

Research article

Efficacy of antigravity and Pilates exercise to improve balance in T2DMK.Kamatchi¹, S.Saranya², G.Tharani¹, K.C.Gayathri³, I.Deepa¹, N.Kaviraja⁴, Meenakshi S.K.¹¹Faculty of Physiotherapy, Dr. MGR Educational and Research Institute, Chennai, Tamil Nadu, India²Joint Care Physiotherapy Clinic, K.K Nagar, Chennai, Tamil Nadu, India³School of Physiotherapy, Chettinad Academy of Research and Education, Kelambakkam, Chengalpet, Tamil Nadu, India⁴Kavi's Physiotherapy and Paediatric Therapy Clinic, Avadi, Chennai, Tamil Nadu, India*(Received: November 2021 Revised: October 2022 Accepted: November 2022)*Corresponding author: **K. Kamatchi**. Email: kamatchi.physio@drmgrdu.ac.in**ABSTRACT**

Introduction and Aim: Increased risk of fall and injury, disturbance in gait and balance is always associated with type 2 diabetes. The more common risk factor in diabetes is the fear of fall. Exercise provides stability, improves the dynamic balance and has a great influence to maintain the equilibrium of the body. The aim of the study was to analyse the effect of antigravity and Pilates exercise to improve balance in diabetes mellitus patients.

Materials and Methods: This is an experimental study and a comparative type. The study was done in the Faculty of Physiotherapy OP department, A.C.S. Medical College and Hospital with a study sample of 30 patients with male and female in the age group of 45 -65 years. Based on the inclusion and exclusion criteria the subjects were segregated into two groups. Group A- were implemented with antigravity exercise for half an hour for three days per week for 12 weeks and Group B -were implemented with Pilates for forty-five minutes for three days per week for 12 weeks.

Results: The study revealed that anti-gravity exercise was better than Pilates exercise and which helps in increasing the balance, muscle strength and prevent falls Risks and provides a great significant difference in post- test mean value ($P \leq 0.001$).

Conclusion: At the end of the study, it indicates that anti-gravity exercise was found to be more effective in improving the balance among diabetes mellitus patients.

Keywords: Balance training; hyperglycaemia; Berg balance scale; timed up and go test; gait impairment.

INTRODUCTION

The most important health problem of the 21st century is diabetes. The leading cause of death in many countries is diabetes and its complications (1). The prevalence of diabetes in the 20-79 years age group has increased in the last two decades. Diabetes mellitus (DM) is nowadays an important issue affecting the public and has a great influence on patients and society. Thus, it is an emergency period to find out the effective treatment and intervention for diabetes control and prevention (2). T2DM and its complications are the main causes for morbidity, and it reduces the life expectancy of the people (3). T2DM is the most common type of diabetes than type 1 and gestational diabetes (4). The most common factors for DM2 that influence is change in the lifestyle of the children due to junk food intake and sedentary life (5). T2DM is the most common cause for fall in elderly population and hence it is considered as geriatric giants. According to WHO, the major influence factor for falls in older adults is poor balance (6).

The prevalence of the disease increases with age, commonly affecting the elderly population aged 65 to 74 years (7). For daily living activities balance and

postural stability is required. It is important to perform sitting, standing, lying down and when balance is affected this leads to developing the fear of falling in patient with DM which in turn affects the quality of life of the patients (8). Fall related injuries are often assumed to have affected the quality of life because of their influence on physical activity levels of affected patients (9). T2DM gradually affects the balance, reaction time and plays a vital role to increase the risk of fall compared with controlled subjects. Major complications such as peripheral neuropathy, diabetic retinopathy are the common causes of mechanisms for falls (10).

The most common factors of T2DM are inactivity due to change in lifestyle which leads to obesity. Nowadays Pilates exercise is the recently used which is used to engage both body and brain which was invented by Joseph Pilates in 1880 (11). For decades, exercise has been considered a cornerstone of diabetes management, along with diet and medication (12). The development of the medicine field gives a way to maintain fitness of the body with different innovative exercise interventions enhancing health (13). Anti-gravity exercise and other lifestyle changes are the strategic parameters in the management of diabetes. Anti-gravity exercises include climbing up and down

the stairs post 1 hour 45 minutes of lunch and dinner (14).

T2DM is a metabolic disorder characterized by hyperglycemia and relative lack of insulin. Balance training improves the additional physical activity. Antigravity and Pilates exercise reduces the blood glucose level and reduces the risk of falls and improves well-being. Regular exercise improves insulin resistance. The subjects must be taught with the difference between physical activity and exercise to be performed. Anti-gravity exercise helps improve the balance among T2DM patients. Usually the diabetic patients undergo walking, but it may not be enough to just walk and so a little bit of exercise can help improve balance. This study was designed to assess whether antigravity and Pilates exercise exhibited differences in balance and risk of falls for T2DM.

METHODOLOGY

The study is a comparative study design with pre and post analyses with a sample size of 30 subjects at A.C.S Medical College and hospital as the study setting. Convenient sampling method was performed. Subjects who were included in the study were of age group selected between 45 - 65 years; subjects with diabetes for more than 7 years, subjects with balance impairment, both male and female. Subjects who were excluded from the study were disabled and mentally retarded people, juvenile diabetes, subjects with infections like foot ulcers, subjects with severe orthopaedic conditions and subjects recently affected with any cardiac conditions. The physiotherapy intervention, anti-gravity and Pilates exercise were given to the two groups. The outcome measure used in the study is Berg balance scale and timed up and go test.

Ethical clearance

Ethical clearance for the study was obtained from the Institutional Review Board A-48/PHYSIO/IRB/2019-2020.

Procedure

Subjects were examined and allotted physiotherapy intervention based on the selection criteria and divided into two groups. First, both the groups were asked about the demographic information (age, occupation, duration of diabetes). Group A subjects were given antigravity exercise. The subject was given a warmup session with a period of 10 min, followed by moderate exercise such as non-jumping jacks for 10 counts with 2 sets of repetition. Followed by several exercises with minimal intensity to be practiced, after a few days based on the capacity of the individual the exercise repetition has been gradually increased. After the set of exercises were

completed cool down exercises were given to relax the muscles and to make the exercise more effective.

Group B subjects were given Pilates exercise. The basic principles of Pilates exercise were explained and general information on them was provided during the beginning of the session. In the first four weeks the exercise was done on mats, followed by standing posture.

Berg balance scales and timed up and go tests were used to assess the balance among T2DM patients.

Exercise protocol

- Antigravity exercise duration: 30 minutes session three times per week.
- Pilates exercise: 45 minutes session three times per week.

Group A anti-gravity exercise

Anti-gravity exercise and other lifestyle changes are the strategic parameters in management of diabetes. Patients is given a moderate exercise training in the form of climbing strains up and down [without knee pain] with warm up session of 10 min, prior to training and cool down phase of 5 min before anti-gravity exercise. After warm up session give anti-gravity exercise such as non-jumping jacks, alternate arm raise, single leg swings by holding the chair. Cool down phase in 5 min takes body to rest.

Single leg raise: Stand on both the legs, by holding the chair lift one leg off the floor as high as possible by bending the knees in right angle.

Pelvic bridging: Press the heels into the floor and activate the glutes and abdominal muscles to raise the pelvis off the floor.

Wall sit: Place your feet firmly on the ground, shoulder on the wall, and then about 2 feet out from the wall. Slide your back on the wall by bending the legs.

Leg raises: Place your legs straight, feet and knees together, raise one leg as far as possible. Pause for a count of 1 or more, with a repetition of 10 counts in each leg.

Non-jumping Jacks: Stand upright with your legs together, arms at side. Spread one leg to be about shoulder width apart. Stretch your arms out and over your head.

Knee raises: Sit on the chair and back must be straight. Maintain your feet on the floor with legs slightly apart, take one leg and lift keeping your knee bent. Raise until the back of the thigh is slightly off the chair. Repeat on the other side.

Group B Pilates exercise

The exercise program is given for a period of 12 weeks and 3 days for a week with a duration of 45

minutes. Each session started with a simple relaxation technique to warm up followed by supine stretching for 30 seconds per side with three repetitions followed by wall hamstring stretch, single knee to chest, pelvic curl, double knee to chest. To provide passive movements at the end of the cool down phase in 5 min takes the body to rest. Moreover, a break of 30 seconds was provided between every exercise.

Single leg stretch: Lie on the floor with both legs extended and arms along the sides. Pull the right knee towards your chest and hold your right knee with both the hands. Repeat on the other side.

Spinal stretch: Sit down with legs extended, exhale. Reach forward up and over the barrel and stretch forward.

Swan: Lie face down on the mat, press your hands into the mat and place elbows back towards your heels. Raise chest and upper spine to move off the mat into an upward arch.

Saw: Sit on the mat with legs extended, touch the left toe with your right hand and left hand is extended back.

Double leg stretch: Lie on the mat with both the legs extended with arms at side. Pull both the knees towards the chest and hold with both the hands for a period of 5 seconds

General instruction during relaxation exercise

Be calm and comfortable in a relaxed position, avoid extra movements, inhale for 4 seconds and hold the breath for 5 seconds and exhale for 7 seconds. Perform this 5 times.

Data analysis

The data were tabulated and analysed using both descriptive and inferential statistics. The parameters were assessed using a statistical package for social science (SPSS) version 24. Paired t-test was adopted to find the statistical difference within the groups and independent t-test (Student’s t-test) was adopted to find statistical difference between the groups.

RESULTS

On comparing the mean values of group A and group B on Berg Balance Scale Score, a significant increase in the post test mean values was seen in both groups, but (Group A - Anti gravity exercises) shows 49.93 which has the higher mean value is effective than (Group B - Pilates exercises) 41.40 at $P \leq 0.001$ (Table 1). Hence null hypothesis is rejected.

On comparing the mean values of group A and group B on Time Up and Go Test Score, it shows significant decrease in the post test mean values in both groups, but (Group A – Anti- gravity exercises) shows 10.20 seconds which has the lower mean value is effective than (Group B - Pilates exercises) 15.66 seconds at $P \leq 0.001$ (Table 2). Hence null hypothesis is rejected.

Table 1: Comparison of Berg balance scale score between group A and group B in pre and post-test

BBS	Group A		Group B		t - test	Df	Significance
	Mean	S.D.	Mean	S.D.			
Pre-test	31.80	4.55	31.86	1.68	-.053	28	0.958*
Post- test	49.93	3.45	41.40	1.24	9.00	28	0.000***

(*- $P > 0.05$), (**- $P \leq 0.001$) Mean, Standard deviation (S.D.), t-test, degree of freedom (df) and p-value between (Group A) and (Group B) in pre-test and post-test weeks.

Table 2: Comparison of time up and go test between group A and group B in pre and post-test

TUG	Group A		Group B		t - test	Df	Significance
	Mean	S.D.	Mean	S.D.			
Pre-test	18.93	1.70	19.00	1.64	-.109	28	.914*
Post- test	10.20	1.47	15.66	1.34	-10.61	28	.000***

(*- $P > 0.05$), (***- $P \leq 0.001$) Standard deviation (S.D.), t-test, degree of freedom (df) and p-value between (Group A) and (Group B) in pre-test and post-test weeks.

Table 3: Comparison of Berg balance scale score within group A and group B between pre and post-test values

#BBS	Pre-test		Post-test		t - test	Significance
	Mean	S.D.	Mean	S.D.		
Group A	31.80	4.55	49.93	3.45	-30.60	.000*
Group B	31.86	1.68	41.40	1.24	-17.40	.000***

(***- $P \leq 0.001$) Standard deviation (S.D.), t-test, degree of freedom (df) and p-value between (Group A) and (Group B) in pre-test and post-test weeks.

Table 4: Comparison of time up and go test within Group A and Group B between pre and post-test values

TUG	Pre-test		Post-test		t - test	Significance
	Mean	S.D.	Mean	S.D.		
Group A	18.93	1.70	10.20	1.47	17.33	.000*
Group B	19.00	1.64	15.66	1.34	10.98	.000***

(***- $P \leq 0.001$) Standard deviation (S.D.), t-test, degree of freedom (df) and p-value between (Group A) and (Group B) in pre-test and post-test weeks.

On comparing pre-test and post-test within Group A and Group B on Berg Balance Scale and Time Up and Go Test score shows highly significant difference in mean values at $P \leq 0.001$ (Tables 3 and 4)

DISCUSSION

The results of the study revealed that after intervention there was a significant difference that anti-gravity exercise is more effective than Pilates in subjects with balance in T2DM by Berg balance scale and timed up and go test. There are several possible mechanisms that explain why anti-gravity exercise promotes balancing among T2DM patients. There are significant improvements that provide balance among T2DM for both these groups.

A comparison study of 12 weeks of Pilates and aquatic training on the dynamic balance of women with multiple sclerosis had concluded the effectiveness of dynamic balance in comparison with Pilates and aquatic training. The direct effects on the quality of life have been improved in giving these exercises as a supplementary treatment along with medical treatment. Cattaneo *et al.*, observed a significant difference in static balance rather than dynamic balance, but the probability in the falls risk has been reduced (15).

The study, which is conducted in Pune, concluded that antigravity exercise was found to be effective in comparison with modified plant-based diet and easy to do without extra cost and time. Significant improvement in reducing fear of fall and improving balance is observed after the exercise program (16).

One of the studies concluded that 8 weeks of antigravity training in a safe environment improved performance during dynamic balance (17). The balance improvement is seen in group A subjects by performing the antigravity exercise, which helps the muscle to become much stronger.

By strengthening the muscles, the balance has been improved. The improvement in balancing and reduced risk of falls is seen in group A subjects rather than group B. The risk of falling with an impaired balance is due to the weakness of the flexor group muscles (18). Strengthening the flexor group of muscles provides balance improvement and promotes a well-developed confidence among the individual

(19). Improving the balance by antigravity and Pilates exercise provides strength and stability, help improves balance among both the groups. Rather than group B, group A subjects has seen improvement in reducing the risk of falls in T2DM.

The muscle power, providing stability and balance has been improved in antigravity exercise training. The strength and stability play a major role in proving balance among individuals (20). In order to improve the strength and stability the antigravity and Pilates exercise is being performed that help improves balance among type 2 diabetes mellitus patients. In comparison with balance improvement in both the subjects, antigravity exercise has a significant improvement in muscle power, providing stability and promotes balance. Although balance improvement was seen in both the groups, the greater amount of improvement is seen in Group A (antigravity exercise) after 12 weeks of intervention.

CONCLUSION

The study concluded that both antigravity and Pilates exercise were effective in providing balance among T2DM patients. Antigravity exercise is effective than Pilates exercise in reducing falls, promoting balance, increases the proprioception, kinesthetic awareness and muscle strength in T2DM.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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