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Comparison of lower extremity stretching and wobble board exercises on improving balance among geriatric population

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ABSTRACT

Background and objective

Ageing is a physiological process accompanied by functional, morphological, biochemical and psychological changes. In geriatric population, there is deterioration in balance, postural control and gait due to impaired cognitive function, decline of sensory, visual vestibular, somatosensory input, motor responses, and musculoskeletal systems that are resulting into postural instability and fall. The number of persons above the age of 60 years is fast growing, especially in India. Falls are the leading cause of traumatic brain injury, fractures & the leading cause of emergency department visits by older adults. Low balance confidence is a major health problem among older adults restricting their participation in daily life. Even though there are many methods to improve balance, it is necessary to investigate an effective method to improve balance in geriatric population. The aim of the study is to compare between the effects of lower extremity stretching and wobble board exercise on balance in geriatric population.

Methods

Thirty subjects were selected for the study on the basis of inclusion criteria and exclusion criteria, and were assigned into two groups of 15 subjects each: Group A underwent lower extremity stretching twice daily for 10 weeks and Group B was treated with wobble board exercise for 15 minutes for 8 weeks. The outcome measures were Berg Balance Scale (BBS), Activity specific Balance Confidence (ABC) scale, Timed Up and Go (TUG) test. Using these outcome measures, pre-test and post-test values were obtained.

Results and discussion

The result was analyzed using t-test and it was found that in paired t-test in lower extremity stretching group, the Berg Balance Scale has improved significantly ($p<0.001$), the Timed Up and Go Test has improved significantly ($p<0.001$) and the Activity specific Balance Confidence scale has increased significantly ($p<0.001$). In wobble board group, the Berg Balance Scale has improved significantly ($p<0.001$), the Timed Up and Go Test has improved significantly ($p<0.001$), the Activity specific Balance Confidence scale has increased significantly ($p<0.001$) between pre and post intervention.
On comparing the difference in the results between the groups, the Berg Balance Scale ($p<0.001$) and Activity specific Balance Confidence scale ($p<0.05$) in wobble board group showed greater change than the lower extremity stretching group; Timed Up and Go Test in lower extremity stretching group showed greater but insignificant change than the wobble board group.

Conclusion

In this study, it is concluded that wobble board exercise group is better in improving Berg Balance Score and Activity specific Confidence scale when compared to the lower extremity stretching group.

Keywords: Balance, Geriatric population, Lower extremity stretching, Wobble board exercise

INTRODUCTION

Ageing is a natural process. In the words of Seneca; "Old age is an incurable disease", but more recently; Sir James Sterling Ross commented: "You do not heal old age. You protect it; you promote it; you extent it" [(1)].

Due to aging, there are various changes which occurs in the body such as impaired cognitive function, decline in sensory, visual, vestibular, somatosensory input, motor responses and musculoskeletal systems that result in decrease of muscle strength in lower limb that contributes to postural instability and results in fall.[(2)]

Falls are among the leading causes of fatal and non fatal injuries in the elderly [(3)]. Falls are often caused by a number of factors. Risk factors may be grouped into intrinsic factors, such as existence of a specific ailment or disease, and external or extrinsic factors includes the environment and the way in which it may encourage or deter accidental falls.[(4)].

Balance is dependent on feedback and feed forward mechanism. Feedback mechanism can be classified depending on information coming from various sensory systems of the individuals or internal stimuli called as intrinsic feedback or feedback or information coming from an external stimuli called as extrinsic feedback. Intrinsic feedback is feedback coming to an individual through the various sensory systems as a result of normal production of movement such as visual information concerning whether a movement was accurate, as well as somatosensory information concerning the position of the limbs as one was moving. Extrinsic (or augmented) feedback is information that supplements intrinsic feedback. It is the feedback or information gained by the individual through the external environment. This includes the verbal and manual feedback required for completion of task by the patient.

Inputs from external and internal environment play a vital role in deciding body's response to a stimulus or proposed action. With age, the individuals rely more on feedback from external environment than body; as the body function is declining. Thus the individual depends more on vision to maintain balance. Improving these proprioceptive, musculoskeletal system responses can help an elderly individual to maintain balance effectively [(5-11)].

With the main biomechanical restriction faced by geriatric population being maintaining balance, Shumway-Cook and Brauer suggest that balance control and training helps maintain activities of daily living such as walking, placing a book on a high shelf, and cleaning, in a geriatric population [(12, 13)].

Sherrington et al. recommends balance training when the population's main goal is to reduce the risk and rate of falls [(14)]. Balance training with regards to fall prevention, targets improvements of postural control by challenging an individual's body alignment of his/her center of gravity in relation to their base of support [(15)].

Balance is the ability to maintain the body's centre of mass (COM) within the limits of the base of support (BOS). Depending on the motor task, people use 3 different strategies to maintain their upright posture. These are known as ankle, hip, and step strategies. Both hip and ankle strategies involve activation of the hip and ankle muscles opposite to the direction of the perturbation [(16)]. When the amplitude of the perturbation is too large, the step strategy is utilized. The step strategy is performed by taking a step in the direction of the perturbation, although the base of support is realigned under the COM. This allows maintenance of the COM within the base of support preventing external forces to disturb balance and thus maintain upright posture [(16, 17, 18)].

METHODOLOGY

Study setting

- Snehajwala Old Age Home, Padalikkad.
- Karunya Geriatric Care Centre, Karingarapulli.
- Pavitratha Old Age Home, Nenmara.

Sample size

- N = 30
- 15 in each group (Group A and Group B).

Inclusion criteria

- Age- 60 to 70 years
- Both male and female.
- Berg Balance Scale of 35-45.
- Timed Up and Go test- not below 15 seconds.

Exclusion criteria

- Severe cognitive impairment that prevented them from understanding instructions.
- Severe musculoskeletal, neurological, or visual impairment that might affect measurements.
- Involvement in other exercise programs.
- Unstable physical and mental condition.
- Any Neurological problems- Damaged CNS, spinal problems, vestibular conditions, visual disability and hearing problems.

Sampling procedure

The total study duration was 3 months. 30 subject (both male and females), age 60- 70 years taken for the study who satisfied the inclusion criteria. The subjects divided equally into two groups, Group A and Group B using randomized method. Each group consists of 15 subjects. Group A received lower extremity stretching twice daily for 10 weeks. Group B received wobble board exercise 15 minutes for 8 weeks. The outcome measures were assessed using Berg Balance Scale (BBS), Timed Up and Go (TUG) Test, Activity specific Balance Confidence (ABC) Scale. Pre treatment score was taken a day before the treatment session and post treatment score was taken the day after the completion of treatment session.

METHODS

Outcome measures

- Static and Dynamic balance: Berg Balance Scale (BBS)
- Basic Mobility Skills: Timed Up and Go (TUG) Test
- Functional Balance: Activity specific Balance Confidence (ABC) Scale

Methods of data collection

Materials used

- Wobble board
- Chair

- Stopwatch
- Measuring tape
- Tape
- Ruler
- Stool

Intervention procedure

Stretching procedure

The treatment included performing hip flexor, hamstring and gastronomies stretching exercises. The subjects used their own body weight rather than the force of an external weight or an assisting person. Subjects were instructed to perform 4 sets of stretches, holding each stretch for 30 seconds and alternating the right and left limb (8 stretches in total). The stretching exercises proceeded and were followed by a warm-up and cool-down period. The warm-up period consisted of:

(1) Sidestepping to the right and then to the left 4 times in each direction,

(2) 3 sets of walking forward 3 steps, clapping, and walking backward 3 steps and clapping, and

(3) Holding on to a chair for balance, 4 sets of lifting the right knee up and then the left knee.

The cool-down period was consisted of:

(1) Taking a deep breath in while bringing both arms over the head and letting the breath out while bringing the arms back down.

(2) Shaking out the arms and legs, and

(3) Using a chair if needed for balance, rotating the wrists and ankles alternatively, clock wise and then counterclockwise.

Wobble board procedure

Stand on the wobble board, feet & shoulder width apart hold on to chair for support if needed and rock the board forward and backward, then side to side. Stand on the wobble board, feet & shoulder width apart. Rotate the wobble board round so that the edge of the board is in contact with floor at all times. Rotate the wobble board in a circle but do not allow the edge of the board to touch the floor.

Balancing on the board with both feet, perform small knee bends to challenge your balance. Gradually bend your knees further into a squat. Again balancing with both feet, reach both arms out in front of you. Do all of the above exercises with eyes closed. This will make them considerably harder.

RESULTS

The present study was designed to compare the effects of lower extremity stretching and wobble board exercise on balance in geriatric population.

Demographic information

Table 1: Mean value of age/height/weight/BMI

Variables	Group A	Group B
Age	67.86	66.33
Height	140.93	150.4
Weight	40.6	43.66
BMI	20.45	19.34

The mean age for the lower extremity stretching group was **67.86** and the mean age for the wobble board exercise group was **66.33.** The mean height for the lower extremity stretching group was **140.93** and the mean height for the wobble board group was **150.4.** The mean Weight for the lower extremity stretching group was **40.6** and the mean weight for the wobble board group was **43.66.** The mean BMI for the lower extremity stretching group was **20.45** and the mean BMI for the wobble board group was **19.34.**

Statistical analysis of BBS (Berg Balance Scale) using t-tests

Mean, S.D. and t-value to compare Pre-test Post-test BBS in Group A

Table 2: Paired t test for BBS in Group A

Test	Mean	SD	Mean Change	N	*T*	*df*	*p-value*
Pre-test	44	1.51	6.33	15	15.44	14	< 0.001
Post-test	50.33	1.68					

Since the *t-value*, 15.44 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test BBS scores among geriatric population in group A. This proves the effect of lower extremity stretching to improve the BBS score.

Mean, S.D. and t-value to compare Pre-test Post-test Berg Balance Scale in group B

Table 3: Paired t test for BBS in Group B

Test	Mean	SD	Mean Change	N	*T*	*df*	*p-value*
Pre-test	43.47	1.81	8.73	15	17.07	14	< 0.001

Post-test	52.2	1.15

Since the *t-value*, 17.07 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test Berg Balance Scale scores among geriatrics in group B. This proves the effect of wobble board exercise to improve the balance.

Mean, S.D. and t-value to compare the pre-test BBS between Group A and B using t-test

Table 4: Unpaired t test for pre test BBS between Group A and B

Group	Pre-test Mean	S.D.	Difference in mean	*N*	*T*	*Df*	*p-value*
Group A	44.00	1.51	0.53	30	0.877	28	0.388
Group B	43.47	1.80					

Since the *t-value* 0.877, shows *p-value*> 0.05, there is no significant difference in pre-test BBS scores between group A and B. So we can consider the groups as homogenous in the baseline level.

Mean, S.D. and t-value to compare the post-test BBS scores between Group A and B using t-test

Table 5: Unpaired t test for post test BBS between Group A and B

Group	Post-test Mean	S.D.	Difference in mean	*N*	*T*	*Df*	*p-value*
Group A	50.33	1.67	1.87	30	3.56	28	< 0.001
Group B	52.20	1.14					

Since the *t-value* 3.56, shows *p-value*< 0.001, there is a significant difference in post-test BBS scores between group A and B. The scores in group B are significantly higher than that in the lower extremity stretching group. Hence wobble board exercise is effective in improving Berg Balance Scale among geriatric population.

Statistical analysis of TUGT (Timed Up and Go Test) using t-tests

Mean, S.D. and t-value to compare Pre-test Post-test TUGT in Group A

Table 6: Paired t test of TUGT in Group A

Test	Mean	SD	Mean Change	N	*T*	*df*	*p-value*
Pre-test	15.87	1.13	3.73	15	14.0	14	< 0.001
Post-test	12.13	1.73					

Since the *t-value*, 14.0 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test TUGT scores among geriatric population in group A. This proves the effect of lower extremity stretching exercise to improve the TUGT score.

Mean, S.D. and t-value to compare Pre-test Post-test TUGT score in Group B

Table 7: paired t test for TUGT in Group B

Test	Mean	SD	Mean Change	N	*T*	*df*	*p-value*
Pre-test	16.2	1.01	5.2	15	13.24	14	< 0.001
Post-test	11.0	1.85					

Since the *t-value*, 13.24 shows $p < 0.001$, there is a significant difference between the pre-test and post-test TUGT score among geriatric population in group B. This proves the effect of wobble board exercise to improve the TUGT score.

Mean, S.D. and t-value to compare the pre-test TUGT scores between Group A and B using t-test

Table 8: Unpaired t test for pre test TUGT between Group A and B

Group	Pre-test Mean	S.D.	Difference in mean	*N*	*T*	*Df*	*p-value*
Group A	15.86	1.12	0.33	30	0.852	28	0.401
Group B	16.20	1.01					

Since the *t-value* 0.852, shows *p-value*> 0.05, there is no significant difference in pre-test TUGT scores between group A and B. So we can consider the groups as homogenous in the baseline level.

Mean, S.D. and t-value to compare the post-test TUGT scores between Group A and B using t-test

Table 9: Unpaired t test of post test TUGT between Group A and B

Group	Post-test Mean	S.D.	Difference in mean	*N*	*t*	*Df*	*p-value*
Group A	12.13	1.72	1.13	30	1.734	28	0.094
Group B	11.0	1.85					

Since the *t-value* 1.734, shows *p-value*> 0.05, there is no significant difference in post-test TUGT scores between the group A and B.

Statistical analysis of ABC (Activity specific Balance Confidence) scale using t-tests

Mean, S.D. and t-value to compare Pre-test Post-test Activity specific Balance Confidence (ABC) score in Group A

Table 10: Paired t test of ABC in Group A

Test	Mean	SD	Mean Change	n	*T*	*df*	*p-value*
Pre-test	89.45	3.28	4.18	15	20.64	14	< 0.001
Post-test	93.62	3.43					

Since the *t-value*, 20.64 shows $p < 0.001$, there is a significant difference existing between the pre-test and post-test ABC score among geriatric population in group A. This proves the effect of lower extremity stretching to improve the ABC score.

Mean, S.D. and t-value to compare Pre-test Post-test ABC score in Group B

Table 11: Paired t test for ABC in Group B

Test	Mean	SD	Mean Change	N	*T*	*df*	*p-value*
Pre-test	87.22	3.01	8.8	15	13.69	14	< 0.001
Post-test	96.02	2.32					

Since the *t-value*, 13.69 shows $p < 0.01$, there is a significant difference existing between the pre-test and post-test ABC score among geriatric population in the group B. This proves the effect of wobble board exercise to improve the ABC score.

Mean, S.D. and t-value to compare the pre-test ABC scores between Group A and B using t-test

Table 12: Unpaired t test of pre test ABC between Group A and B

Group	Pre-test Mean	S.D.	Difference in mean	*n*	*T*	*df*	*p-value*
Group A	89.44	3.27	2.23	30	1.94	28	0.062
Group B	87.21	3.00					

Since the *t-value* 1.94, shows *p-value*> 0.05, there is no significant difference in pre-test ABC scores between group A and B. So we can consider the groups as homogenous in the baseline level.

Mean, S.D. and t-value to compare the post-test ABC scores between Group A and B using t-test

Table 13: Unpaired t test for post test ABC between Group A and B

Group	Post-test Mean	S.D.	Difference in mean	*N*	*t*	*Df*	*p-value*
Group A	93.62	3.43	2.39	30	2.24	28	< 0.05
Group B	96.02	2.31					

Since the *t-value* 2.24, shows *p-value*< 0.05, there is a significant difference in post-test ABC scores between group A and B. The scores in group B are significantly higher than that in group A. Hence wobble board exercise is effective in improving ABC score among geriatric population.

DISCUSSION

The results showed that, lower extremity stretching exercise significantly improved Berg Balance Scale, Timed Up and Go Test and Activity specific Balance Confidence scale in geriatric population.

In this study, the Berg Balance Scale score for lower extremity stretching exercise group showed significant change, from 44 to 50.33 (p<0.001). Timed Up and Go Test score showed significant change, from 15.87 to 12.13 (p<0.001). Activity specific Balance Confidence scale showed significant increase from 89.45 to 93.62 (p<0.001).

Normal functioning of the musculoskeletal system is imperative for balance maintenance. The decreased flexibility in the elderly also decreases their ability to recover quickly from a perturbation. Lack of necessary range of motion (ROM) would decrease the effectiveness of hip and ankle strategies. If a person is unable to counteract a perturbation due to lack of flexibility and lack of appropriate ROM, the perturbation may result in fall. Prior research has shown that there is a correlation between short hip and ankle muscles and increased falls in the elderly. [19, 20] Stretching is commonly utilized to stretch the muscle and increase the ROM around the joint and theorized to improve balance performance [21, 22, 23, 24, 25].

The reasons for improvement in balance in stretching can be attributed to the below theory. Stretching might have induced changes in both peripheral neural (proprioception) and mechanical output (musculotendinous unit or stiffness) affecting the ability to adapt adequately to the stability challenges [26]. The prolonged static- stretching protocol may have reduced the stiffness of the joint, fascia, and musculo-tendinous unit, thus hindering balance. These changes might affect the muscle afferent input to the central nervous system and the muscle output during balance.

The results also showed that, wobble board exercise significantly improved Berg Balance Scale, Timed Up and Go Test and Activity specific Balance Confidence scale in geriatric population.

The Berg Balance Scale score for wobble board exercise group showed significant change, from 43.47 to 52.2 (p<0.001). The change in the score is due to the improvement occurring in the strength of lower extremity. Waddington GS. Adams RD conducted the study on the effects of wobble-board training on ability to discriminate between different extents of ankle inversion movements on 20 elderly healthy of aged groups 65 to 85 years for 5-week wobble board exercise intervention was given. They conclude that training with a wobble board provides and improves the ability of movements into ankle inversion on to discriminate different degrees of ankle inversion [27].

Timed Up and Go Test score for wobble board exercise group showed significant change, from 16.2 to 11.0 (p<0.001). The improvement in the TUGT may attribute to improvement in muscle strength and flexibly among elderly individuals.

Activity specific Balance Confidence scale for wobble board exercise group showed significant increase from 87.22 to 96.02 (p<0.001)

ABC scale measures the functional balance and also assesses confidence level among participants. Wobble board training is effective for elderly people to improve their standing balance, by which they frequently control their center of gravity and maintain a standing posture on unstable surface conditions

Wobble board exercise provides information about the motor strategies (i.e. ankle, hip, and stepping strategies) and associated with muscle activation patterns that result when a person is standing on a wobble board surface, that unexpectedly translates or tilts which stimulates proprioception on the ankle joint strategy.[28]

Balance involves the interaction of automatic postural and voluntary motor commands of both the trunk and limb musculature.[29, 30] Automatic postural responses are modulated by both trunk and leg inputs [31], with the central nervous system (CNS) performing anticipatory postural adjustments when expecting self-inflicted postural perturbations.[32] Because under conditions of high instability the CNS may suppress anticipatory postural adjustments, voluntary responses of trunk and limb muscles to postural challenges would play a prominent role. Stretch-induced changes to either the afferent limb muscle responses (proprioception) or the mechanical output would be expected to affect the ability to adapt effectively to stability challenges.

From this study it is found that group which had received wobble board exercise had a better effect in improving Berg Balance Scale and Activity specific Balance Confidence scale than the other group which had received lower extremity stretching exercise. Timed Up and Go Test had greater but insignificant improvement in lower extremity stretching exercise group than in wobble board exercise group.

Hence the discussion can be concluded that wobble board exercises can improve Berg Balance Scale and Activity specific Balance Confidence scale when compared to lower extremity stretching exercise among geriatric population.

Strength of the study

- Number of participants was equal in both groups
- Participants independently committed to the

treatment sessions.

- Enhance the cost- effectiveness of the program.

Limitations of the study

- Only short- term effects being evaluated
- As the measurements were taken manually, this may introduce human error, which could threat the study's reliability.
- Inability to perform blinding.
- Administering the ABC to this population proved to be problematic. The participants often did not perform all the tasks listed on the ABC and, therefore, they were unable to rate their confidence. For example, item 16 of the ABC.

Future research

- The sample size of subjects should be increased; hence it may lead to a better valuable result.
- The treatment sessions of the study should be increased. It may lead to better and valuable result.
- A follow-up study could ensure the long-term effect of the treatment program.
- Another outcome measuring tools can be used. Example- BMI.

CONCLUSION

This study was conducted to know the effect of lower extremity stretching and wobble board exercise on balance in geriatric population.

In the statistical analysis Students't' test was used for the calculation of the results. Paired't' test was used for the intra group comparison of pre and post test results. Independent't' test was used for the inter group comparison. Result of my study indicates that the geriatric population benefited from both interventions; lower extremity stretching and wobble board exercise. In paired t test both group shows significant improvement in Berg Balance Scale, Timed Up and Go Test and Activity specific Balance Confidence scale. However, the BBS and ABC improved better in wobble board exercise group than the lower extremity stretching group. But statistical analysis shows no better significance between groups for TUGT. So, both interventions are effective in improving TUGT in geriatric population.

So, I conclude that both lower extremity stretching and wobble board exercises have significant effect on balance among geriatric population. And wobble board exercise is more effective than lower extremity stretching in improving balance. So, these are a major contribution to the prevention of falls in geriatric population.

CONFLICT OF INTEREST

None

SOURCE OF FUNDING

Self

ETHICAL CLEARANCE

Approved by the Institutional Ethics Committee of Medical Trust Hospital on 8th May 2019. Ref No. MTH/MPT/EC/1203/19

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