a statistically significant difference in values between the Multidirectional stepping training group and the conventional balance exercises group.

Graph-1 compares the pre-test and post-test values of (Group A) Multidirectional stepping training using Fall Efficacy Scale. The mean value of the pre-test is 21.073, and the mean value of the post-test is 15.73. As a result, when the p- value <0.005, the findings are considered statistically significant.

Graph-2 Compares the pre-test and post test values of (Group B) conventional exercise using Fall Efficacy scale. The mean value of the pre test is 21.46, and the mean value of the post test is 17.780. As a result, when the p- value<0.005, the findings are considered statistically significant.

Graph-3 compares the pre-test and post-test values of (Group A) Multidirectional Stepping Training using Balance Outcome Measure for Elderly Rehabilitation. The mean value of the pre test is 7.78, while the mean value of the post-test value is 12.43. As a result, when the p-value<0.005, the findings are considered statistically significant.

Graph-4 compares the pre-test and post-test values of (Group B) Conventional Exercise using Balance Outcome Measure for Elderly Rehabilitation. The mean value of the pre-test is 7.31, and the mean value of the post test is 11.048. As a result, when the p-value is, the findings are considered statistically significant.

Graph-5 Compares the post test values of Group A and B, revealing that the mean value of Group A was 12.43 using Balance Outcome Measure for elderly rehabilitation, whereas Group B mean value was 11.048 using Balance Outcome Measure for Elderly Rehabilitation. The post-test value of Group A was 15.73 using Fall Efficacy Scale, whereas the Group B mean value was 17.78 using Fall Efficacy Scale. As a result, the findings are considered statistically significant when p-value<0.005. This shows that Multidirectional stepping Training shows effective results than Conventional Group.

Discussion

Achieving a goal that requires an upright posture requires planning and executing a movement while also receiving and integrating sensory inputs.[3] The study's goal is to determine the effectiveness of Multidirectional Stepping training in improving balance and preventing falls among geriatric population. This study provides the signs of improved balance and reduced fear of falling and its risk factors among geriatric population. The results showed a beneficial impact on enhancing balance and preventing falls in the older population.

In 2013, a study by Teixeira et.al indicated that elderly people who practice multidirectional stepping enhance their balance and cognitive function.[12] In the view of this finding we decided to instruct the geriatric population with multidirectional stepping Training in order to improve balance and prevent fall among them.

In 2022, S.Khan et.al undertook a study on square stepping exercises and foam stability exercises on falls in community dwelling elderly indicated that foam stability exercises were less efficient than square stepping exercises for preventing falls in elderly people which was carried out for 4 weeks and 5 days a week.[13] With comparing the above study, it can be said that multidirectional stepping training is more efficient and safe in improving balance and preventing fear of fall when it was given for 4 weeks and 3 sessions a week with subjects of 41 in each group.

According to Jessica et.al study, certain aspects of functional mobility appear to be improved by activating synergists and agonists of locomotion muscles, which in turn affects the improvement of mobility.[10] Furthermore, it is said that SSE is a low-intensity exercise that focuses on functional mobility, reducing the likelihood of falling. This mechanism may account for the SSE group's lower rate of falls than the Walking group's, as the former appears to have sufficient functional fall-prevention capacity. From our study findings, the results from fall efficacy scale and Balance outcome measure for elderly rehabilitation indicated that multidirectional stepping training is more efficient than conventional exercises because multidirectional stepping training

is a promotion of public health and rehabilitation simply requires inexpensive, low-tech equipment. SSE on the square stepping mat helps coordination while also providing visual feedback by indicating the number patterns to be followed. Due to the use of low-tech equipment, multidirectional stepping training requires less investment. Furthermore, because of the multidirectional Steps forward, backward, lateral, and oblique, the synergist and agonist leg muscles are better stimulated during SSE. Conventional exercise includes toe lifts, marching in a place, heel to toe walk, step up and step down, calf stretch whereas multidirectional stepping training involves movement in multiple directions. Therefore it can be said that multidirectional stepping training improves balance and prevents fall improves functional fitness and quality of life.

Conclusion

This study revealed that multidirectional stepping training can enhance balance and reduce fall risk factors among geriatric population. Multidirectional stepping training is a safe, low-cost and practicable exercise alternative to conventional exercise, with a positive influence on improving balance and reducing fear of falling in the senior population. As a result, multidirectional stepping exercise increases lower extremity muscle strength balance, improves quality of life, and leads to fall prevention in the older population.

Ethical Clearance: The ISRB Committee of a private hospital and institution in Chennai has provided its clearance for the conduct of human research that complies with all applicable national laws, institutional regulations.(Application Number 03/087/2022/ISRB/SR/SCPT)

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Conflict of Interest: The author states that there is no conflict of interest.

References

1. Spirduso WW, Francis KL, MacRae PG. Physical dimensions of aging. Champaign, IL: Human kinetics; 1995 Jan
2. Dsouza SA, Rajashekar B, Dsouza HS, Kumar KB. Falls in Indian older adults: a barrier to active ageing. Asian J GerontolGeriatr. 2014 Jun;9(1):1-8
3. Lazaro RT, Reina-Guerra SG, Quiben M, editors. Umphred's Neurological Rehabilitation: Umphred's Neurological Rehabilitation-E-Book. Elsevier Health Sciences; 2019 Dec
4. Rogers ME, Rogers NL, Takeshima N, Islam MM. Methods to assess and improve the physical parameters associated with fall risk in older adults. Preventive medicine. 2003 Mar 1;36(3):255-64
5. Committee for Osteoporosis Treatment of The Japanese Orthopaedic Association. Nationwide survey of hip fractures in Japan. Journal of orthopaedic science: official journal of the Japanese Orthopedics Association. 2004;9(1):1-5.
6. MJ G. The prevention of falls in later life: a report of the Kellogg International Work Group on the Prevention of Falls by the Elderly. Dan Med Bull. 1987;34(4):1- 24
7. Sherrington C, Whitney JC, Lord SR, Herbert RD, Cumming RG, Close JC. Effective exercise for the prevention of falls: a systematic review and meta-analysis. Journal of the American Geriatrics Society. 2008 Dec;56(12):2234-43.
8. Lees MA, Edwards J, McCain JE, Bouchard DR. Potential value of home square-stepping exercises for inactive older adults: an exploratory case study. BMC geriatrics. 2022 Dec;22:1-5.
9. Shigematsu R, Okura T. A novel exercise for improving lower-extremity functional fitness in the elderly. Aging clinical and experimental research. 2006 Jun;18:242-8.
10. Pereira JR, Gobbi S, Teixeira CV, Nascimento CM, Corazza DI, Vital TM, Hernandez SS, Stella F, Shigematsu R. Effects of Square-Stepping Exercise onbalance and depressive symptoms in older adults. Motriz: Revista de EducaçãoFísica. 2014 Oct;20:454-60.
11. Means KM, Rodell DE, O'Sullivan PS. Balance, mobility, and falls among community-dwelling elderly persons: effects of a rehabilitation exercise program. American journal of physical medicine & rehabilitation. 2005 Apr 1;84(4):238-50.
12. Teixeira CV, Gobbi S, Pereira JR, Vital TM, Hernandéz SS, Shigematsu R, Gobbi LT. Effects of square-stepping exercise on cognitive functions of older people. Psychogeriatrics. 2013 Sep;13(3):148-56.
13. Khan S, Agrawal R, Indorewala M, Qureshi M. Comparison of square stepping exercises and foam stability exercises on falls in community-dwelling elderly. Indian Journal of Gerontology. 2022;36(3):303-15.