Effect of Otago Exercise on Balance Problem in Elderly Diabetic Women Patients

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ABSTRACT

Falls is a major concern for elderly adults with diabetes mellitus. In this randomized, controlled study, sixty elderly diabetic women patients were included. Balance disturbance and falling risk were assessed by berg balance scale and timed up and go test. All of parameters were evaluated before and after 12 weeks from the beginning of the training. Thirty patients underwent Otago exercise program plus conventional balance exercise ,while conventional balance exercise was applied in the remaining thirty patients , there were significant change in berg balance scale and Timed up and go tests in both groups post treatment compared with that pretreatment and There was a significant increase in the berg balance scale and a significant decrease Timed up and go of the group A post treatment compared with that of the group B. It was concluded that Otago exercise program plus conventional balance exercise improve balance more than conventional exercise only

Keywords: Conventional balance exercise / Diabetes /Otago exercise

INTRODUCTION

Diabetes is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both Among the estimated 8.3% of people with diabetes, 90% have type 2 diabetes mellitus (DM), and the number of affected people is expected to increase by 55% by 2035. DM is very common and is especially seen in the elderly population. Associated diseases, such as age-related insulin secretion, increased insulin resistance, obesity, a low level of physical activity and medications may be cited as reasons for the high prevalence of diabetes in the elderly population **(Khan., et al.,2020)**.

Each year, one in 10 older adults (ages 65 and older) reports a fall injury requiring medical attention or limiting activity for at least a day. Older adult falls result in an estimated US$50 billion in medical costs annually. In 2018, falls accounted for more than 60% of all older adult unintentional injury–related emergency department (ED) visits. About three million older adults were treated for an unintentional fall in an ED, and 30% of those treated required hospitalization. Previous reports indicate that the most common body part injured is the head. The majority of hip fractures (95%) in older adults are due to falls, and falls result in approximately 80% of traumatic brain injury (TBI)-related ED visits, hospitalizations, and deaths in older adults. Injury diagnosis varies with age, and women experience more fractures, including hip fractures, from a fall than men **(Haddad, et al.,2020)**

Falls is a major concern for elderly adults with diabetes mellitus. The annual incidence of falls in elderly diabetic individuals was up to 39%. Approximately 30.6% of individuals with diabetes and 19.4% of individuals without diabetes experienced recurrent falls in the longitudinal aging study. Declines in sensory function caused by

neuropathy or retinopathy may lead to increased risk of falls in diabetic persons **(Yang, et al.,2016).**

Balance impairment can develop as a result of damage or deficit in following systems, as these are main components which help in maintaining balance by visual system (eyes), vestibular system (ears), Proprioceptive system (the body's sense of where it is in space). Degeneration or loss of function in any of these systems can lead to balance deficits **(Suleman and Fatima. 2019).**

Age-related limitation in postural movements and balance-stabilizing responses to external postural perturbations are contributing factors to loss of balance and falls **(Sanders et al. 2019).**

The Otago Exercise Program (OEP) is an evidence-based fall prevention program proven to improve strength and mobility and reduce falls and fall-related injuries in high-risk older adults, The OEP was developed and evaluated in New Zealand in the late 1990s **(Shubert et al. 2018).**

Recent evidence has suggested that a multi-component exercise regimen focusing on flexibility, strength, balance and endurance can effectively improve balance, mobility, and physical performance as well as reduce the incidence of falls and falls-related injuries in community-dwelling older adults. The Otago exercise program (OEP) encompasses all the aforementioned aspects and was developed for community-dwelling older adults aged >65 years old. The OEP consists of a set of exercises for leg muscles strengthening and balance retraining exercises and is designed to prevent falls, particularly for individuals aged >80 years who have fallen in the previous year. Most studies have reported the OEP to be an effective fall prevention strategy that benefits balance function and lessens fear of falling **(Chiu et al. 2021).**

Conventional balance training (CBT) exercise includes training the strength and endurance maximizing flexibility and postural control has been proven effective in improving functional ability in addition to reducing the

risk of fall in elderly individuals **(Khot and Hande.2017).**

The balance berg scale (BBS) is a 14-item tool to assess balance ability. The items examine the subject's ability to maintain positions or movements of increasing difficulty by diminishing the base of support from sitting and standing to single leg stance **(Berardi et al. 2020)**

The Timed Up and Go (TUG) test is one of the most common tests used to examine balance, gait speed, and functional ability related to the performance of basic activities of daily living (ADL) in older populations. It can also help track clinical changes over time. The TUG measures the time it takes a participant to stand up from a chair, walk 3 Mata comfortable speed, walk around a cone, walk back, and sit down on the chair. If individuals require less than 10s, they are considered to have free mobility. The time frame between 10–20s is considered to have independent mobility. If the task is completed in 20–29s, the individual has variable mobility, and if it takes the individual more than 29s, the individual has impaired mobility. With a "cut-off" value of 14s or more, the TUG is considered a good predictor for identifying healthy individuals at risk of falling. Internal consistency, reliability, validity, and responsiveness are excellent **(Klotzbier et al. 2021)**.

So, the objective of the current study was to determine the effect of Otago exercise on balance problems in elderly diabetic women patients

MATERIALS AND METHODS

Subjects and study design

This randomized and controlled study. Which aimed to compare the result of different physiotherapy exercise program on balance and falling problem ,was conducted in the Department of physical therapy, Maghagha General Hospital ,the study was done between January and April 2022 .60 (women) patients participated in this study ; they were recruited from Maghagha General Hospital , there ages ranged from 65 to 75 with BMI ranged from (25: 29,9 kg/m2), HbA1c level required was $\geq$ (6.5%) .They were assigned randomly into two groups A and B (study and control):Group A(study group)thirty patients (women) who were received Otago exercise program plus conventional balance exercises program for successive 12 weeks, 3 times per week, 50 to 60 minutes for each session . Group B (control group) thirty patients (women) who were received conventional balance exercises only for successive 12 weeks, 3 times per week, 30 minutes for each session.

The Timed Up and Go test (TUG):

It was used to determine fall risk and measure the progress of balance, sit to stand and walking. The patients were asked to wear their regular footwear and can use a walking aid, if needed, set on a 46-cm height armchair with their back contacting the chair back support, then stand up, walk 3 meters as quickly and safely as possible, turn around, walk back and sit down. They were allowed to use a gait assistive device as preferred. The timing was started at the instruction "go" and stopped when the participants sat with their Back touching back support. They performed the TUG twice, as a practice session and the latter as the test. This test has been reported excellent test-retest reliability.

Berg balance scale (BBS)

It was used to assess balance performance through functional tasks that require equilibrium and is commonly used in the elderly. Berg balance scale contained 14 items to assess balance. Each item could be scored from 0 to 4, indicating the lowest and highest performance levels, respectively. Thus, the maximum score of the scale was equal to 56. The patients were asked to maintain a given position for a specific time. Progressively more points were deducted if:

- The time or distance requirements were not met

- The patient's performance warranted supervision
- The subject touched an external support or received assistance from the examiner

The items of the test were as the following:

- Sitting to standing
- Standing unsupported
- Sitting unsupported
- Standing to sitting
- Transfers
- Standing with eyes closed
- Standing with feet together
- Reaching forward with outstretched arm
- Retrieving object from floor
- Turning to look behind
- Turning 360 degrees
- Placing alternate foot on stool
- Standing with one foot in front
- Standing on one foot

1. Session for group A (Otago exercise plus conventional balance exercise) was about 50 to 60 min
2. Session for group B (conventional balance exercise only) was about 30 min

Otago exercise program:

For group A (study group)

Each session of Otago exercise program consisted of lower limb strengthening exercises, balance training exercises, and endurance. Progression of exercises was done by increasing the duration and then intensity. It started with warm up which was consisted of flexibility exercises for 5 min. and 17 strength and balance exercises, which were progressed over the course of the plan of care. Examples of exercises include (with weights on the ankles): bending and straightening the knee from a sitting position, standing on one leg for 30 s, walking in a heel-toe pattern, and standing up and sitting down from a chair. Patients in group A got Otago exercise plus conventional exercise, each session was about 50 to 60min.

Conventional balance exercise:

For group A (study group) and group B (control group):

Each session of Conventional balance exercise consisted of the following:
- Flexibility for: Calf, hamstring, quadriceps, hip flexors & hip adductors (15 sec hold and 5 repetitions).
- Strength for: Abdominal (curl ups), spinal extensors (prone extension), hip abductors (side lying with a weight around the ankle), hip extensors (in prone), hamstring (prone knee flexion) and quadriceps (knee extension in high sitting): all movements were given for 10 repetitions.
- Postural control: Stepping in all direction, reaching to limits of stability in different position (kneeling, half kneeling, standing: on hard surface and foam surface), step up and down, tandem standing and walking, single limb standing (eyes open and closed).
- Endurance: Walking for 12 minutes at self-selected comfortable pace on a level surface Surfaces and general endurance training
- Each session about 30 min

Follow up procedures

The follow up procedures included TUG test and Berg balance scale for balance assessment pre and post training for each group

Statistical analysis

Unpaired t-test were conducted for comparison of subject characteristics between groups. Normal distribution of data was checked using the Shapiro-Wilk test. Levene's test for homogeneity of variances was conducted to ensure the homogeneity between groups. Mixed MANOVA was conducted to investigate the effect of treatment on TUG, BBS, 1-minute STS and DGI. Post-hoc tests

using the Bonferroni correction were carried out for subsequent multiple comparison. The level of significance for all statistical tests was set at $p < 0.05$. All statistical analysis was conducted through the statistical package for social studies (SPSS) version 25 for windows (IBM SPSS, Chicago, IL, USA).

- Results

Demographic and other baseline data in both groups: Table (1) represents a summary of subjects' demographic data and clinical characteristics at the beginning of the study as age, HBA1C and body mass index (BMI) as shown in tables (1).

Effect of treatment on TUG, BBS, :

Mixed MANOVA revealed that there was a significant interaction of treatment and time (F = 52.45, p = 0.001). There was a significant main effect of time (F = 721.23, p = 0.001). There was a significant main effect of treatment (F = 2.73, p = 0.03).

Within group comparison:

There was a significant decrease in TUG in the group A and B post treatment compared with that pre treatment ($p > 0.001$). The percent of change in TUG in group A and group B was 21.77 and 11.64% respectively.

There was a significant increase in BBS in the group A and B post treatment compared with that pre treatment ($p > 0.001$). The percent of

change in BBS in group A was 14.5, 25.24 and 23.13% while that in group B was 8.77, 12.16 and 14.54% respectively. (Table 2).

Between groups comparison:

There was no significant difference in all variables between groups pre-treatment ($p > 0.05$). Comparison between groups post treatment revealed a significant decrease in TUG in the group A compared with that of group B ($p < 0.001$). Also, there was a significant increase in BBS in the group A compared with that of group B ($p < 0.01$). (Table 2).

Table 1. Comparison of subject characteristics between group A and B:

	Group A	Group B			
	Mean ± SD	Mean ± SD	MD	t-value	p-value
Age (years)	68.86 ± 2.81	69.4 ± 2.97	-0.54	-0.71	0.47
BMI (kg/m²)	26.96 ± 1.56	27.57 ± 1.5	-0.61	-1.54	0.12
HbA1c	6.46 ± 0.07	6.49 ± 0.08	-0.03	-1.48	0.14

SD, Standard deviation; MD, Mean difference; p value, Probability value

Table 2. Mean TUG, BBS pre and post treatment of the group A and B:

	Pre treatment	Post treatment			
	Mean ± SD	Mean ± SD	MD	% of change	p value
TUG (sec)					
Group A	20.3 ± 1.61	15.88 ± 1.43	4.42	21.77	0.001
Group B	19.76 ± 1.8	17.46 ± 1.93	2.3	11.64	0.001
MD	0.54	-1.58			
	p = 0.23	*p = 0.001*			
BBS					
Group A	37.23 ± 2.17	42.63 ± 2.28	-5.4	14.5	0.001
Group B	36.96 ± 2.41	40.2 ± 2.63	-3.24	8.77	0.001
MD	0.27	2.43			
	p = 0.65	*p = 0.001*			
	p = 0.64	*p = 0.001*			

SD, Standard deviation; MD, Mean difference; p value, Probability value

DISCUSSION

The finding of this study showed that Otago exercise program plus conventional exercise had significant effect more than conventional exercise only on balance and falling problem in elderly diabetic women. There was a significant increase in the BBS post training with percentage of increase (14.5%.8.77%.) for group A and group B respectively and There was a significant difference between group A and B (p = 0.001). There was a significant decrease in the TUG of the post training with percentage of decrease (21.77%. 11.64%) for group A and group B respectively, and There was a significant difference between group A and B (p = 0.001) So there was significant difference between group A and group B in post training TUG and BBS

This study agreed with (**Patel and Pachpute.2015**) who evaluated the effect of Otago exercise program on 30 patients who were falling under moderate fall risk, aged 60 years and above, according to the result of the study The Otago exercise program is significantly effective increasing strength of lower limb and improving in balance, gait and prevention of fall in elderly people

The result of this study come in support with the result stated by (**Jahanpeyma et al. 2021**) who evaluated controlled trial included 72 individuals over 65 years of age . The participants were randomized into the Otago exercise group and walking(control group). The Otago group performed 45 min of Otago exercises 3 days/week for 12 weeks plus a walking program on 3 other days of the week. The control group did only the walking program who evaluated the effect of the Otago exercise program on falls, balance, and physical performance in old-aged, and they observed a significant difference between the Otago and walking groups in terms of mean change in balance score at the end of the 12-week intervention compared to pre-intervention values (p < 0.001). BBS score in the Otago group increased significantly from 44 before the intervention to 50 after the intervention (p < 0.001), while there was no significant change in median BBS score in the walking group after the intervention (p = 0.250). Comparison of post-intervention median BBS scores between the groups also revealed a significant difference (p < 0.001).

The result of this study coincided with results achieved by (**Dadgari et al. 2016**) who examined the effects of OEP to decline the incidence of falls among elderly community dwellers To assess improvement of functional capacity, the results of TUGT and BBS were compared for subjects' post intervention results in the control and experimental groups. The TUGT results present significant differences between control and experimental groups when comparing the post-intervention results of TUGT (x2 = 36.99, df = 2, P-value = 0.017). In addition, BBS results present significant differences between control and experimental groups when comparing the post-intervention results (x2 = 21.31, df = 2, P-value = 0.025*)*

This study agreed with (**Abd-Elraziek et al. 2021**) who found that Otago training significantly improved health status of studied subjects and demonstrated that Otago training significantly reduced the risk of falling among the studied subjects, this may be due to the fact that OEP is a combination of muscle strengthening, balance training, and walking programs for the reduction of falls among elderly. The result showed that the Otago training significantly reduced the risk of falling among the studied elderly.

The results of this study coincided with results achieved by (**Chiu et al. 2021**) who demonstrated that there were effects of OEP interventions on actual balance performance (i.e., static, dynamic, proactive or reactive balance) and perceived balance (i.e., balance confidence or fear of falling) in older adults; and OEP protocol leads to the greatest balance improvements

This study disagreed with (**Saerang et al. 2021**) who demonstrated randomized control group design. Twenty-six elderly women in nursing homes age 60 years old or more who meet inclusion criteria, divide into 2 groups, with thirteen subjects in each group. The intervention group performed the Otago exercise program 3 times a week for 8 weeks and the control group had no intervention. Performed Otago exercise program for 8 weeks reduced the risk of falling by decreased the TUG test in the treatment group by 0.99 seconds, while in the control group there was no decrease in the TUG time. The effect size value of the treatment group was 0.3, indicating that the Otago exercise program had a small effect on reducing the risk of falling with the TUG test**.**

The result of the current study was not consistent with (**Binns and Taylor. 2011**) who reported that OEP had no significant effects on elderly individuals' muscle strength and balance Participants in both the OEP group and the control group who had similar degrees of lower limb weakness, gait speed and functional mobility . The OEP participants had a slightly lower dynamic

balance score at baseline than the control group although this was not a statistically significant difference OEP participants were more fearful of falling as measured by the MFES

CONCOLUSION

From results of the current study, it was concluded that Otago exercise program plus conventional exercise had significant effect more than conventional exercise only on balance and falling problem in elderly diabetic women.

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