A Comparative Study on the Effect of Pilates and Otago Exercises on Balance in Elderly Individuals

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Abstract

Backround

The ageing process is associated with decreasing functional abilities lower quality of life and
increasing health care costs for the community. In India geriatric population over the age of
60 is likely to increase from 8% in 2015 to 19% in 2050, and elderly will constitute nearly
34% of the total population in the country by the end of the century. Physical factors like balance play an important role in health of elderly. It is the base of independent living. Consequences of fall include pain, loss of confidence and independence in carrying out every day activities which can lead to social isolation. So, this study aimed to assess the effectiveness of pilates and otago exercises on balance in elderly individuals.

Methods

The subjects were assessed for inclusion and exclusion criteria. Samples were selected through purposive sampling method. Participants of both groups were assessed balance by Timed up and go test (TUG). Group A were given pilates exercises and group B were given
Otago exercises.

Results

The result of within group analysis shows significant difference (P<0.5) for TUG in group A
As well as group B. TUG in group B showed better improvement compare to group A.

Conclusion

The present study shows that otago exercise group is more effective in improving balance
compare to pilates exercise group.

Keywords

Aging, Balance, Timed up and go test [TUG], Pilates exercises, Otago exercises.

1. Introduction

As the age progress, physical changes such as slow reaction time, postural imbalance

DOI: https://doi.org/10.5281/zenodo.15711094

decrease in flexibility and mobility may occur due to changes in visual, vestibular, sensory and motor system. Physical factors like balance plays an important role in health of elderly.

Balance is the ability to align body segments against gravity to maintain or move the body within the available base of support without falling, the ability to move the body in equilibrium with gravity via interaction of sensory and motor systems [1]. It is the base of Independent living [2]. Prevalence of imbalance leading to fall is 30.26% in males and 54.02 In females in Karnataka India [3].

As compared to healthy young adults the healthy elderly individuals are found to have Significant impairments in static as well as dynamic balance because there is a progressive Loss of functioning of visual, vestibular, sensory and motor system [4].

There are many tests and scales that are used to access balance. Timed Get Up and Go (TUG) test developed by Mathias et al is a quick measure of assessing dyanamic balance and mobility [5]. This test is used to examine functional mobility and balance deficits in this study. It has acceptable validity and realibility [6].

Furthermore Sarcopenia and consequent muscle strength loss along with endurance occurring in older adults increase the risk of falls as functional mobility and postural balance are also affected, to diminish these aspects, physical exercises is used to postural balance by building muscle mass, strength and endurance which will reduce the risk of fall [7].

Exercises can improve maximal and submaximal aerobic capacity, boost maximal cardiac output, decrease resting blood pressure and develop favorable changes in body, bone and muscle composition. Lack of physical activity has negative effect on cardiometabolic health body composition along with functional fitness and physical independence [8].

Regular physical activity will delay the disability and promote independent living [9].

Several studies have revealed that regular exercise lessens dependency in older people[10].

Previous studies have shown the positive effects of exercising in improving the balance and lessening depression which is supplementary to health and falling in the elderly[11].

Pilates constitutes group of functional exercises and movements by using persons own body weight. It helps to correct postural deficit and develops corporal stability by involving the whole body as a functional unit as well as integrating an individual in to his or her functional challenges in daily life [12]. In a community dwelling older population pilates may be effective in improving postural stability [13]. It is a kind of cognitive and motion training program used to improve strength concentration muscle control and flexibility along with postural stability and breathing. The ideal method to be applied in elderly population within

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preventive programs in fall is pilates because it does not offer any risk of lesion [14].

On the other hand, Otago exercises is a homebased balance and strength program of fall
prevention develop by professor John Campbell for elderly in response to the frequency and
severity of fall injury [15]. It helps to improve muscle strength and physical performance of
an individual [16]. Otago exercises has been shown that it reduces risk of fall and improve
function [17]. Otago consist of three phases muscle strengthening, balance training
and walking [18].

Pilates and Otago exercises both emphasize on improving muscle strength and control along
with postural stability individually which will help in reducing balance.
The purpose of this
study is to find out which exercise is more effective and to compare the effect of Pilates and
Otago exercises to improve balance in elderlypopulation

2. Literature Review

Zhare R (2019) conducted a study on application of otago exercise in treating fall risk in
elderly patient found that physical activity as an intervention strategy shows improvement in
gait, balance, coordination and physical fitness.

Deoliveria Le etal (2020) conducted a study on effect of pilates on muscle strength postural
balance and quality of life of older adults. They concluded that pilates exercise significantly
improved isokinetic torque of knee flexors and extensors, postural balance and aspects of
health related quality of life in older adults. Therefore the objective of present study is to
compare the effect of otago and pilates exercises to improve balance in older individuals and
to see which one is more effective to improve balance in older individuals.

3. Material and Methods

The study design was an comparative or longitudinal study with purposive sampling. The
relevant data is collected from the residents in old age home and community of Bangalore
city. The ethical approval was obtained from our institutional ethical committee.

The sample size was 64 subjects who were randomly assigned to two groups.
Group A consists of 32 subjects with pilates exercises and group B consisting of 32 subjects
with otago exercises.

The subject were selected according to the inclusion and exclusion criteria. The intervention
to be done was explained to the subject. A written and signed consent were obtained from all
Subjects.

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3.1 Inclusion Criteria

The inclusion criteria was age between 60-80 years, mini mental status examination score more than 24, participants willing to participate in physical activities, both gender are included.

3.2 Exclusion Criteria

Exclusion criteria were old age individuals suffering from any musculoskeletal disorders, vestibular disorders central nervous system pathology cardiovascular disorders cognitive impairment and individuals using walking aids.

3.3 Outcome Measures

Mini mental status examination score has been taken for exclusion to assess the cognitive impairment so that it does not interfere with the training program.

The balance was assessed by timed up and go test. The patient is seated comfortably in a firm chair with arms and back resting against the chair. The patient is instructed to rise stand momentarily and ten walk 3 meters (10Feet) towards wall at normal walking speed turn without touching the wall return to the chair, turn and sit down. Tape is used to mark the walking distance and turning point. A score less than or equal to 10 second is normal, less than or equal to 20 second is good mobility, can go out alone without walking aid, less than or equal to 30 second, cannot go outside alone requires walking aid indicate high risk fall.

3.4 Intervention

Group A perform pilates exercises. It constitutes group of functional exercises and movements by using persons own body weight. Subjects start exercises with warm up exercises which includes feel weight on feet, breathing, knee bends, spine rotations, side bends, roll downs in standing for 6 times each. Exercises are as follows Abdominal curls, shoulder bridge, small leg circles, pregnant cat, single leg kicks front back and side, single leg stretch, spine stretch forward, spine stretch side, saw exercise and against wall rolling down.

Group B perform otago exercises. It comprised of three phases namely muscle strengthening balance training and walking. Subject start exercises with warm up that include head movements, Neck movements, back extension, trunk movements, ankle movements in sitting and standing for 6 times each. Strengthening exercises include knee extensors, knee flexors, hip abductor, calf and toe raise. Balance training exercises include backward walking, walking and turning around sideways walking, tandem stance, tandem walking, one leg stand, heel toe walking backward, sit to stand and walking on a normal pace. Walking should be done for 110 minutes twice a week for 10 weeks. All exercises were performed for 10 weeks 3 times per week. Each exercise was done with 8 repetitions and for duration of 35 minutes per session

3.5 Statistical Analysis

Data was analyzed using statistical package SPSS19.0 (SPSS Inc., Chicago, IL) and level of significance was set at p,0.05.

Normally of the data was assessed using Shapiro Wilkins test. Descriptive statistics was performed to find out the mean and standard deviation and proportion of the respective groups. Inferential statistics was performed by Paired t test (within the group) and Independent t test (between the group) to find out the statistical significance. Chi square was used to analyze the association between categorical variables.

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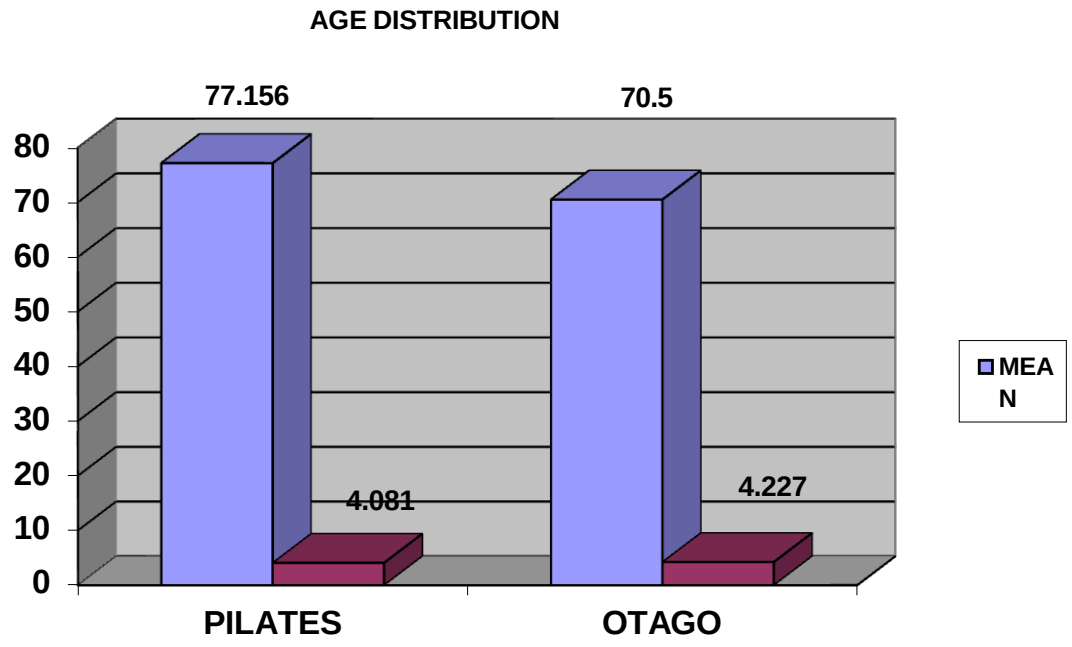
4. Result

Table 1: Age Distribution

	MEAN	SD
PILATES (N=32)	72.156	4.081
OTAGO (N=32)	70.50	4.227
Independent t test (p value)	0.106	

*** P <0.05 is statistically significant**



Graph 1: Age Distribution

Table 1 and Graphs 1 shows mean age of participants in both the groups.
In PILATES group mean age was 72.156 compared to the OTAGO Group (70.5)

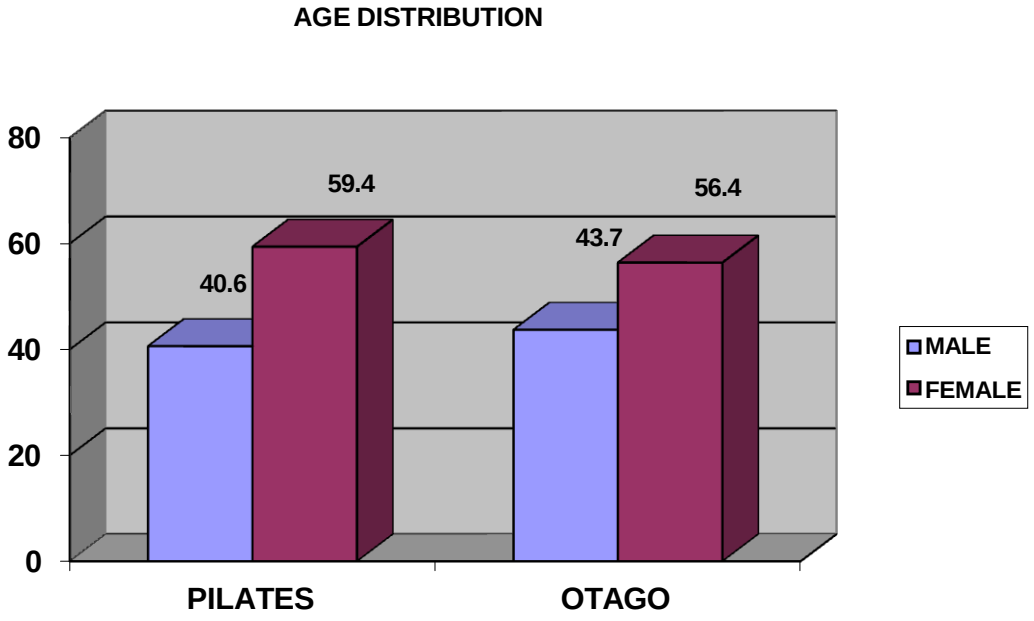
The groups are comparable as it has no significant difference between them.

DOI: https://doi.org/10.5281/zenodo.15711094

Table 2: Percentage Distribution of Genders

	MALE		FEMALE	
	NUMBER	PERCENTAGE	NUMBER	PERCENTAGE
PILATES(N =32)	13	40.6	19	59.4
OTAGO(N=32)	14	43.7	18	56.3
Chi Square test(p value)	0.172			

*** P <0.05 is statistically significant**



Graph 1: Percentage Distribution of Genders

Table 2 and Graph 2 shows the percentage distribution of Genders in the study. PILATES group consists of 40.6% males and 59.4% Females. OTAGO group consists of 43.7% males and 56.3% females. The group are comparable as it has no significant association between the groupsregardinggender

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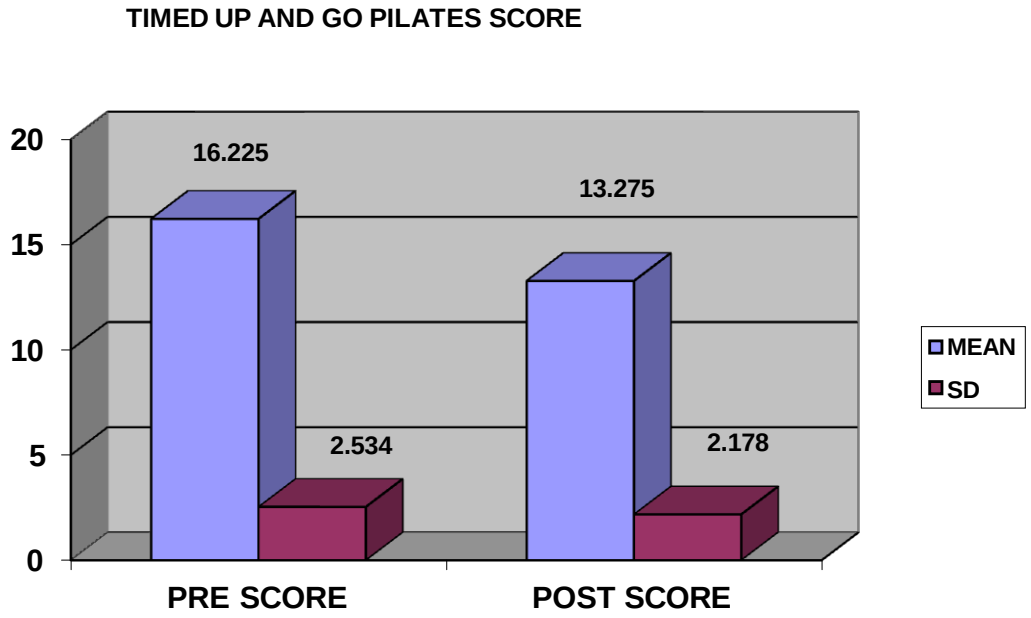
DOI: https://doi.org/10.5281/zenodo.15711094

Table 3: Comparison of scores of Timed Up and Go test, PILATES Group A

		MEAN	SD
Timed Up and Go Test	**PRE SCORE**	**16.225**	**2.534**
	POST SCPRE	**13.275**	**2.178**
	DIFFERENCE	**2.95**	**0.356**
P Value (Within group) paired t test	**(0.00) * (t=1.84)**		
% reduction	**18.18%**		

*** P <0.05 is statistically significant**



Graph 3 : Comparision of scores of Timed Up and Go test PILATES Group A

Table 3 and Graph 3 results showed that there is a significant difference present within the group A PILATES method given to the elderly for improving balance using Timed Up and go test (p=0.0001).

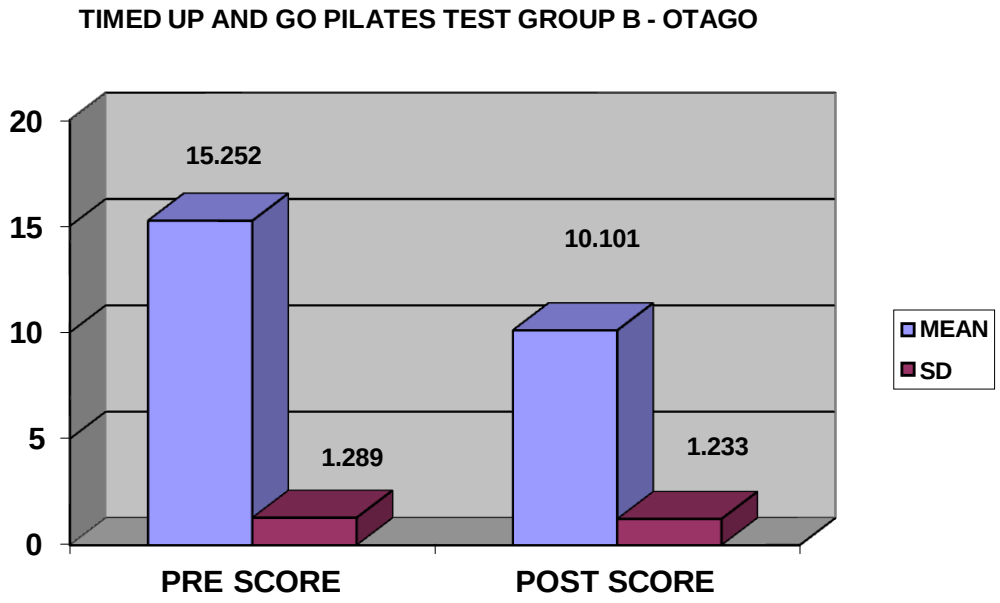
Hence, we reject the null hypothesis (p=0.0001) and accept the alternate hypothesis that there is a significant effect of PILATES method in improving balance of the elderly participants using Timed Up and go test. The percentage pre-post difference observed was 18.18%. The mean score of Timed go up and go test time was reduced from 16.225 to 13.275 whereas the standard deviation get reduced from 2.534 to 2.178 after the intervention.

DOI: https://doi.org/10.5281/zenodo.15711094

Table 4 : Comparision of scores of Timed Up and Go test Group B -OTAGO

		MEAN	SD
Timed Up and Go Test	**PRE SCORE**	**15.252**	**1.289**
	POST SCORE	**10.101**	**1.233**
	DIFFERENCE	**5.151**	**0.056**
P Value (Within group) paired t test	**(0.000) * (t=15.28)**		
% reduction	**33.77%**		

*** P <0.05 is statistically significant**



Graph 4 : Comparision of scores of Timed Up and Go test Group B – OTAGO

Table 4 and Graph 4 showed that there is a significant difference present within the group B OTAGO method given to the elderly for improving balance using Timed Up and go test (p=0.0001). Hence we reject the null hypothesis (p=0.0001) and accept the alternate hypothesis that there is a significant effect of OTAGO method in improving balance of the elderly participants using Timed Up and go test. The percentage pre-post difference observed was 33.77%. The mean score for Timed go up and go test time was reduced from 15.252 to 10.101 while standard deviation gets reduced from 1.289 to 1.233 after the intervention.

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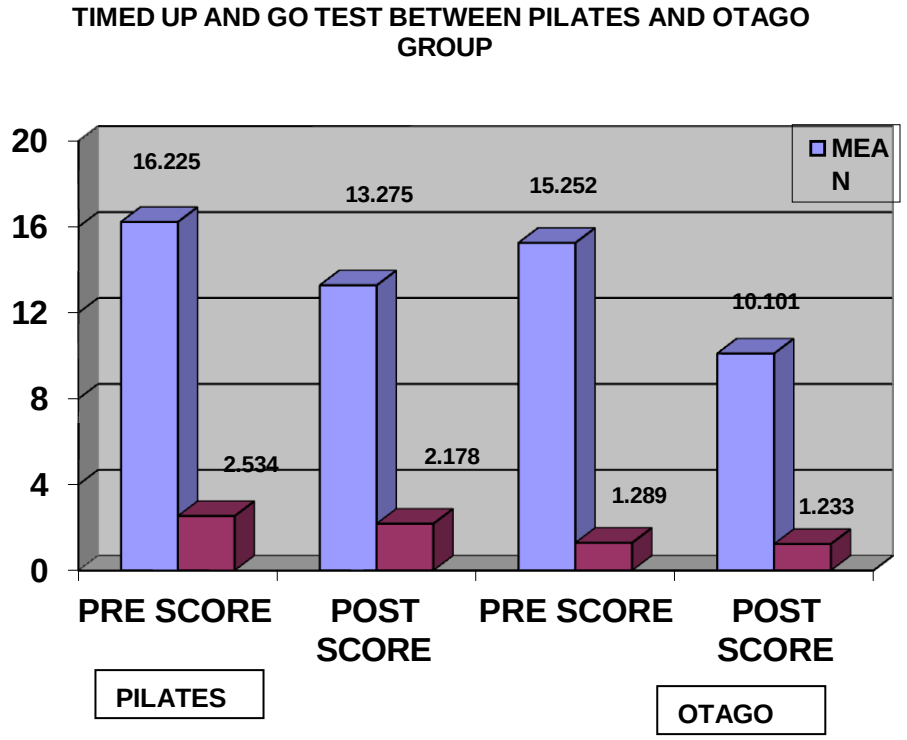
Table 5: Comparison of scores of Timed Up and Go test between PILATES and OTAGO group (Group A Vs Group B)

BETWEEN GROUPS	PILATES		OTAGO		P VALUE (Independent t test)
	MEAN	SD	MEAN	SD	
PRE SCORE	16.225	2.534	15.252	1.289	0.06(t=1.87)
POST SCORE	13.275	2.178	10.101	1.233	0.000* t =6.96
REDUCTION	18.18%		33.77%		

*** P <0.05 is statistically significant**



Graph 5: Comparision of scores of Timed Up and Go test between PILATES and OTAGO group (Group A Vs Group B)

The between group comparison has reported that there is a significant difference in post intervention score in improving balance in elderly individual which was assessed by using Timed upand go test. The higher percentage difference was observed among OTAGO method compared to PILATES method (p=0.0001). At baseline the scores were not significant and comparable (p=0.06). Percentage wise comparison showed (33.77% vs 18.18%) OTAGO group has more reduction in score than PILATE's group. Hence the study has proven that though both the methods has shown significant improvement (within the

DOI: https://doi.org/10.5281/zenodo.15711094

group) in improving balance using Timed up and go test, OTAGO method proved better compared to the pilates method.

4.1 Discussion

The present study is done to compare the effect of pilates and otago exercise on balance in elderly individuals. Evidence from various literatures demonstrates that the pilates and otago exercises are effective in improving balance. The outcome measures of this study were timed up and go test with .91 and .92 intrarater and interrater reliability which was used for the evaluation of balance.

The result of the present study was consistent with the previous studies done in 2015 by Oliveria et.al which revealed that pilates can contribute to the improvement of postural balance consequently reducing the risk of falls wereas on the other hand the other study supported otago by Jin Lee et.al in 2017 who proved that otago exercise can improve muscle strength balance and physical factors in elderly women to prevent falls

In the present study the researcher has selected 64 subjects with balance issue which were equally divided into two groups within the age group of 60 to 84 years as shown in table 1 and graph 1. The age in the group A was 72.156 and group B was 70.5. The standard deviation of group A was 4.081 and group B was 4.227. Further this was supported by Engers P.B et al who conducted systemic review in Brazil 2016 which also had patients whose age group was ranging from 61 to 87 years [19].

As per the gender distribution analysis in group A there were 40.6% of males and 59.4% ofha females whereas in group B, there were 43.7% of males and 56.3% of females who had participated in the in the present study as shown in table 2 and graph 2.

Table 3 and graph 3 shows the result of timed up and go test in group A participants who were given pilates

exercises had a pre-score mean 16.225 on day 1 with standard deviation 2.534 which

was reduced to the mean of 13.275 and standard deviation 2.178 at the end week 10, the difference of mean and standard deviation was 2.95 and 0.356 respectively. Thus the present study showed significant improvement in balance assessed by time up and go test between day one of first week and last day of 10^{th} week($P<0.05$) in group a. The study supported by Isabela et.al, who has published research report in 2012 on who has concluded that pilates method offers a benficial tool to improve the abilities to maintain body balance [20]. In this model the central sensory motor system by the use of information provided by vision system vestibular system including joint position sense and peripheral sense is informed of body position against centre of gravity and as a result provides the appropriate motor response in form of a pre-planned movement patterns. Thus, according to systems theory and the effect of exercise on improving each of these systems, it seems logical that pilates exercises improve balance in elderly [21].

Moreover, the improvement of balance due to the pilates exercises can be obtained for the improvement of muscle strength and psychological factors of the participants. Since, the loss of muscle strength in lower extremities puts the center near the ankle joint, which in turn impairs the balance and leads to fall. Furthermore, improvement in muscle strength can cause displacement of the ankle joint center and improve balance [22].

Table 4 and graph 4 shows the result of timed up and go test in participants who were given otago exercises of group B,

DOI: https://doi.org/10.5281/zenodo.15711094

participants had a pre-score mean 15.252 on day 1st week with standard deviation 1.289 which was reduced to the mean of 10.101 and standard deviation 1.233 at end of week 10. The difference of mean and standard deviation was 5.151 and 0.056 respectively. Thus, the present study showed significant improvement in balance assessed by timed up and go test between day 1 of first week and last day of 10th week ($P<0.05$) in group B. The effectiveness in improving balance was supported by Selvaraj et.al study published in 2018 which revealed that there is significant difference in Tinetti performance-oriented mobility assessment and timed up and go test in otago exercise group [23].

A lower extremity weakness has also been reported as an important intrinsic factor found among older adults who have fallen. Otago exercise program developed by Ac Martin et.al had already proven its effectiveness in reducing fall risk by improving lower limb strength and balance [24].

Balance is a process that we use to control the center of mass in accordance to the base of support whether we are in motion or at stationary phase. Otago exercise might have relaxed capsules increase joint movement angle and applied stress to joint capsules thus preventing adhesion to collagen tissue. Hence, augmented joint activity might have promoted activity of synovial fluid and accelerated nutrition supply to the joint, resulting in activation of joint receptors [24].

Balance training provided by the exercise might have also improved both ankle and knee. Knee flexion tibialis anterior ankle plantar and dorsiflexion are all involved in Otago exercise. The exercises might have invigorated these muscles, increasing the synthesis of actin and myosin, thus increasing muscle cross sectional area and muscle strength during the process. In addition, muscle strength training of Otago exercise is a repeated resistance exercise. It might have prevented inactivity in the elderly. Thus helps in improving balance [25].

In table 5 and graph 5 the result shows significant reduction of 18.18% in timed up and go test score of pre-post mean and standard deviation in group A whereas in group B the reduction of 33.77% when comparing both groups group B is found to be more effective in improving balance compare to group A. Furthermore, the study was buoyed by Does the 'Otago exercise programme' reduce mortality and falls in older adults? a systematic review and meta-analysis published in 2010 conducted by Thomas et.al in Australia.[26]

This revealed significant difference could be due to the additional balance exercise involved in otago intervention along with lower limb strengthening. Balance training often involve activities that challenge patients limits of stability. And thus, assist in improving balance [27].

Overall, in this study, Otago exercise program proved to be better in improving balance than pilates, but the Otago method has shown minute better performance than Pilates exercise. In our view application of Otago exercise program can be of great help for elderly in geriatric rehabilitation. The limitation of the study is the study was carried out on small sample size with no control group, further more flexibility, strength was not taken into consideration and the frequency of male and female subjects was not equally distributed.

5. Conclusion

The present study showed significant differences in the outcome measures of timed up and go test in group A and group B. The present study also shows that Otago exercises program has shown better progress in the percentage wise improvement in balance than the Pilates exercise group. Hence we reject null hypothesis and accept the alternate hypothesis that there will be significant difference in Otago exercise versus Pilates exercises in improving balance in elderly

DOI: https://doi.org/10.5281/zenodo.15711094

individuals. The recommendations of this study was done only on young old and mid old elderly, further studies are also suggested to detect the progress in participants with older age group and future studies should take strength and flexibility under consideration.

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