

# THE EFFECT OF AEROBIC EXERCISES ON BALANCE IN DIABETIC NEUROPATHY PATIENTS

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## ABSTRACT

**Objective:** To compare the effectiveness of balance exercises with and without aerobic exercises in improving balance of diabetic neuropathic patients.

**Material and Methods:** A Randomized Control Trial was conducted on 38 diabetic neuropathic patients in Armed Forces Institute of Rehabilitation Sciences, Rawalpindi-Pakistan from Sep 2015 to Jan 2016. Patients were randomly divided into control group (n=20) and experimental group (n=18) by toss and coin method. Control group was given only balance exercises while Experimental group received balance and aerobic exercises for Six weeks. Treatment outcomes were assessed on Berg Balance scale, Functional Reach Test, Romberg Test and Backward Release Test and Nerve Conduction Studies. Statistical analysis was done by using SPSS 20.

**Results:** The Mean Values  $\pm$  SD for Berg Balance scale, Functional Reach, Romberg and Backward Release Test were found to be significant ( $P < 0.05$ ) in aerobic treatment group as compared to traditional balance exercises group. Significant improvements have also been reported in different parameters of nerve conduction studies with  $P < 0.05$

**Conclusion:** Aerobic Exercises shows marked improvements in balance of diabetic neuropathic patients as compared to simple balance exercises. According to the Nerve Conduction Study (NCS) reports it was also observed that with aerobic exercises the complications of neuropathy were greatly minimized.

**Key words:** Diabetic Polyneuropathy, Aerobic Exercises, balance training.

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## INTRODUCTION

Diabetes is a group of metabolic diseases, characterized by hyperglycemia resulting from defects in insulin secretion, action or both. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of different organs, especially the eyes, kidneys, nerves, heart, and blood vessels.<sup>1</sup> In long standing cases of both diabetes type 1 and 2, about 60 % individuals had diabetic neuropathy. 113 patients who were newly diagnosed with type 2 diabetes were reported in a cross sectional survey. Among those cases about 68.5 % diagnosed had poor glycemic control and about 50 % were those who had a good

glycemic control.<sup>2</sup>

Diabetic neuropathy is divided into symmetric neuropathies mostly present as a case of chronic neuropathies which includes sensorimotor polyneuropathies distally; predominant neuropathy of large and small fibers and chronic inflammatory demyelinating polyradiculopathies (CIDP). The most common neuropathy among diabetic patients is diabetic symmetrical poly neuropathy (DSPN).<sup>3</sup> There is loss of vibration, proprioception and thermal sensation that can lead to muscular atrophy, musculoskeletal impairments and autonomic dysfunction in later stages. Most common symptoms of diabetic neuropathy are pain, tingling, numbness, and weakness in hands and feet.<sup>4</sup>

Patients suffering from diabetes are more prone to fall, possibly due to balance issues and sensory ataxia. The most common problem is the loss or reduced sensory information from feet thus altering the control of central nervous system on posture and upright position.<sup>5</sup> In addition , functional balance is also affected in patients presenting with type II diabetes presenting

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with peripheral neuropathy that affects many functional activities of patients.<sup>6</sup>

Exercise is believed to be a cornerstone in the management of diabetic patients along with proper nutrition and medications.<sup>7</sup> The most common complaint in patients with diabetic neuropathy is postural imbalance. This occurs because of proprioceptive loss. Peripheral neuropathy enhances the postural sway when visual clues don't support balance, however, this does not cause postural strategies to develop limb load asymmetry.<sup>8</sup> Activity of daily living and quality of function is affected in such patients. As the patient has increased risk of fall, the consequence is reduction in mobility, activity avoidance, admitting in hospital and mortality. Both physiological and cognitive behavioral factors are responsible for gait alterations in diabetic neuropathy.<sup>9</sup> According to various studies, different proprioceptive trainings were found to improve balance in the patients suffering from diabetic neuropathy.<sup>10</sup> Patients suffering from type II diabetes are at increased risk of fall. After provision of exercises, improvements can be noted in balance, proprioception, lower-limb strength, reaction time, and, consequently, decreased risk of falling.<sup>11</sup>

Various studies have shown positive effects of different exercise protocols for treating the symptoms of diabetic neuropathy like focused balance training, strength training and aerobic exercise training.<sup>5,12,14</sup> However, aerobic exercises have shown not only to prevent the development of neuropathy occurring as a result of diabetes by changing the natural history of symptoms<sup>13</sup> but will it also improve the symptoms once neuropathy has developed. The current study is designed to explore the effects of aerobic training on diabetic peripheral neuropathy; to determine whether aerobic training improves just the balance of these patients or it can also help to reverse the effects of peripheral neuropathy, investigated on electrodiagnostic studies.

### MATERIAL AND METHODS

A Randomized control trial was conducted in Benazir Bhutto Hospital and Armed Forces Institute of Rehab Medicine (AFIRM), Rawalpindi from Sep 2015 to Jan 2016. After approval from ethical review committee of Riphah International University, data collection started. On the basis of inclusion and exclusion criteria, 38 diagnosed cases of diabetic neuropathy patients with type II diabetes were enrolled in the study by using non probability purposive sampling. Patients included in the study were those having age 40 and above, diabetic history of one or more year, stable blood glucose control. All other patients with foot Ulceration, Unstable heart disease, co- Morbid conditions limiting exercise

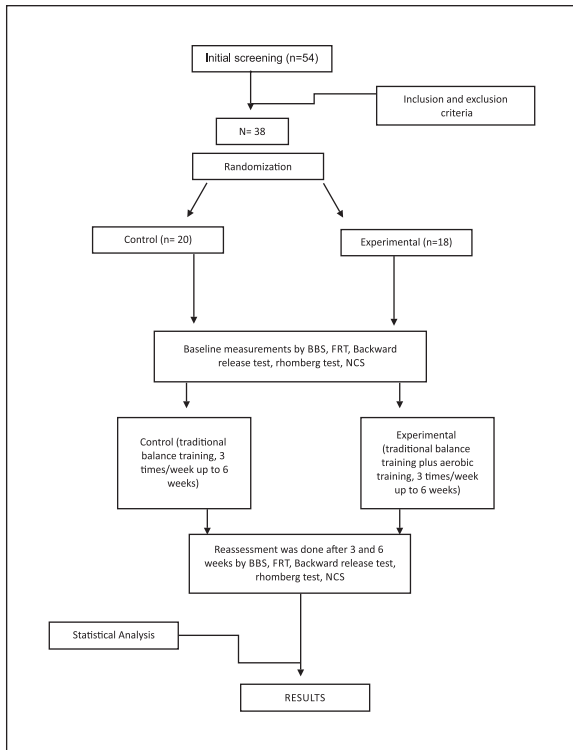
and any other disorder of the CNS causing weakness and sensory loss were excluded from the study. After selection of the patients, informed consent was taken from all the patients and then patients were randomly allocated to control (n=20) and experimental group (n=18) by using toss and coin method. After baseline assessment, traditional balance training was provided to the control group for 30 minutes, 3 times/week up to 6 weeks. This traditional balance training include exercises like; Stable to unstable base of support: bipedal to semi-tandem, tandem to one leg stance, Surface: from broad to decrease surface, changes in speed of different activities for static balance, reaching activities, Controlled perturbations applied by therapist for improving all kinds of balance.

Experimental group received Warm-up by stretching and flexibility exercises for 5 minutes, Treadmill walk for 6 minutes, Stationary bicycle for 6 minutes, 3 times a week for 6 weeks according to American diabetes association. Data was collected from all 38 patients at baseline, after 3 weeks and then after 6 weeks from both groups by using Berg Balance scale, Rhomberg test, functional reach test and backward release test. Additional electrodiagnostic studies were carried out for experimental group only to observe the exact differences. There were no drop outs from the study as exercise protocol was properly explained to all patients before enrollment in the study with signed consent to complete the study. Statistical analysis was performed by using SPSS 20 and both descriptive and inferential analysis was performed. Independent samples t test was used for comparisons between the groups and paired t test for pre and post intervention comparisons.

### RESULTS

According to the results out of 38 patients, 14 (36.8%) patients were male and 24 (63.2%) were females. Most of the patients suffering from diabetic neuropathy were those who have been suffering from diabetes for more than 10 years (50%). In Berg Balance scale the mean  $\pm$ SD recorded at baseline for control group was  $32.05 \pm 10.23$  and for experimental group was  $28.5 \pm 8.9$ . At the end of third week, the mean  $\pm$ SD of control group was  $32.60 \pm 9.93$  and experimental group was  $37.61 \pm 5.82$ . After the end of 6 weeks the Mean  $\pm$ SD of control group was  $34.45 \pm 10.03$  and experimental was  $47 \pm 4.65$ . There is significant improvement ( $P \leq 0.05$ ) in experimental group as compared to control after 6 weeks of treatment as shown in Fig 1. In Functional Reach Test, the mean  $\pm$ SD recorded at baseline for control group was  $2.35 \pm 1.08$  and for experimental group was  $2.5 \pm 1.72$ . At the end of third week the mean  $\pm$ SD of control group was  $2.65 \pm 1.18$

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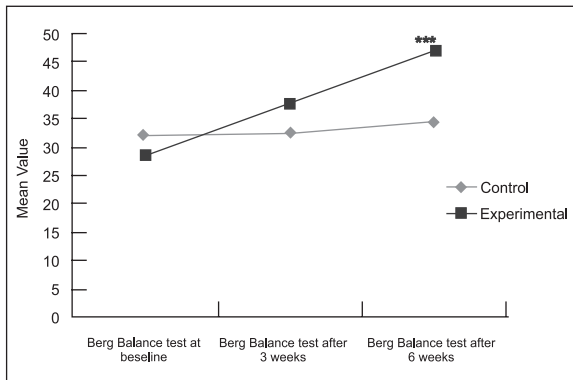


Fig 1: Mean Value of Berg Balance test in both Control and Experimental Groups. There is a significant difference shown at 6 weeks intervention. \*\*\* = (P<0.001)

and experimental group was  $3.66 \pm 1.78$ . After the end of 6 weeks the Mean  $\pm$ SD of control group was  $3.4 \pm 1.6$  and experimental was  $6.11 \pm 2.32$ . There is significant improvement ( $P \leq 0.05$ ) in experimental group as compared to traditional treatment group after 3 and 6 week of treatment as shown in Fig 2. Similarly, in Romberg test which was measured in seconds, the mean  $\pm$ SD recorded at baseline for control group was  $11 \pm 5.28$  sec and for experimental group was  $16.66 \pm 8.91$  sec. At the end of third week, the mean  $\pm$  SD of control group was  $10.90 \pm 5.01$  sec and experimental group was

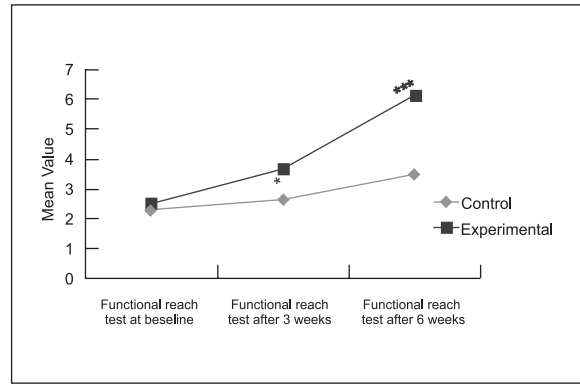


Fig 2: Mean Value of Functional Reach Test (Inches) in both Control and Experimental Patients. There is a significant difference at 3 week and 6 week intervention with \*\*\* = (P<0.001)

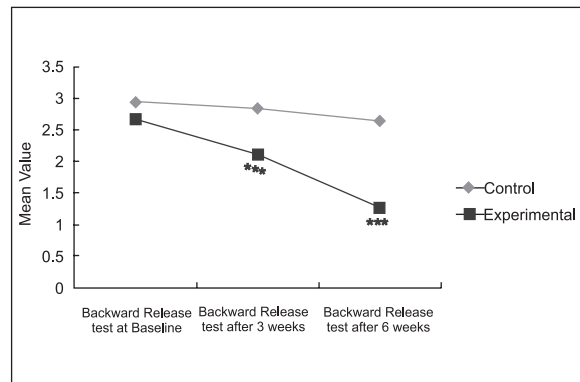


Fig 3: Mean Value of Backward Release Test in both Control and Experimental Patients. Significant difference was observed at 3rd and 6th week of intervention. \*\*\* = (P<0.001)

$20.27 \pm 7.75$  sec. After the end of 6 weeks the Mean  $\pm$ SD of control group was  $12.5 \pm 5.69$  sec and experimental was  $26.38 \pm 5.63$  sec. There is significant improvement ( $P \leq 0.05$ ) in experimental group as compared to traditional treatment group at the end of 3rd week and after 6 weeks of treatment. In Backward Release Test the mean  $\pm$ SD recorded at baseline for control group was  $2.95 \pm 0.82$  and for experimental group was  $2.66 \pm 1.02$ . At the end of third week the mean  $\pm$ SD of control group was  $2.85 \pm 0.87$  and experimental group was  $2.11 \pm 0.83$ . After the end of 6 weeks the Mean  $\pm$ SD of control group was  $2.65 \pm 0.98$  and experimental was  $1.27 \pm 0.46$ . There is significant improvement ( $P \leq 0.05$ ) in experimental group as compared to traditional treatment group after 3 and 6 weeks of treatment as shown in Fig 3. While NCS was performed only for experimental group and mean  $\pm$ SD was recorded for different parameters of Median, Ulnar, Common Peroneal and Tibial nerve before and after the 6 weeks program. There is significant improvement ( $P \leq 0.05$ ) in all the parameters for Median,

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**Table 1: P values of different parameters of nerve conduction studies**

Nerves	DML (ms)	PML (ms)	Motor Amplitude (mV)	Motor Velocity (m/s)	SLP (ms)	Sensory Amplitude (uv)	Sensory velocity (m/s)
Median	0.06*	0.64	0.05*	0.038*	0.026*	0.166	0.08
Ulnar	0.04*	0.33	0.008*	0.042*	0.015*	0.167	0.06
Common Peroneal	0.02*	0.03*	0.019*	0.023*	0.170	0.177	0.18
Tibial	0.02*	0.53	0.05*	0.253	0.026*	0.166	0.08

Table I shows post test p values of different parameters of nerve conduction studies of median , ulnar, common peroneal and tibial nerve (\*= (P<0.05) )

Ulnar, Common Peroneal and Tibial nerve observed at the end of 6 week. Details are provided in Table I.

### DISCUSSION

The current study showed improved balance in those receiving aerobic exercises with traditional balance training than those receiving only traditional balance training. Aerobic exercises have shown to improved balance and reduce complications that occur as a result of diabetic polyneuropathy. Similar in a study conducted by Dixit et al regarding the effectiveness of aerobic exercises in diabetic polyneuropathic patients, significant improvements have been found. Furthermore according to the results of their study, moderate intensity aerobic exercises help to control progression of neuropathy.<sup>15</sup> The current study showed significant improvements in various parameters of nerve conduction studies. Similar improvements in nerve conduction studies were reported by Balducci et al. They also reported marked improvements in various variables of nerve conduction studies after providing aerobic exercises in diabetic neuropathic patients.<sup>13</sup>

In current study, marked improvement was observed on berg balance scale. A similar study was conducted to improve the postural stability and balance in diabetic neuropathy patients and showed significant results.<sup>16</sup> The results of current study are also supported by the results of a study conducted to evaluate the effects of aerobics in diabetic neuropathic patients and reported that regular exercise can change the progression of neuropathy.<sup>17</sup> Their results showed significant improvements with aerobics even on nerve conduction studies. Tabari et al did a study on effects of aerobic exercises in diabetes and have shown that aerobic exercises training promote the effectiveness of medical treatment in type 2 diabetes mellitus but they failed to mention the effect of exercise on balance.<sup>18</sup> Pan et al has reported significant benefits of various exercise protocols in improving the balance of patients suffering from diabetic neuropathy.<sup>19</sup> Their review also supports the results of current study. Another study was conduct-

ed to compare effectiveness of ball therapy with frenkel exercises for diabetic neuropathy treatment and has reported significant improvements in both groups with more improvement in ball therapy group.<sup>20</sup> Their results also support the results of the current study. However in current study only the effectiveness of aerobic exercise is compared with traditional one, other exercise protocols should also be compared to find a better one. Small duration of study , unequal distribution of gender along with post interventional nerve conduction studies only for experimental group were few limitations of the study that must be addressed in future studies. Further associated factors like height, BMI should also be explored. Further regimens for treatment of diabetic neuropathy should also be compared. Long follow up should be carried out to see the exact effects of aerobic exercises on diabetic neuropathy so that exact changes can be reported on objective measures.

### CONCLUSION

Aerobic exercises when provided along with traditional balance training improves balance in diabetic neuropathic patients and can also help in reversing the symptoms of neuropathy as indicated by the results of nerve conduction studies.

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### **AUTHOR'S CONTRIBUTION**

Following authors have made substantial contributions to the manuscript as under:

**Kiani N:** Main idea

**Maryam M:** Data collection and assembly of data

**Malik AN:** Interpretation of the data

**Amjad I:** Critical revision of the article to important intellectual contents

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.