RESEARCH PAPER

Comparative Study on the Effectiveness of Aerobic and Resistance Exercise on Functional Mobility and Psychological Well-Being in Patients with Diabetic Peripheral Neuropathy

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ABSTRACT

Background: Diabetic Peripheral Neuropathy (DPN) is one of the most common and disabling complications of diabetes mellitus, significantly affecting not only physical function but also psychological well-being. Individuals with DPN frequently experience pain, numbness, balance impairment, reduced mobility, fear of falling, and limitations in daily activities, which can contribute to emotional distress, anxiety, stress, and depressive symptoms. These psychological concerns often reduce motivation for physical activity and negatively impact overall quality of life. Therefore, there is an increasing need for comprehensive rehabilitation approaches that address both physical disability and mental health aspects of DPN. Exercise interventions, particularly aerobic and resistance training, have demonstrated beneficial effects on physical performance, glycemic control, and nerve function; however, limited evidence exists regarding their comparative effectiveness in improving functional mobility and psychological outcomes among individuals with DPN.

Objective: To compare the effectiveness of aerobic and resistance exercise on functional mobility and Psychological Well-being in patients with Diabetic Peripheral Neuropathy."

Methods: This comparative study involved 30 patients with DPN randomized into two groups. Group A (n=15) performed aerobic exercises, while Group B (n=15) engaged in resistance training targeting major muscle groups. Both interventions were conducted for 40mins per session for 8 weeks. Outcomes were measured using TUG and DASS 21.

Results: Post-intervention data showed significant improvements in both groups compared to baseline. Group A (Aerobic) demonstrated a more pronounced reduction in DASS 21score compared to Group B. However, Group B (Resistance) showed superior gains in lower limb strength, while Group A maintained a slight advantage in functional mobility. Statistical analysis indicated that aerobic exercise is marginally effective for Functional mobility. Whereas resistance training significantly enhances musculoskeletal support.

Conclusion: Both aerobic and resistance exercises are effective in managing DPN symptoms. Aerobic exercise should be prioritized for patients primarily requiring improved Psychological wellbeing, while resistance training is essential for addressing muscle strength associated with neuropathy.

Keywords: *Diabetic Peripheral Neuropathy, functional mobility, DASS 21, Aerobic Exercise, Resistance Training*
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INTRODUCTION

Diabetic Peripheral Neuropathy (DPN) remains a major contributor to long-term morbidity among individuals with diabetes. It is characterized by a spectrum of complications extending beyond sensory deficits, including chronic neuropathic pain, postural instability, and reduced functional capacity. Diabetic peripheral neuropathy (DPN) affects a substantial proportion of individuals in India, with reports indicating a prevalence of approximately 58%, with or without overt clinical manifestations[1]. The most commonly reported signs and symptoms of DPN include lower limb numbness, tingling sensations, pain, and muscle weakness. Despite their clinical significance, these symptoms are often

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overlooked, particularly among underprivileged populations, due to limited awareness, financial constraints, and inadequate access to healthcare. As a result, the lack of timely recognition and management of DPN can lead to severe complications such as progressive nerve damage, muscle weakness, impaired balance, foot ulceration, and reduced functional mobility[2]. These complications further contribute to increased psychological stress, dependency, and caregiver burden, and in advanced cases, may result in non-traumatic lower limb amputation.

The accelerated global aging process is another main reason that has made late-life depression (LLD) a serious public health issue[3]. LLD is characterized by low mood, loss of interest, and sleep disturbances but also often accompanies a decline in cognitive function, significantly impacting patients' quality of life (Kanellopoulos et al., 2020; Respino et al., 2019)[4]. Research indicates that exercise can relieve depressive symptoms through various mechanisms, such as promoting the release of neurotrophic factors in the brain, regulating the hypothalamic-pituitary-adrenal axis, and improving cerebral blood flow (Luft, Haute, et al., 2021; Luft, Levices, et al., 2021. Aerobic, strength, or balance training, comprehensively enhance the physical fitness of older adults (Bai et al., 2022) and optimizes physiological parameters like weight, blood pressure, and blood sugar levels, thus enhancing their overall quality of life (Coletti et al., 2022; Mikkelsen et al., 2022; Riaz et al., 2022)[5].

Patients with diabetic peripheral neuropathy (DPN) often continue their daily activities similar to other individuals with diabetes and may perceive themselves as healthy due to ongoing medication. However, a lack of awareness regarding the severity and potential consequences of DPN frequently leads to delayed initiation of rehabilitation. This delay contributes to clinical deterioration, whereas early rehabilitation interventions can play a significant role in slowing or preventing further deterioration.

There are evidences that long-term supervised aerobic exercise training may delay the onset of DPN. Even mild aerobic exercise training, could be an effective treatment to prevent the onset the natural history of DPN (Balducci et al., 2006, Lemaster et al., 2008)[6].

Studies on lifestyle intervention programs have proven to be effective in glycemic control for type 2 diabetes patients (Balducci et al., 2006, International Diabetes Foundation, 2006)[7].

Resisted exercises Reduced pain sensation and electrophysiological dysfunction, accompanied by increases in neurotrophic factors, have been observed in response to resistance training, although to a lesser extent compared to aerobic training (Cefis et al., 2023; Dobson et al., 2014; Groover et al., 2013; Ma et al., 2019; Zhang et al., 2021)[8]. The physiological effects associated with neurotrophic factor secretions promote reversing myelinic damage and restoring Ca2+ ionic channels, explaining the enhanced neural input transmission (Shankarappa et al., 2011)[9]. Resistance training is also associated with the production of exerkines, which is responsible for tissue regeneration and remodelling, paramount for mitigating diabetes-related complications (Chow et al., 2022; Robbins & Gerszten, 2023)[10].

These impairments often compromise walking ability and increase the risk of falls, thereby limiting independence in daily activities. In addition to physical limitations, individuals with DPN frequently experience psychological distress, including elevated levels of stress, anxiety, and depression, reduced motivation and coping up strategies which further reduce their overall quality of life. Beyond the primary symptoms, these individuals must navigate various physiological and psychological factors—ranging from chronic pain and mobility issues to emotional distress—all of which necessitate significant, and often difficult, lifestyle adaptations.

Consequently, there is a growing need for comprehensive rehabilitation strategies that not only improve glycemic control and physical function but also address psychological well-being. Exercise interventions, particularly aerobic and resistance training, have shown promising effects; however, their comparative effectiveness in improving both physiological and psychological outcomes in DPN remains inadequately explored." Despite advancements in glycemic management,

METHODOLOGY

A comparative study was conducted for 10 diabetic peripheral neuropathy patients with age group of 45-60 of both genders were selected based upon Inclusion criteria: Patients clinically diagnosed with Diabetic Neuropathy, HbA1c 7.0% – 8.0%, Both gender, Age 45 – 60 years, POMA score - 19-23, Borg scale – 40% to 60%, Patients able to walk with or with support and Exclusion criteria: Un co-operative patients, Any other Neurological Deficits like Stroke, Parkinsonism, etc, Recent Lower limb Trauma, Recent surgeries in Abdomen, Spine, Lower limb, Any other Cardiovascular Deficits Like CAD, MI, Any Respiratory disorders Like Asthma, COPD. The patients were divided into two groups using lot method using random sampling method into Group A (Aerobic exercise, n=15) & Group B (Resisted Exercise, n=15). The subjects were followed for the period of 8 weeks with intervention duration of 40 mins for 4 days per week for 8 weeks. The pre and post test value were measured with the help of CRT for functional mobility and Psychological wellbeing using DASS 21.

PROCEDURE

The subjects were selected based on the inclusion and exclusion criteria. An inform consent was obtained from them. A complete assessment was done and then the subjects were divided into two groups Group A (Aerobic Exercise) & Group B (Resisted Exercise) using simple random sampling. The subjects participating in this study were informed that they have to do the exercise regularly and can withdraw from the study if they have any

difficulty. The patients were asked to were comfortable clothing and shoes and asked to be comfortable and relaxed then the both groups received warm exercise before the start of the exercise and cool down exercise at the end of the training.

Warm up session included the following: Ankle toe movements, Heel raises, Gentle stretching of calf and hamstring muscles & Deep breathing exercises and cool down session included Slow walking and Breathing exercises.

Warm up exercises: 5 mins

Cool down exercises: 5 mins

- **Group A (Aerobic exercises)** : Marching in place: 3 mins, Side stepping: 5mins, Step-ups: 3 mins, Toe taps: 2 mins and Heel raises: 2 mins. Rest periods were allowed if they feel fatigue and the duration of the exercise was 30 mins.
- **Group B (Resisted Exercises) :** The strength training (resistance group) routine will be focused on the large muscle groups. Using resistance band [Red color]. Leg extension; Leg Press ; Knee Curl; Calf raise; wall Squats.

The volume of exercise was progressed from 1 set of 8 repetitions up to 3 sets (1 × 8 to 3 × 8) and according to the individuals capability but has to execute all of these repetitions as early as possible. The follow up was done for CRT and DASS 21 values was noted before and after the treatment session for Diabetic Neuropathy patients, analyzation was done

DATA ANALYSIS

Statistical analyses were performed by using IBM SPSS for windows version 20(IBM SPSS statistics for windows, version 20.0 IBM corp. Armonk, NY, USA). The level of significance was set at alpha = 0.05. Intra-group comparisons (pre- test vs post-test) within each group were analyzed using the Paired T-test. The means and standard deviation (SD) were used as continuous data.

Table 1: Analyses of Pre-Test and Post-Test Values of Crt Within Group A

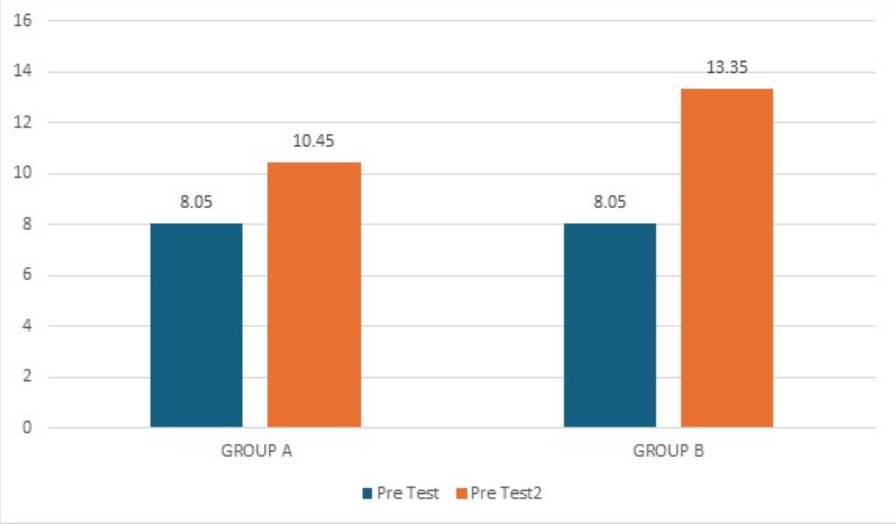
CRT	N	Mean	SD	Std. Error Mean	Mean Diff	df	t value	P
Pre-test	15	8.05	0.76	0.15	2.40	14	50.413	*
Post-test	15	10.45	0.95	0.17				

***Significant difference**

Table 2: Analyses of Pre-Test and Post-Test Values of Crt Within Group B

CRT	N	Mean	SD	Std. Error Mean	Mean Diff	df	t value	P
Pre-test	15	8.05	0.75	0.23	5.3	14	9.787	*
Post-test	15	13.35	1.03	0.35				

***Significant difference**



Graph 1: Analyses of Pre-Test and Post-Test Values Crt Between Group A and Group B

Table 3: Analyses of Pre-Test and Post-Test Values of Dass 21 Within Group A

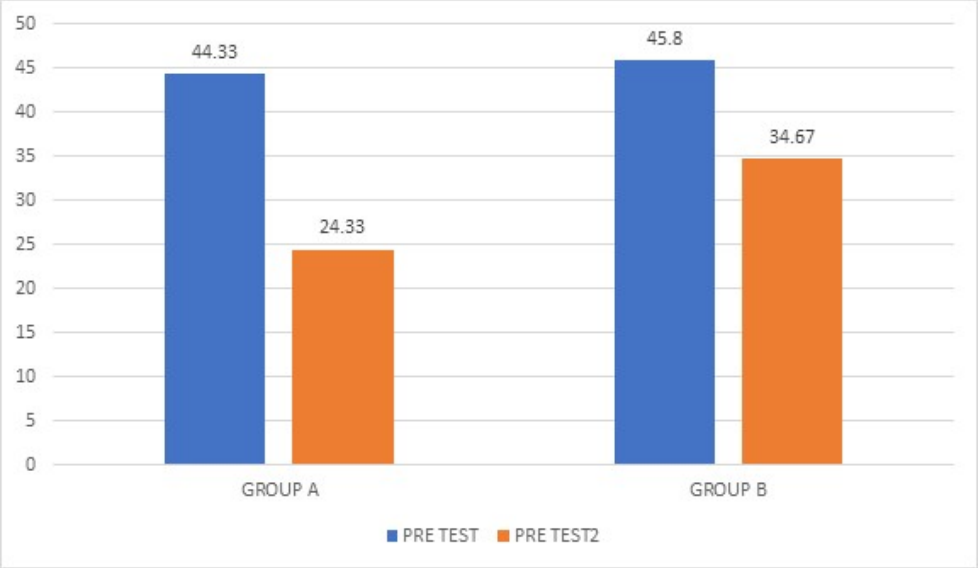
DASS 21	N	Mean	SD	Std. Error Mean	Mean Diff	df	t value	P
Pre-test	15	44.33	9.51	1.43	20	14	6.649	*
Post-test	15	24.33	8.95	3.01				

***Significant difference**

Table 4: Analyses of Pre-Test and Post-Test Values of Dass 21 Within Group B

DASS 21	N	Mean	SD	Std. Error Mean	Mean Diff	df	t value	P
Pre-test	15	45.8	11.43	0.15	20.13	14	13.85	*
Post-test	15	34.67	9.65	0.85				

***Significant difference**



Graph 2: Analyses of Pre-Test and Post-Test Values of Dass 21 Between Group A and Group B

RESULT

There was a significant effect on CRT and DASS 21 between groups and within the groups ($p<0.05$)

Table 1: Shows the pre and post mean ± SD value of CRT in group A 8.05± 0.76 &10.45± 0.95 respectively

Table 2: Shows the pre and post mean ± SD value of CRT in group B 8.05±0.75 & 13.35± 1.03 respectively

Table 3: Shows the pre and post mean ± SD value of DASS 21 in group A 44.33±9.51 & 24.33±8.95 respectively

Table 4: Shows the pre and post mean ± SD value of DASS 21 in group B 8. 45.8±11.43 & 34.46±9.65 respectively

DISCUSSION

The present study was done to compare the effectiveness of aerobic and resistance exercise on functional mobility and Psychological Well-being in patients with Diabetic Peripheral Neuropathy."

The findings of the study demonstrated improvements in both groups following the intervention program. However, differences were observed in the degree of improvement between aerobic exercise training and resistance exercise training.

Functional mobility showed improvement in both groups as evidenced by better performance in mobility-based outcome measures such as the Chair raise test. Exercise training may improve lower limb muscle performance, joint mobility, balance, coordination, and neuromuscular control, thereby enhancing mobility in patients with diabetic peripheral neuropathy. Group B improved significantly than Group A because resisted exercise enhanced muscle strength, by recruiting more motor fibers, improved circulation, and reduced fatigue during muscle work. Aerobic exercise may contribute more toward endurance by improving oxygen utilization and cardiovascular fitness, whereas resistance exercise may enhance muscular support and stability during walking activities.

Patients with diabetic peripheral neuropathy commonly experience reduced sensation, muscle weakness, impaired balance, and decreased physical performance. Structured exercise programs help counteract these impairments by improving muscular and cardiovascular function. Exercise may also improve confidence in mobility and reduce fear of movement among patients.

The comparative findings of the present study suggest that both aerobic and resistance exercise are beneficial interventions for patients with diabetic peripheral neuropathy. The results of the study are consistent with previous literature suggesting that therapeutic exercise plays a vital role in the management of diabetic peripheral neuropathy. Several studies have reported improvements in glycemic control, mobility, balance, and walking performance following structured exercise interventions.

Improvement in CRT scores observed in both groups may be attributed to enhanced lower limb muscle activation, improved circulation, better neuromuscular coordination, and increased physical endurance produced by regular

exercise training. Aerobic exercise enhances cardiovascular efficiency and oxygen supply to peripheral tissues, thereby reducing fatigue and improving mobility. Resistance exercise improves muscle strength, joint stability, and functional performance, which directly influence activities such as standing, walking, and sit-to-stand transitions assessed through the Chair Rise Test.

The reduction in DASS-21 scores following intervention indicates improvement in psychological status among participants. Exercise is known to positively influence mental health through release of endorphins, reduction of stress hormones, improved sleep quality, and enhanced self-confidence. Aerobic exercise particularly may provide greater psychological benefits due to its rhythmic and continuous nature, which promotes relaxation and emotional well-being.

Patients with Diabetic Peripheral Neuropathy often experience pain, reduced mobility, fear of movement, and decreased participation in daily activities, which may contribute to anxiety, stress, and depressive symptoms. Regular supervised exercise can improve physical independence and confidence, thereby positively influencing emotional health.

The findings of the present study are consistent with previous literature reporting that exercise therapy plays a significant role in the management of Diabetic Peripheral Neuropathy. Several studies have reported that aerobic exercise improves endurance, circulation, and quality of life, while resistance exercise improves muscle strength and functional capacity. The present study further supports the importance of incorporating structured exercise programs into physiotherapy rehabilitation for patients with Diabetic Peripheral Neuropathy.

Overall, both aerobic and resistance exercise were found to be effective interventions for improving functional mobility and psychological well-being. However, depending on treatment goals, aerobic exercise may be preferred for improving psychological status, while resistance exercise may be more beneficial for enhancing lower limb functional performance and mobility.

CONCLUSION

This study concludes that Aerobic exercise should be prioritized for patients primarily requiring improved Psychological wellbeing, while resistance training is essential for addressing muscle strength associated with neuropathy. Structured exercise intervention of 8 weeks was beneficial in the rehabilitation of patients with Diabetic Peripheral Neuropathy and should be included as an early essential component of physiotherapy management.

Limitations: The sample size was relatively small, the duration of intervention was limited, and long-term follow-up was not performed. Lifestyle factors such as diet, medication adherence, and daily physical activity were difficult to control completely and may have influenced the results.

Future studies can be conducted with larger sample sizes, longer intervention duration, and combined exercise protocols to determine the most effective rehabilitation approach for patients with diabetic peripheral neuropathy.

CONFLICT OF INTEREST

The authors have no conflicts of interest regarding this investigation.

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