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Effectiveness of Otago exercise program in reducing fall among elderly living in old age home

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Abstract

Background and Objectives: Falls are one of the major problems in the elderly and are considered one of the “Geriatric Giants”. Recurrent falls are an important cause of morbidity and mortality in the elderly. In developed countries, one in every three older adults aged 65years and above fall every year. Injuries resulting in decreased mobility and independence will occur in 20 - 30% of those who falls. The aged in Kerala constitute 11% of the population. The Kerala Ageing survey, conducted among more than 5000 elderly in 14 districts of Kerala, was the keystone of study. The result of the survey have shown that the age of participants ranged from 60 to over 100 years of age with 54% being women. The result of the study show that falls and fractures are a significant issue among older adults. There is an increase in older population due to high life expectancy and increased life span. Fall related injuries are common, result in considerable health care utilization and are a major cause of long term pain and functional impairments among older adults. The risk factors include:

1. Biological risk factors

Muscle weakness or balance problems

Medication side effects

Chronic health conditions like arthritis and stroke

2. Behavioral risk factors

Inactivity

Alcohol use

3. Environmental risk factors

Poor lighting

Lack of stair railing

Lack of grab bars inside and outside the tub or shower

Poor designed public places

Fall related injuries may eventually result in many long term complications like pressure ulcer, hospital acquired pneumonia (HAP), urinary tract infections, and lower extremity venous thromboembolism (VTE) and even disability or deaths, especially in patients with comorbidity.

Keywords: Geriatric giants, disability or deaths, considerable health

Introduction

Physical Therapy covers a wide area of problems concerning the elderly, there are many conditions that affect people as they grow older. Physiotherapists play a key role in enabling older people to use a number of body systems fully to enhance mobility and independence. In a study by Catherine Sherrington *et al.* (2015) ^[16] “Physiotherapy in the prevention of falls in the older people”, some of the balance challenging exercises suitable for prescription to older people are graded reaching in standing, stepping in different directions, sit to stand, heel raises. Falls in elderly are common in India. Lack of exercise, fitness and nutrition leads to gradual decrease in muscle strength, decreased physical activity, therefore affects the balance, strength and functional capacity which can result in falls in the elderly

Strength, flexibility, balance and reaction time are considered the most readily modifiable risk factors for falls. The Otago exercise program is the most widespread fall prevention program. It was developed and tested in four controlled trails by a research team at the University of Otago Medical School, New Zealand, led by Professor John Campbell. The programme was designed specifically to prevent falls.

It consists of a set of leg muscle strengthening and balance retraining exercises progressing in difficulty, and a Walking plan.

Participants are expected to exercise three times a week and go for walk at least twice a week. Overall the exercise programme was effective in reducing by 35% both the number of falls and the number of injuries resulting from falls.

Methodology

In this study institutional living older adults were taken into consideration. Subjects were selected after screening for the fulfillment of the Inclusion and Exclusion criteria. 30 elder individuals were selected randomly and equally divided into two groups-Control group and Experimental Group.

Control group continued with the usual activities without the fall prevention program and experimental group underwent Otago Exercise Program.

The exercises took about 30-40 minutes to complete. Participants did exercises 3 times a week and went for a walk atleast twice a week for 6 weeks. The education sessions included information about the causes of recurrent falls, the results of recurrent falls, introduction to Otago exercises and strategies to avoid recurrent fall.

Conclusion

It is observed that, 6 week Otago Exercise Programme leads to a significant improvement in balance, reducing fear of fall, and improvement in lower extremity functioning the elder individuals living in old age home. This observation is supported by statistical analysis. Based on the outcomes of the study, it can be concluded that Otago Exercise Programme can be performed as a mandatory routine to improve balance, reducing fear of fall, improves lower extremity function and thus decreases the frequency of falls which leads to mortality and morbidity of old age people living in institutions.

The Otago Exercise Programme conducted among elderly living at an old age home in a rural community in Kottayam district of Kerala has been found to be effective in reducing risk of falls and improves lower extremity function and changing the perception about fall among those participating in such a program.

Objectives of the study

- To study the effect of Otago exercise program on tendency to fall among group of elder individuals living at old age home.
- To study the effectiveness of Otago exercise program in affecting the tendency to fall by comparing with a control group of elder individuals.

Need of the study

To find out the effectiveness of Otago exercise program in reducing fall in elderly individuals living in an old age home.

Hypothesis

Null Hypothesis

A 6 week Otago exercise program is not effective in reducing falls in elderly individuals living in old age home.

Alternative Hypothesis

6 week Otago exercise program is effective in reducing falls among of elderly individuals living in old age home.

Review of literature

1. Abhijeet Manohari and Deepali Hande (2019) ^[1].

- Conducted a study on 'Effect of six weeks Otago Exercise Program on balance in older adults'.

2. Miss Nancy N Patel, Dr. S Shweta Pachpute (2016) ^[3].

- Conducted a study on 'The effect of Otago Exercise Program for fall prevention in elderly people'.

3. Ali Dadagiri *et al.*, (2015) ^[1]

- Conducted a study on 'Randomized control trials on Otago Exercise Program to reduce fall among elderly community dwellers in Shahroud, Iran'.

4. Rachel Zhronne (2017) ^[2].

- Conducted a study on 'Application of the Otago Exercise Program in treating fall frequency and fall risk in an elderly patient living independently: A case study'.

5. Anabela Correia Martins *et al.*, (2018) ^[4]

- Conducted a study on 'Does modified Otago Exercise Program improve balance in older people? A systematic review'.

Methodology

Study Design

Experimental Study Design

Sampling Method

Simple random sampling

Sample Size

30 Subjects

Selection Criteria

Inclusion Criteria

- Age over 60 years and above
- Subjects who are able to walk for a minimum distance of 10 meters.
- Subjects with history of falls within past 12 months

Exclusion criteria

- History of lower extremity fracture in last 12 months
- People with poor visual and auditory sense
- Severe articular involvement limiting physical activity.
- Subjects who can't do exercise due to acute or chronic diseases.
- Recommendation discouraging participation for any reason by any medical consultant

Materials used

1. Locally available furniture – chairs (20 inches) with and without arm rests
2. Stopwatch (Timer App)
3. A laptop with audio visual aids is used for presentation on OEP
4. Set of Weight Cuffs.

Study setting

Old age home

Study duration

October, 2020 to July, 2021

Outcome Measures

-There are 3 outcome measures used in the study.

1. Berg Balance Scale
2. Fall Efficacy Scale
3. Chair Stand Test

Variables

- Independent variable is the Otago Exercise Programme.
- Dependent variable are Balance, Lower Extremity Strength and Fear of Fall which are measured by Berg Balance Scale, Chair Stand Test and Fall Efficacy Scale.

Study procedure

The study population included 30 subjects fulfilling both inclusion and exclusion criteria. Subjects were randomly allocated to Experimental group (n=15) and Control group (n=15) from Anjaneya Charitable old age home, Chembu, Vaikom Taluk, Kottayam. Informed consent was obtained from each subject prior to participation. A description about the study procedures was given to the subjects prior to commencing the study. A total of 30 subjects was divided into two groups by random sampling method, Group A (n=15) & Group B (n=15).

Group A: Experimental Group

- Fifteen subjects were randomly selected from willing participants into Experimental group.
- After taking the baseline values on the outcome tools they were initiated into Otago Exercise Programme routine. The final score was taken after 6 weeks training of OEP.

The OEP includes set of leg muscle strengthening and balance retraining exercises progressing in difficulty, and a walking plan.

- The training period consists of education regarding the fear of falls and OEP
- Each OEP session consist of 5-10 min warm up 30-40 min strength training and 5-10 min cool down training for 3 times a week.

Group 2: Control Group

- Fifteen subjects were randomly selected from the willing participants and these subjects continued with their usual activity and no training program was given
- Baseline values for the outcome tools was taken on day 1 and finally after completion of 6

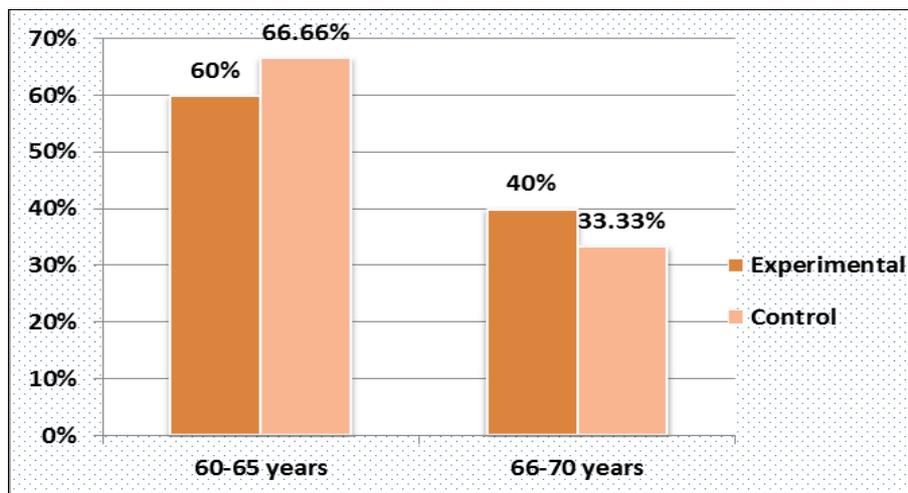
Otago exercise program: Strengthening exercises

Statistical Analysis

Table 1: Age distribution of elder individuals

Group	Mean	SD	Minimum	Maximum
Experimental	63.53	3.04	60	60
Control	64.4	3.39	60	69

Age	Experimental Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
60-65 yrs.	9	60%	10	66.66%
66-70 yrs.	6	40%	5	33.33%
Total	15	100.0%	15	100.0%

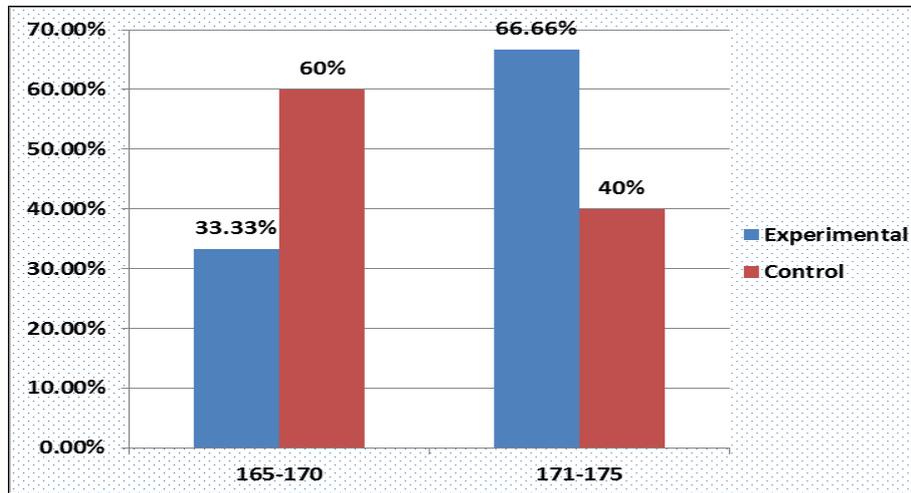


Graph 1: Age distribution of elder individuals

Table 2: Height distribution of elder individuals (In cm)

Group	Mean	SD	Minimum	Maximum
Experimental	169	2.62	165	174
Control	169.33	2.32	165	172

Height (cm)	Experimental Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
165-170 cm	5	33.33%	9	60%
171-175	10	66.66%	6	40%
Total	15	100.0%	15	100.0%

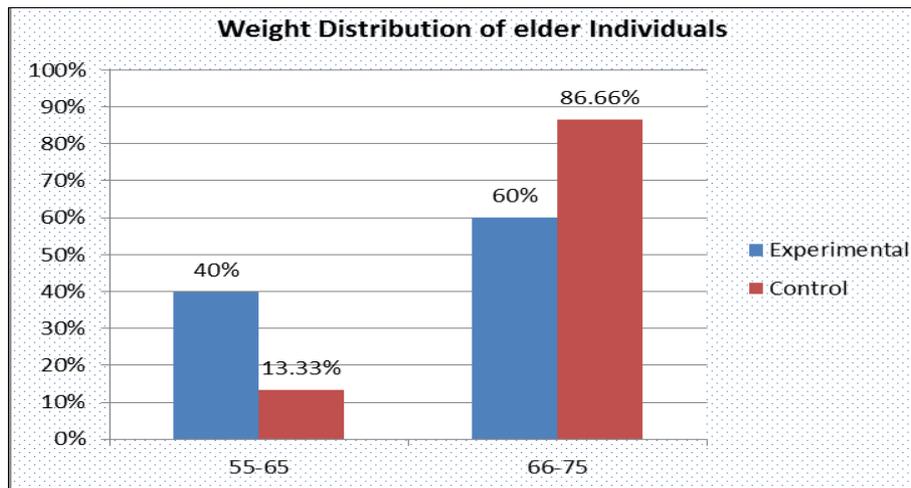


Graph 2: Height distribution in elder individuals

Table 3: Weight distribution of elder individuals (in kg)

Group	Mean	SD	Minimum	Maximum
Experimental	64.33	4.3	57	69
Control	67.67	1.39	65	69

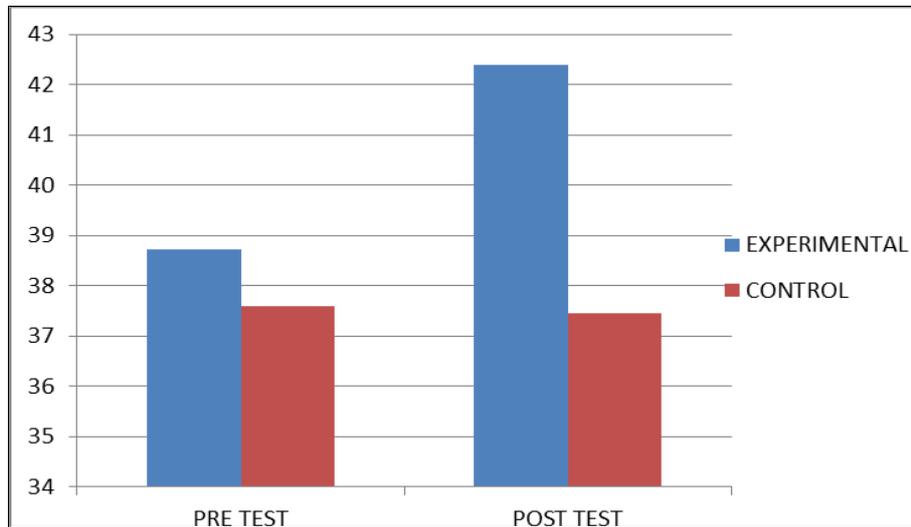
Weight(Kg)	Experimental Group		Control Group	
	Frequency	Percentage	Frequency	Percentage
55-65	6	40%	2	13.3%
66-75	9	60%	13	86.6
Total	15	100.0%	15	100.0%



Graph 3: Statical analysis of berg balance scale using t tests

Table 4: Comparison of pre-test post test balance in experimental and control Groups

Group	Pre-test mean	SD	Posttest mean	SD
Experimental	38.73	2.28	42.4	2.09
Control	37.6	2.58	37.46	3.06



Graph 4: Comparison of pre-test post test balance in experimental and control Groups

Table 5: Mean S.D and t-value to compare pre-test and post-test Balance on Berg Balance Scale in Experimental Group

Test	Mean	SD	Mean Change	n	t	df	table value	p-value
Pre-test	38.73	2.28	3.66	15	15.78	14	2.14	< 0.05
Post-test	42.4	2.09						

The mean column displays the mean pre-test and post-test Balance scores among elder individuals in the experimental group. SD is the standard deviations of the balance scores in pre & post respectively. Mean change 23.66 units is the difference between pre-test and post-test (38.73 units & 42.4 units). Since the t-value, 15.78 units is greater than the table

value 2.14 units, $p < 0.05$, there is a significant difference existing between the pre-test and post-test balance scores among elder individuals in the experimental group. This suggest that 6 weeks Otago Exercise Programme helps in reducing risk of falls.

Table 6: Mean S.D and t-value to compare pre-test and post-test Balance on Berg Balance Scale in Control Group

Test	Mean	SD	Mean Change	n	t	df	Table Value	p-value
Pre-test	37.6	2.58	0.13	15	0.39	14	2.144	<0.05
Post-test	37.46	3.06						

Table 7: Mean S.D and t-value to compare pre-test Balance scores between Experimental and Control Groups using t-test

Group	Pre-test Mean	S.D	Difference in Mean	n	t	df	Table value	p-value
Experimental	38.73	2.28	1.13	30	1.27	28	2.04	<0.05
Control	37.6	2.58						

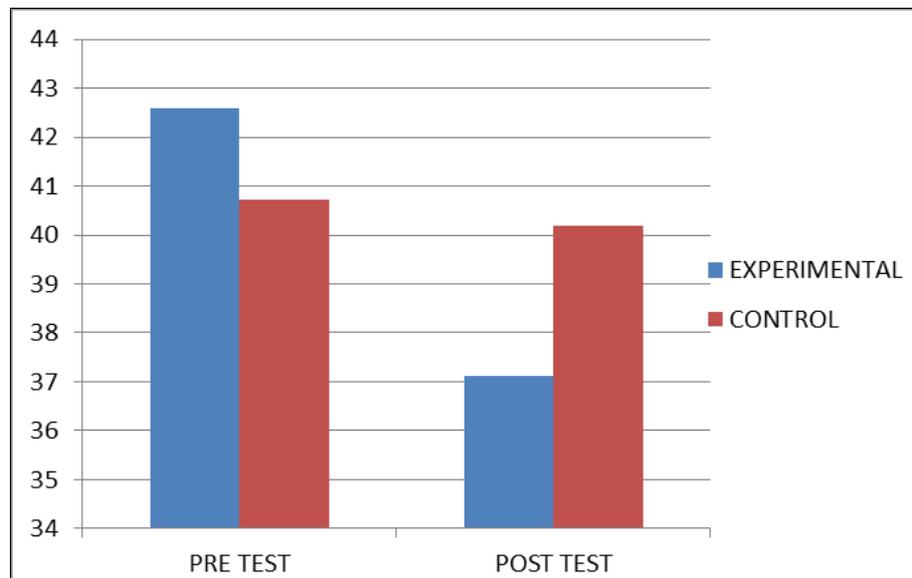
Table 8: Mean S.D and t-value to compare post-test Balance scores between Experimental and Control Groups using t-test

Group	Mean	S.D	Difference in mean	n	t	df	Table value	p-value
Experimental	42.4	2.09	4.93	30	5.14	28	2.04	<0.05
Control	37.46	3.06						

Stastical analysis of fear of fall on fall efficacy scale using t test

Table 9: Comparison of Pre-test Post-test fear of fall in Experimental and Control Groups

Group	Pre-test mean	SD	Post-test mean	SD
Experimental	42.6	2.87	37.13	2.47
Control	40.73	2.43	40.2	1.74



Graph 5: Comparison of Pre-test Post-test fear of fall in Experimental and Control Groups

Table 10: Mean, S.D and t-value to compare Pre-test and Post test of fear of fall on fall efficacy scale in Experimental Group.

Test	Mean	SD	Mean Change	n	t	df	Table value	p-value
Pre-test	42.6	2.87	5.53	15	23.4	14	2.14	<0.05
Post-test	37.13	3.47						

Table 11: Mean, S.D and t-value to compare Pre-test Post Fear of fall on Fall efficacy Scale in control group

Test	Mean	SD	Mean Change	n	t	df	Table value	p-value
Pre-test	40.73	2.43	0.53	15	1.52	14	2.14	<0.05
Post-test	40.2	1.74						

Table 12: Mean, S.D. and t-value to compare the pre-test fall efficacy scores between Experimental and Control Groups using t-test

Group	Pre-test Mean	S.D	Differences in mean	n	T	df	Table value	p-value
Experimental	42.6	2.87	1.93	30	1.98	28	2.04	<0.05
Control	40.73	2.43						

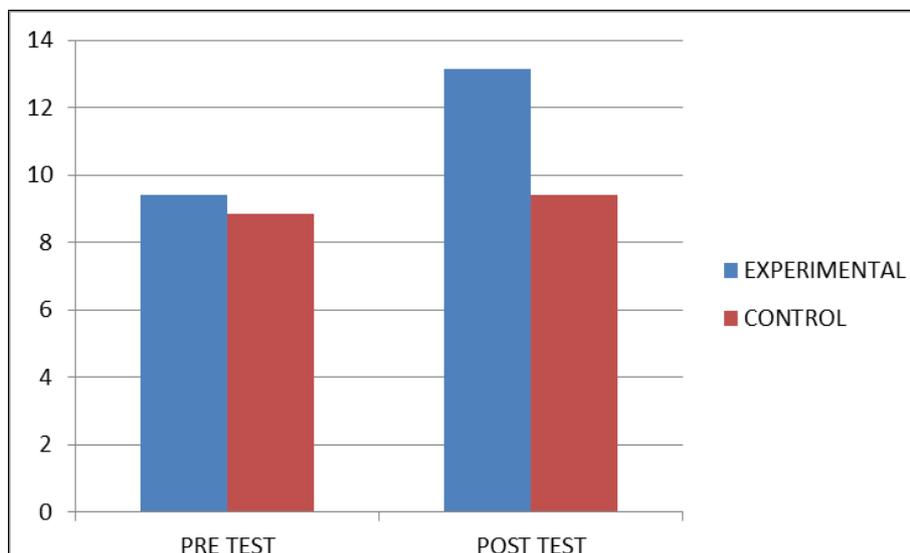
Table 13: Mean S.D. and t-value to compare the post-test fall efficacy scores between Experimental and Control Groups using t-test

Group	Mean	S.D	Difference in mean	n	t	df	Table value	p-value
Experimental	37.13	2.47	3.06	30	3.92	28	2.04	<0.05
Control	40.2	1.74						

Statistical analysis of chair stand test using t test

Table 14: Comparison of Pre-test Post-test values of chair stand test in Experimental and Control Groups

Group	Pre-test mean	SD	Post-test mean	SD
Experimental	9.4	1.45	13.13	1.35
Control	8.86	1.64	9.4	1.95



Graph 6: Comparison of Pre-test Post-test values of chair stand test in Experimental and Control Groups

Table 15: Mean, S.D and t-value to compare Pre-test and Post test values of chair stand test Experimental Group

Test	Mean	SD	Mean Change	n	t	df	Table value	p-value
Pre-test	9.4	1.45	3.73	15	14	14	2.14	<0.05
Post-test	13.13	1.35						

Table 16: Mean, S.D and t-value to compare Pre-test Post values of chair stand test in Control group

Test	Mean	SD	Mean Change	n	t	df	Table value	p-value
Pre-test	8.86	1.64	0.53	15	2.25	14	2.14	<0.05
Post-test	9.4	1.95						

Table 17: Mean, S.D. and t-value to compare the pre-test values of chair stand test between Experimental and Control Groups using t-test

Group	Pre-test Mean	S.D	Differences in mean	n	T	df	Table value	p-value
Experimental	9.4	1.45	0.53	30	0.94	28	2.04	<0.05
Control	8.86	1.64						

Table 18: Mean S.D. and t-value to compare the post-test values of chair stand test between Experimental and Control Groups using t-test

Group	Mean	S.D	Difference in mean	n	t	df	Table value	p-value
Experimental	13.13	1.35	3.73	30	6.07	28	2.04	<0.05
Control	9.4	1.95						

Results

Experimental Group

Evaluation of Berg-Balance Scale

By comparing the pre-test and post-test Balance scores in older adults in the experimental group Mean change 23.66 units is the difference between pre-test and post-test (38.73 units & 42.4 units). Since the *t*-value, 15.78 units is greater than the table value 2.14 units, $p < 0.05$, there is a significant difference existing between the pre-test and post-test balance scores among elder individuals in the experimental group. This proves that 6 weeks Otago exercise program helps in reducing falls.

Evaluation of fall efficacy scale

By comparing pre-test and post-test fall efficacy score in older adults in the experimental group Mean change (5.53 units) is the difference between pre-test and post-test (42.6 units & 37.13 units). Since the *t*-value, 23.4 units is greater than table value 2.14 units, $p < 0.05$, there is a significant difference existing between the pre-test and post-test fall efficacy scores among elder individuals in the experimental group. This proves the effect of 6-weeks Otago exercise program to reduce the fear of fall.

Evaluation of chair stand test

By comparing the pretest and post test chair stand test score in older adults in experimental group Mean change (3.73 units) is the difference between pre-test and post-test (9.4 units & 13.13 units). Since the *t*-value, 14 units is greater than table value 2.14 units, $p < 0.05$, there is a significant difference existing between the pre-test and post-test chair stand test scores among elder individuals in the experimental group. This proves the effect of 6-weeks Otago exercise program to improve lower extremity function

Control group

Evaluation of berg balance scale

While comparing the pre-test and post-test Berg balance scale. Mean change 0.13 units is the difference between pre-test and posttest (37.6 units & 37.46 units). Since the *t*-value 0.39 units is less than 2.144 units, $p < 0.05$, there is no significant difference existing between the pre-test and post-test balance scores among elder individuals in the control group. So, we have seen that there is significant change in balance score among the elder individuals in experimental group whereas there is no significant change in balance among individuals in the control group. Hence 6 weeks Otago exercise program is very much effective in improving balance

among elder individuals.

Evaluation of fall efficacy scale

By comparing pre-test and post-test fall efficacy scale Mean change 0.53 units is the difference between pre-test and post-test (40.73 units & 40.2 units). Since the t-value, 1.52 units is less than table value, 2.14 units, $p < 0.05$, there is no significant difference existing between the pre-test and post-test fall efficacy scores among elder individuals in the control group.

So we have seen that there is significant change in fall efficacy score among the elder individuals in experimental group whereas there is no significant change in fall efficacy among individuals in the control group. Hence 6-weeks Otago exercise program is very effective in reducing risk of falls among elder individuals.

Evaluation of chair stand test

By comparing pre-test and post-test chair stand test score Mean change 0.53 units is the difference between pre-test and post-test (8.86 units & 9.4 units). Since the t-value, 2.25 units is less than table value, 2.14 units, $p < 0.05$, there is no significant difference existing between the pre-test and post-test chair stand test scores among elder individuals in the control group.

So we have seen that there is significant change in chair stand test score among the elder individuals in experimental group whereas there is no significant change in fall efficacy among individuals in the control group. Hence 6-weeks Otago exercise is very effective in improving lower extremity function in elder individuals.

Limitations

- Due to less number of male subjects, findings of the study cannot be generalized to all elder individuals.
- Fall frequency for the past one year is taken into consideration while it could be extended for more.

Discussion

The purpose of the study was to find out the effectiveness of Otago Exercise Program in reducing risk of falls in elderly living at old age home. The Otago Exercise Program includes a set of leg muscle strengthening and balance retraining exercises progressing in difficulty and a walking plan and education about various aspects leading to fall and fear of falling.

In this study institutional living older adults were taken into consideration. Subjects were selected after screening for the fulfilment of the Inclusion and Exclusion criteria. 30 elder individuals were selected randomly and equally divided into two groups-Control group and Experimental Group.

Control group continued with the usual activities without the fall prevention program and experimental group underwent Otago Exercise Program.

The exercises took about 30-40 minutes to complete. Participants did exercises 3 times a week and went for a walk at least twice a week for 6 weeks. The education sessions included information about the causes of recurrent falls, the results of recurrent falls, introduction to Otago exercises and strategies to avoid recurrent fall.

On Statistical analysis, the mean pre-treatment balance scores of experimental and control group are 38.73 units and 37.6 units and mean post- test treatment balance scores of experimental and control group are 42.4 units and 37.46 units respectively. This result shows that there is an increase of 3.67 units in the experimental group and 0.13 units in the

control group, which indicates that there is a considerable increase in experimental group.

On statistical analysis, the mean pre-treatment fall efficacy scores of control and experimental group are 42.6 units and 40.73 units and mean post treatment fall efficacy scores of control and experimental group are 37.13 units and 40.2 units respectively. The result shows that there is an increase of 5.53 units in the experimental group and 0.53 units in the control group, which indicates that there is a considerable increase in experimental group.

On Statistical analysis, the mean pre-treatment chair stand test of experimental and control group are 9.4 units and 8.86 units and mean post- test treatment chair stand test scores of experimental and control group are 13.13 units and 9.4 units respectively. This result shows that there is an increase of 3.73 units in the experimental group and 0.53 units in the control group, which indicates that there is a considerable increase in experimental group. This suggest that the Otago Exercise Program is effective in reducing the fear of falls in the elderly individuals living at old age home.

Statistically, significant improvement in function is seen in all 3 the groups and between the groups. However, the improvement in experimental group is greater than that of control group. Improvement in function may be attributed to the improvement of balance, improve lower extremity function and the reduced fear of fall.

Otago Exercise Program helps to improve balance because it targets all the physical components needed to stay upright-leg strength, flexibility, range of motion and reflexes-all of which tend to decline with age. Hence the study concludes that the Otago Exercise Program has a significant role in reducing risk of falls, reducing fear of fall, improving balance and improving lower extremity function in institutional living older adults.

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