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Effect of OTAGO Exercise Programme on Strength, Balance and Mobility in Elderly: An Experimental Study

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Abstract

Background: Elderly population develops many health related disorders which disrupt their balance and so functional performance. Many treatment options are available and Otago Exercise Programme (OEP) can be more effective hence objective of this study was to find out the effect of OEP on Strength, Balance and Mobility in elderly.

Methodology: In this experimental study, 30 elderly participants with age 60 years and above with the history of falls at least once and walking independently were included. With random sampling, two groups of 15 each were made. Pre assessment was done by time up and go test (TUG), 4 stage balance test, 30 sec chair stand test and 10 metre walk test. OEP comprising of Strengthening and balance exercises were given to experimental group and theraband strengthening was given to control group for 3 sessions/week supervised for 4 weeks and participants were instructed to do same exercises at home for next 4 weeks. Post outcome measures were assessed after 4 and 8 weeks. Adherence was checked by the exercise adherence questionnaire.

Results: The experimental group showed statistically significant improvement in Strength, Balance and Gait speed (P value<0.05) than control group. Mean difference in TUG post treatment score in Group A was 2.733 and Group B was 0.6. Mean difference in 30 sec chair stand test score for Group A was 1.067 for and Group B was 0.2.

Conclusion: Otago Exercise Programme is effective in improving Strength, Balance and Mobility in the elderly, thus preventing falls in them.

Keywords: Aging; Falls; Gait Speed; Timed Get up and Go; Strength.

Introduction

Ageing is characterized by progressive physiological processes where degeneration of organ systems and tissues with consequent loss of functional reserve of these systems. As a person ages, their anatomy and physiology undergo many

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changes that become more apparent with increasing chronological age.[1] Balance is a foundation of our ability to move and function independently. A deterioration of balance function, as a consequence of disease or simply increasing age, will increase the occurrence of clinical balance problems as well as the risk of balance loss and falls. Decreased balance and increased postural sway (oscillating movements of body over feet during relaxed standing) both occur with advancing age.[1] The literature suggests that there are age related changes in the control of spontaneous postural sway, suggesting an increase in the amount of correction activity required to maintain stability. Loss of balance is increased when the subjects are asked to make the movement more rapidly. When difficulty of balance tasks increases, it might increase the power of an head-stabilization-in-space strategy in old people.[2]

Impaired balance is one of the intrinsic factors leading to falls in elderly. Accidental falls are a major health problem and affect one in every three elderly individuals over the age of 60. The occurrence of falls depends on extrinsic factors (related to the environment) and intrinsic factors (related to the subject). Strength and power reduction, gait parameter changes, postural control and visual, functional, and cognitive deficits are the main intrinsic factors for balance loss and fall. Fallers have shown reduced lower limb strength, changes in gait parameters, the worst performance in dynamic balance test, and leads to an increased risk of falls.[3] A 2012 Cochrane Systematic Review conducted and reported that clinical assessment done by a health care provider along with individualized treatment of known identified risk factors, and also referral if needed, and proper follow-up reduces the rate of falls by 24%.[4] Behavioural risk factors include risky behaviours such as hurrying, sedentary lifestyle, and multiple medications. Socio-economic risk factors include low income, low education, inadequate housing, and limited access to health care services. Environmental (extrinsic) risk factors include physical environmental features in the home or community that may pose hazards, such as slippery or uneven surfaces, steps, and poor building design. It is hypothesised that the symptoms of weakness, fatigue, dyspnoea, syncope, and postural hypotension contribute to decrease in activity levels and subsequent physical deterioration that increase risk for fall.[5]

The most common predictors of falls are abnormalities of gait or balance and a history of fall in the past year.[6] Exercise has beneficial physiologic effects in older adults, including effects on strength, aerobic capacity, flexibility, and bone strength.[7] A comprehensive programme of strengthening, balance, and/or endurance training effectively reduces falls and fall risks in older adults.[8] Cumming R. reported that exercises help to prevent falls, but which one is the best from all type of exercise was not very well established. They mentioned that the exercise activities which have shown the best results are Tai Chi, endurance training and intensive strength and home-based exercises prescribed by a physical therapist.[9]

Exercises alone are effective in reducing fall rates in older adults in community and sub-acute settings, whereas multifactorial interventions are more effective in long-term care settings.[10] One programme that encompasses all of these aspects may be the ‘Otago exercise programme’ (OEP).[11] Otago is a muscle strengthening and balance retraining program delivered at home by a physical therapist with Otago training through a minimum of seven home visits as well as monthly phone calls when there is not a home visit over the course of a year. Otago Exercise programme was developed and tested by the New Zealand Falls Prevention Research Group in New Zealand. It is one of a few fall prevention programs that improves strength and balance and reduces falls and fall related injuries among older adults. It has only been implemented on an individual basis in home settings. It is not known whether the program would be effective in group or long-term care settings.

Many fall prevention programmes are implemented in communities without regards to evidence of its effectiveness. It is very important to Translate the evidence-base into practice but it involves changing the attitudes as well as behaviours of older people, many healthcare professionals and various organisations.[12] Otago has only been implemented on an individual basis in home settings. But its effectiveness in group is not yet proved as well

as adherence and long term effect is not known. Hence the need of the study is to check the effectiveness of Otago exercise programme on balance, strength and gait speed in elderly in the long term care settings as well as to check adherence of this programme.

Methodology

In this experimental study design, 30 elderly participants were selected from Jyeshtha Nagrik Club, Nana-nani park, Bhosari and study was conducted at Dr. D. Y. Patil College of Physiotherapy, Pune. Written Informed Consent was taken from the participants. Ethical approval was taken from Institutional Ethical Committee. Random allocation of the subjects were done by chit method and then they were divided into 2 groups, 15 in experimental group A and 15 in control group B. Participants were included if they are having age 60 years and above, have fallen at least once in the past year, can walk in their home independently with or without a walking aid and Mini Mental Scale score 24 or above. Participants were excluded if they had fall due to syncope, vertigo, severely impaired vision, Disabilities in auditory sensation and vestibular organs, Neurological conditions like Stroke, Parkinson, etc and Fractures in the past year and severe deformities in lower extremities. Pre assessment was taken by the following outcome measures- 30 sec chair stand test, 4 stage balance test, Time up and go test and 10 metre walk test. Group A received Otago Exercise Program which consist of flexibility exercises, strengthening and balance exercises and walking plan; group B received thera-band strengthening exercises for all the lower limb muscles and walking plan. Supervised 3 sessions /week for 4 weeks was conducted and outcome measures were assessed at the end of 4 weeks. Progression was given in between after completion of 2nd week. All participants were told to do the same exercise at their home for another 4 weeks ahead that is self exercise without supervision. This showed self motivation. Exercise pamphlets were given them to help to do exercises. Outcome measures were checked again at the end of 8 week. Adherence questionnaire was given to the participants to check for the adherence of these exercise programmes.

Exercise protocol for Group A:

- Flexibility exercises:- Head movements, Neck movement, Back extension, Trunk movements- trunk rotations, Ankle movements- plantarflexion and dorsiflexion
- Strengthening exercises-Quad drills, Hams curls, Side hip strengthening for abductors, Calf raises with hold support and with no support, Toe raises with and without hold support
- Balance exercises-Knee bends or squats with and without hold support, Backward walking with and without hold support, Walking and turning around like a figure of eight movement, Sideways walking, Heel toe standing with and without hold support, Heel toe walking with or without hold support, One leg stand with and without hold support for 10 sec then progress to 30 sec, Heel walking with and without hold support, Toe walking with and without hold support, Heel toe walking backwards, Stand to sit with 2 hands, 1 hand and no hands and Stair walking.
- Walking plan:

  Walk upto 30 minutes at their usual pace at least twice a week

  30 minute walk can be broken up into shorter intervals, such as three ten minutes session
- Criterion for Progression of the exercises :-
  - Strengthening: Participants should complete two sets of 10 repetitions before progressing to the next level and Increasing weights should not produce adverse effects if prescribed and done correctly
  - Balance retraining: Progress from holding onto a stable structure to performing the exercise without support
- Precautions to be taken during exercise- Wear appropriate footwear and clothing, Drink water in between the exercise sessions to avoid dehydration, Pace out exercise sessions at regular intervals to avoid fatigue, Avoid exercising in extreme temperatures,

Immediately stop exercise if you feel dizzy, lightheaded or pain in lower limb, upper limb, back or chest pain and Avoid exercising when actually ill with fever.

Statistical Analysis: The outcome measures score was recorded and tabulated for statistical analysis. SPSS software was used The Pre readings and post readings of all the outcome measures were compared with independent t test. The Repeated Measure ANOVA was then used to analyse the significance of within and between the groups for all the outcome measures. Level of significance was kept at 0.05%.

Results

Table 1: Demographic details of both groups

	Group A	Group B
Females	5	4
Males	10	11
Age	71.4 ± 7.268	66.46 ± 4.533
BMI	27.11 ± 4.82	26.93 ± 5.37

Table 2: pre, post 4 weeks and post 8 weeks parameters of all outcome measures.

Outcome measures	Group A	Group B	Diff.
30 sec chair stand test			
Pre Mean and SD	10.87 ± 1.85	12.20 ± 2.51	-1.33
Post 1 Mean and SD	12.2 ± 1.61	12.6 ± 2.03	-0.4
Post 2 Mean and SD	14 ± 1.65	12.53 ± 1.55	1.47*
4 Stage Balance test			
Pre Mean and SD	5.60 ± 1.06	5.73 ± 0.80	-0.13
Post 1 Mean and SD	8.87 ± 1.06	7.2 ± 1.03	1.67*
Post 2 Mean and SD	9.87 ± 0.35	7.8 ± 1.32	2.07*
Time Up and Go test			
Pre Mean and SD	14.27 ± 2.25	13.67 ± 1.84	0.6
Post 1 Mean and SD	11.87 ± 1.51	12.53 ± 1.41	-0.66
Post 2 Mean and SD	10.6 ± 1.40	11.87 ± 1.41	-1.27*
Gait Speed			
Pre Mean and SD	0.43 ± 0.07	0.44 ± 0.06	-0.01
Post 1 Mean and SD	0.51 ± 0.059	0.48 ± 0.06	0.03
Post 2 Mean and SD	0.57 ± 0.070	0.51 ± 0.06	0.06*

* Statistical significance observed between groups.

Table 1 shows demographic detail of participants from both groups. Age and Body Mass Index of both groups showed non significant difference. Table 2 showed Pre parameters of all 4 outcome measures were analysed using t test and found not significant difference between both groups. Hence there was no baseline difference found in both groups, they were comparable. Comparison of post readings after 4 weeks and 8 weeks between 2 groups was carried out by t test. Group A showed more significant improvement than group B in all the outcome measures including 30 sec chair stand test, 4 stage balance test, Time Up and Go test and 10 metres walk test as p< 0.001, but it didn't show significant difference after 4 weeks except 4 Stage Balance test.

Discussion

This purpose of this study was to find whether increase in strength, balance and gait speed which are the intrinsic factors affects falls in elderly or not. We found that significant improvement within and between the groups for all the 3 parameters. Consistent improvement was although seen more in the experimental group of Otago Exercise Program than that of the control group.

The fast twitch type 2 fibres show greater hypertrophy than slow twitch type 1 fibres with strength training. This increase is largely the result of an increase in contractile protein content. The process

of muscle hypertrophy is directly related to an increase in the synthesis rate of myosin. The increase in total contractile protein with strength training occurs without a parallel increase in the total volume of mitochondria within the cells. This adaptation may have an impact on the capability of the muscle to sustain power output. The muscle hypertrophy and increased strength, along with the changes in body composition and hormonal and nervous system adaptations associated with strength training, have a substantial impact on the daily activities of living and functional independence of the elderly. These increase in muscle strength and size were associated with clinically significant improvements in gait speed, balance and functional independence.[13]

The observed improvements in balance were likely attributed to the specific exercise protocols. Balance activities including single-leg standing, tandem walking, heel raises, toe raises, backward walking, mini squats, etc which have contributed to the significant improvement in balance as measured by the 4 Stage Balance test.

TUG assessed ability to maintain balance during timed locomotion and ambulatory transfers. It also correlates with self efficacy (Falls efficacy scale) demonstrating that a relationship existed between fear of falling and functional mobility in the elderly population. Multi-component exercise programs appear to be the most effective interventions for improving the overall health status of frail elderly individuals.[14] This statement is supported by the literature, in which positive effects on functional capacity are more often observed when more than one physical-conditioning component (*i.e.*, strength, endurance, or balance) comprises the exercise intervention,[15] compared with only one type of exercise.[16] Otago exercise was helpful in walking, standing erect, control of the body when it moves in a small range of area, and regaining balance when moving unconsciously. Otago exercise helped walking posture with regard to movement correction and muscle activation pattern and the helped with balance control with regard to the base of support. Otago exercise programme showed a significant increase in strength, balance and mobility in the elderly which are improved by backward walk, walking and turning around, heel to toe walking, and stair walking in the exercise program.[11] These factors are an important predictors or causes of falls in the elderly. The subjects worked on muscle tone, and strength while walking. In addition, through stair walking, the subjects practiced with a fixed foot support, acceleration, balance control, extension and contraction of the lower limb, and ankle dorsiflexion to move the centre of gravity to control the afferent, efferent, and contraction of the lower limb muscles. As a result, coordination and weight shifting were learned through movement of the lower limbs, and this improvement resulted in an increase in mobility or gait. Thus by improving the parameters there can be reduction in the rate of falls among elderly.

Subjects were asked few questions regarding the adherence of the exercise programme which included the easiness or difficulty to perform the exercise by self, frequency of performing the exercise at home and whether the group exercise was giving better results. There was thus 100% adherence seen for both the groups. The newer programme that is Otago Exercise programme was also found to be Adherent to the elderly.

Our study revealed that the factors leading to falls due to ageing such as decreased strength, impaired balance and gait speed improved well after undergoing Otago Exercise training programme. Otago Exercise programme was also found to be effective in long term and also adherent in the elderly.

Further research can be done for various other neurological condition like parkinsons disease, stroke (with minimum gait score) and in various age groups of elderly each separately.

Conclusion

The study concludes that the Otago Exercise Programme was found to be effective in the long term care in improving the Strength, Balance and Gait speed in the elderly, thus reducing the risk of falls in the elderly. It also concluded that the adherence of the Otago Exercise Programme was very good in the elderly.

Conflict of Interest: There is no conflict of interest in the study

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