

Effects of Balance Training Versus Aerobic Exercise with Stretching to Improve Postural Stability and Walking Performance in Diabetic Peripheral Neuropathy Patients

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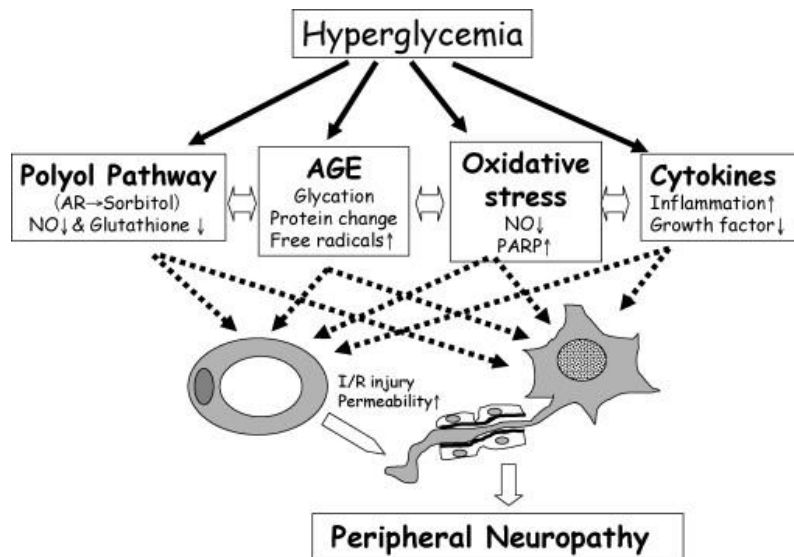
Abstract: Diabetic peripheral neuropathy is one of the serious known micro vascular complications of both type 1 and type 2 diabetes mellitus having been diagnosed in 20-50% of the diabetic population. Moreover, one third of the patients with diabetic peripheral neuropathy are affected by balance and gait disturbance. The incidence of developing diabetic peripheral neuropathy increases with the chronicity of the disease and poor glycemic control. As per the recent study it was noticed that in patients with uncontrolled blood sugar levels the nerves get weakened and damaged. Due to these nerves are unable to send signals which leads to diabetic neuropathy. Postural instability and balance disorder are common finding in diabetic neuropathy due to decreased proprioception and increased reflex reaction time. Around 30% of people with diabetic peripheral neuropathy experience muscle weakness, loss of ankle reflexes, and decreased balance, coordination and gait control, thereby, limiting walking and increasing the risk of fall-related injuries. Hence, the need of the study is to find out the effectiveness of balance training versus aerobic exercise along with stretching to improve postural stability and walking performance in diabetic peripheral neuropathy patients. **Materials and Methodology:** The experimental study was done to compare the effects of Balance training versus Aerobic Exercise with stretching to improve postural stability and walking performance in Diabetic peripheral neuropathy patients. Group A consist of 15 subjects with Balance training and Group B consist of 15 subjects with Aerobic exercise. The outcome measure is calculated by using Berg Balance Scale, Time up and go test and Single leg stance test based on inclusion and exclusion criteria. Indoor cycle, sphygmomanometer, stop watch, tape, couch these are the materials needed during the treatment. **Result:** On comparing pre test and post value within Group A and Group B and post test value between the groups on Berg Balance scale, Time up and Go test, Single leg stance shows a highly significant difference in mean value at P value < 0.05. **Conclusion:** The study concludes that the balance training along with stretching were effective improvement in postural stability and walking performance in diabetic peripheral neuropathy patients.

Keywords: Diabetic peripheral neuropathy, balance training, postural stability, walking, berg balance scale, time up and go test, single leg stance test, stretching

1. Introduction

Diabetes is a common metabolic disease having serious health implication and its incidence is increasing day by day. The global burden of diabetes is alarmingly high, with over 382 million diabetics in 2013 which is expected to rise up to 592 million by 2035. Diabetic neuropathy is a progressive disease and a serious complication of diabetes that occurs due to nerve damage. One of the many complications of diabetes mellitus is diabetic peripheral neuropathy (DPN), which is defined as “the presence of symptoms or signs of peripheral nerve dysfunction in people with diabetes after exclusion of other causes. Diabetic peripheral neuropathy develops slowly, and insidiously, worsening over time. Signs of the disease may be present even before a person is formally diagnosed with diabetes. Symptoms begin in the longest nerves in the body, affecting the feet first and later

the hands in a “stocking-glove” pattern, the symptoms usually spread slowly and evenly up the leg and arms. Poor balance control and increased falling risk have also been reported in people with diabetic peripheral neuropathy. DPN can be defined as a symmetrical, length-dependent sensorimotor polyneuropathy attributable to metabolic and micro vessel alterations resulting from chronic hyperglycemic and cardiovascular risk covariates. Painful symptoms such as burning, tingling (pins and needles or paraesthesia), shooting (like electric shock) or lancing (stabbing) are present in around one third of patient with DPN and around 20% of all diabetic patients. The pathophysiology is characterized by predominantly metabolic/inflammatory damage that affects the peripheral nerves responsible for conducting the motor and sensory impulses.



Diabetic peripheral neuropathy encompasses sensory, motor, and autonomic neuropathy. Loss of large myelinated fibers and other proprioceptive afferent fibers causes disturbed light touch sensation, pressure sensibility, joint position sense and vibration²⁵. Disturbed joint position sense leads to increased instability of posture. Balance is concerned primarily with preserving, attaining, or restoring the center of mass in relation to the limits of stability within a given base of support, and plays an important role in mobility as well as stability. Balance or postural control depends on the interactions between sensory inputs (somato sensory inputs, visual inputs and vestibular inputs) and motor response via central integrative processing systems. Balance training is considered to be a very important tool for prevention of falls in older populations. It has been shown to produce improvement in different aspects of postural control, balance and gait. There was improvement in static balance such as one leg stance, tandem stance as well as in the dynamic balance such as forward reached test, walk over beam and five times sit to stand. Functional and mobility task as a dynamic balance measure like up and go test or performance-oriented mobility also improved past balance training. Depending on a person's ability, static balance exercise may be used initially until they are able to progress to more advanced dynamic balance tasks. Aerobic exercise is a physical activity that uses body's large muscles groups, is rhythmic and repetitive. It increases heart rate. The aerobic exercises include walking, cycling and swimming. After provision of exercise, improvement can be noted in balance, proprioception, lower-limb strength, reaction time and consequently decreased risk of falling. Stretching by improving flexibility, range of motion and elasticity to relieve stiffness in the afflicted joints and strengthen the muscle. Stretching reduces the risk of falling and helps to improve poor posture.

Sensory Nerve Impairment:

Sensory loss can be restricted to the toes; it can extend over to the feet; or spread over the lower legs or cross the knee level, totally depending on how intense the peripheral nerve lesions. Later, it may progress to upper extremities and trunk. In most severe cases the summit of the scalp can be affected as a consequence of the involvement of the longest fibers of trigeminal nerve²⁴. In the proximal parts, superficial

sensations such as pain and temperature are predominantly affected. Loss of large myelinated fibers and other proprioceptive afferent fibers causes disturbed light touch sensation, pressure sensibility, joint position sense and vibration²⁵. Disturbed joint position sense leads to increased instability of posture²⁶.

Motor Nerve Impairment:

Weakness in the distal parts of the body happens late in the nature history of DPN²⁶. With increased severity of DPN, a positive Romberg's sign and ataxia may be found due to the weakness in the ankle plantar flexors and dorsiflexors²⁶. This instability in the muscle leads to difficulty in maintaining the balance (static as well as dynamic) and it ultimately affect the gait.

Balance and Postural Stability:

Balance is defined as the ability to maintain or return the body's Centre of gravity within the limits of stability that are determined by the base of support³⁴. Postural control is the control of the body's position in space for the purpose of balance and orientation³⁵. Balance is concerned primarily with preserving, attaining, or restoring the center of mass in relation to the limits of stability within a given base of support³⁶⁻³⁷, and plays an important role in mobility as well as stability. Balance or postural control depends on the interactions between sensory inputs (somato sensory inputs, visual inputs and vestibular inputs) and motor response via central integrative processing systems.

Objective of the study

The objective of the study was to find this comparative effect of Balance training and Aerobic exercise with stretching to improve the postural stability and walking performance in diabetic peripheral neuropathy patient.

2. Procedure

Balance is concerned primarily with preserving, attaining, or restoring the center of mass in relation to the limits of stability within a given base of support and plays an important role in mobility as well as stability. Postural control is the control of the body's position in space for the purpose of balance and orientation. Balance training

enhanced balance sway index, with significant improvement in antero posterior sway index, medio lateral sway index and overall sway index with eyes open as well as eyes closed condition. Balance training exercise have been used to activate the sensory afferent system to improve balance in diabetic patients. Aerobic exercise improves muscles strength, endurance and flexibility, improves balance, increases mental function, assisting in weight management or weight loss, help to manage blood sugar. Aerobic exercise is also effective in reducing the risk or severity of peripheral neuropathy in patients.

30 diabetic peripheral neuropathy patients were assigned into two experimental groups by simple random sampling method. All 30 subjects were involved for pre-test assessment which include drug dosage and activity level of patient. Group A will perform Balance training with stretching and Group B will perform Aerobic exercise with active stretching.

3. Outcome Measures:

- **Berg Balance Scale:** The berg balance scale is used to objectively determine a patient’s ability (or inability) to safely balance during a series of predetermined tasks.
- **Time Up and Go test:** This test measures the dynamic balance and functional mobility in older adults.
- **Single Leg Stance test:** The single leg stance test is used to assess static postural and balance control. The single leg stance test is a balance assessment that is widely used in clinical setting to monitor neurological conditions

Variables:

Dependent Variable:

- Postural stability.
- Walking performance.

Independent Variables:

- Balance training with stretching.
- Aerobic exercise with stretching.

Group A:

Balance training with stretching:

Subjects: 15

Study duration: 6 week

Treatment session: 5 days /week

Treatment duration: 50-60 minutes (total training duration)

Exercises:

Static balance exercise: (20 minutes)

- Single leg stance
- Tandem stand
- Feet together

Dynamic balance training: (20 minutes)

- Heel-to-toe walking
- Squat
- Sit-to-stand
- Side-Leg raise with support

Stretching: (10 minutes) (common to both group)

Lower limb stretch:

- Standing Quadriceps
- Seated knee to chest
- Hamstring stretch
- Calf muscle stretch

Back stretch:

- Farmer stretch
- Seated roll down
- Seated gentle backbend

Group B:

Aerobic Exercise along with stretching:

Subjects: 15

Study duration: 6 weeks

Treatment sessions: 5days/week

Treatment duration: 50-60 minutes with resting period 10 minutes.

Exercises:

- Marching
- Walking
- jogging
- Cycling
- Stretching

4. Data Analysis

The comparative mean values, mean difference, standard deviation and unpaired ‘t’ values between Group A and Group B on Berg Balance Scale.

S.NO	Berg Balance Scale	Improvement			Unpaired ‘t’ Value
		Mean	Standard Deviation	Mean difference	
1	Group APost-test	46.87	3.66	4.14	3.1805 (P<0.05)
2	Group BPost-test	42.73	3.45		

The comparative mean values, mean difference, standard deviation and unpaired ‘t’ values between Group A and Group B on Time Up and Go test.

S.NO	Time Up and Go test	Improvement			Unpaired ‘t’ Value
		Mean	Standard Deviation	Mean difference	
1	Group APost-test	10.73	2.81	2.6	2.5272 (P<0.05)
2	Group BPost-test	13.33	2.82		

The comparative mean values, mean difference, standard deviation and unpaired t values between Group A and Group B on Single Leg Stance test.

S.NO	Single LegStance test	Improvement			Unpaired 't' Value
		Mean	Standard Deviation	Mean difference	
1	Group APost-test	38.50	3.10	7.12	5.3938 (P<0.05)
2	Group BPost-test	31.38	4.05		

5. Results

The study was done to compare the effectiveness of balance training and aerobic exercise along with stretching to improve postural stability and walking performance in diabetic peripheral neuropathy patients. In this study, 30 subjects were selected and divided into two experimental group by simple random sampling method. Group A patients received balance training along with stretching over a period of 6 weeks and Group B patients received aerobic exercise along with stretching in the same period of time to find the effectiveness of treatment. The statistical reports that the comparison of means values between the two groups in Berg balance scale were obtained. The mean value of Group B was 43.27 which were lesser than Group A value of 47.4. The unpaired t test value was 3.1805 at 0.05% level which was greater than tabulated value (2.048). Similarly, the comparison of mean value between two groups in Time up and go test were obtained. The mean value of Group A was 10.73 which was lesser than Group B value of 13.33. The unpaired t test value was 2.5272 at 0.05% level which was greater than tabulated value (2.048). And the comparison of mean value between two groups in single leg stance test were obtained. The mean value of Group A was 10.73 which was lesser than Group B value of 13.33. The unpaired t test value was 2.5272 at 0.05% level which was greater than tabulated value (2.048). The statistical analysis show that there is a significant improvement in postural stability and walking performance in two groups but there is a marked improvement in postural stability and walking in Group A who were undergone balance training along with stretching. The result was found that the Group A proved to be highly effective than Group B in the same duration of study. The statistical analyses shows that there is a significant improvement in postural stability and walking performance in diabetic peripheral neuropathy patients in Group A

6. Discussion

The study was conducted to determine the effectiveness of balance training and aerobic exercise along with stretching to improve postural stability and walking performance in diabetic peripheral neuropathy patients. Diabetic peripheral neuropathy is a progressive disease and a serious complication of diabetes that occurs due to nerve damage. Uncontrolled high blood sugar (hyperglycemia) mainly affects the nervous system. Postural instability, walking difficulties and balance disorder are common finding in diabetic peripheral neuropathy. The patients may feel more unsteady than usual and uncoordinated when they walk. This occurs when the body adapts to changes brought on by muscles damage. Chronically elevated blood sugars can also damage the nerves. This can lead to muscle weakness. They may have difficulty in walking or getting up from chair and risk of falling. Thus, the aim of the study was to assess the

effectiveness of balance training with stretching and aerobic exercise along with stretching to improve postural stability and walking performance in diabetic peripheral neuropathy patients.

References

- [1] Guariguata L, Whiting DR, Hambleton I, Beagley J, Linnenkamp U, Shaw JE. Global estimates of diabetes prevalence for 2013 and projections for 2035. *Diabetes Res Clin Prac* 2014;103:137-
- [2] Ramachandran A, Snehalatha C, Ma RC. Diabetes in South-East Asia: an update. *Diabetes Res Clin Pract.* 2014; 103: 231-237.
- [3] Boulton AJ, Gries FA, Jervell JA. Guidelines for the diagnosis and outpatient management of diabetic peripheral neuropathy. *Diabet Med.* 1998; 15: 508-514.
- [4] National Diabetes Fact Sheet. Centers for Disease Control and Prevention. 2010
- [5] Tesfaye S. Recent advances in the management of diabetic symmetrical poly-neuropathy. *J Diabet Invest* 2010;2:33-42
- [6] Goodman CC, Fuller KS. Pathology: implications for the physical therapist. Elsevier Health Sciences; 2014 Nov 5.
- [7] Ribu L, Hanestad BR, Moum T, Birkeland K, Rustoen T. A comparison of the health-related quality of life in patients with diabetic foot ulcers, with a diabetes group and a non-diabetes group from the general population. *Qual Life Res.* 2007; 16: 179-189.
- [8] Tesfaye S, Stevens LK, Stephenson JM, Fuller JH, Plater M, Ionescu- Tirgoviste C, et al. Tesfaye S. Recent advances in the management of diabetic symmetrical poly-neuropathy. *J Diabet Invest* 2010;2:33-42
- [9] Prevalence of diabetic peripheral neuropathy and its relation to glycaemic control and potential risk factors: the EURODIAB IDDM Complications Study. *Diabetologia.* 1996; 39: 1377-1384.
- [10] Davies M, Brophy S, Williams R, Taylor A. The prevalence, severity, and impact of painful diabetic peripheral neuropathy in type 2 diabetes. *Diabetes Care.* 2006; 29: 1518-1522.
- [11] Katulanda P, Ranasinghe P, Jayawardena R, Constantine GR, Sheriff MR, Matthews DR. The prevalence, patterns and predictors of diabetic peripheral neuropathy in a developing country. *Diabetol Metab Syndr.* 2012; 4: 21.
- [12] Pradeepa R, Rema M, Vignesh J, Deepa M, Deepa R, Mohan V. Prevalence and risk factors for diabetic neuropathy in an urban south Indian population: the Chennai Urban Rural Epidemiology Study (CURES-55). *Diabet Med.* 2008; 25: 407-412.
- [13] Bansal D, Gudala K, Muthyala H, Esam HP, Nayakallu R, Bhansali A. Prevalence and risk factors of development of peripheral diabetic neuropathy in type 2 diabetes mellitus in a tertiary care setting. *J Diabetes Investig.* 2014; 5: 714-721.