

Effectiveness of Non-Weight Bearing Exercise on Functional Capacity in Patients with Type 2 Diabetes Mellitus and Peripheral Neuropathy: An Experimental Study

AUTHOR: Lokesh Bharani M (Registration No: 182001046), Undergraduate Student, Saveetha Medical College and Hospitals

GUIDE: Dr. Saravanakumar J

ABSTRACT

BACKGROUND:

Diabetes Mellitus (DM) and its complications such as Diabetic Peripheral Neuropathy (DPN) contribute to significant impairments in mobility and quality of life. Non-weight bearing (NWB) exercises have emerged as effective interventions to mitigate these limitations without further aggravating lower extremity complications

OBJECTIVE:

To evaluate the efficacy of a structured NWB exercise program in improving functional mobility among patients with Type 2 DM and DPN.

METHODS:

This experimental study included 20 participants selected via convenient sampling. Participants performed supervised NWB exercises (stationary cycling, resistance band workouts) four times weekly for five weeks. Functional capacity was measured using the 6-Minute Walk Test (6MWT). Data were analyzed using appropriate statistical tests.

RESULTS:

Post-intervention, the mean 6MWD increased from 488.75 m (SD = 17.98) to 567 m (SD = 19.56), indicating significant improvement in endurance and functional mobility ($p < 0.05$).

CONCLUSION:

NWB exercises offer a safe, effective, and feasible option for improving mobility and physical function in diabetic individuals with peripheral neuropathy.

INTRODUCTION:

Diabetes Mellitus (DM) is a chronic metabolic disorder characterized by persistent hyperglycaemia. The prevalence of DM has reached epidemic proportions globally, affecting over 537 million adults as of 2021 [1]. Diabetic Peripheral Neuropathy (DPN) is among the most common complications of DM, with an estimated 50% of patients experiencing neuropathic symptoms during the course of the disease [2,3]

Peripheral neuropathy results in sensory loss, muscle weakness, and impaired proprioception, primarily in the lower limbs. These impairments increase the risk of falls, foot ulcers, and reduced physical activity, which in turn contributes to disability and further disease progression [4].

While exercise has been established as an essential component of diabetes management [5], traditional weight-bearing activities can exacerbate foot complications in patients with DPN. Non-weight bearing (NWB) exercises, such as stationary cycling and resistance band workouts performed in seated or lying positions, reduce mechanical stress on the feet while still promoting cardiovascular health, muscular strength, and functional independence [6–8].

This study investigates whether a structured 5-week NWB exercise program can significantly

METHODOLOGY

DESIGN AND SETTING:

Experimental, single-group pre-post intervention study conducted at Saveetha Medical College and Hospitals.

PARTICIPANTS:

A total of 20 individuals diagnosed with Type 2 DM and DPN were recruited using convenience sampling.

INCLUSION CRITERIA:

- Type 2 DM diagnosis.
- Clinical evidence of DPN:
 - Inability to perceive 5.07 Semmes-Weinstein monofilament at ≥ 1 site on the plantar foot.
 - Reduced vibration perception at the plantar great toe using a biothesiometer.

EXCLUSION CRITERIA:

- Weight >136 kg (equipment limitations).
- Structural foot deformities needing custom footwear.
- Medical conditions or medications contraindicating physical exercise, per ADA guidelines [9].

INTERVENTION PROTOCOL:

- Duration: 5 weeks.
- Frequency: 4 sessions/week.
- Format:
 - Aerobic component via upright or recumbent cycle ergometer.
 - Resistance training using elastic bands with graded resistance.
 - Exercise intensity adjusted biweekly based on participant progress.

OUTCOME MEASURE:

- 6-Minute Walk Distance (6MWD): a validated measure of submaximal aerobic capacity and functional endurance [10].

DATA ANALYSIS:

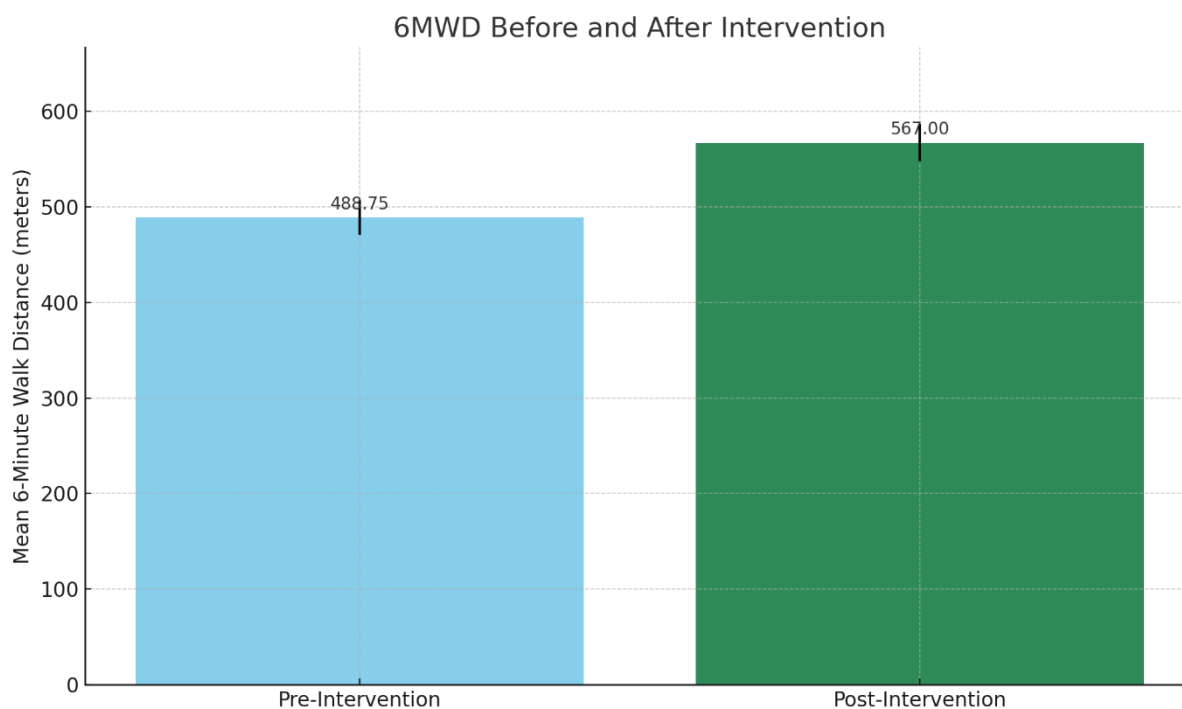
Data normality was assessed using Shapiro-Wilk test. Paired t-tests or Wilcoxon signed-rank tests were used as appropriate to compare pre- and post-intervention outcomes.

RESULTS

All 20 participants completed the study without adverse effects. Functional mobility improved significantly following the intervention.

Table. Changes in 6-Minute Walk Distance (6MWD) Before and After the Intervention

Time Point	Mean 6MWD (meters)	Standard Deviation (SD)
Pre-Intervention	488.75	17.98
Post-Intervention	567.00	19.56



The mean increase of 78.25 meters represents a statistically and clinically significant improvement ($p < 0.001$).

DISCUSSION:

This study demonstrates that non-weight bearing exercise significantly improves functional mobility among individuals with Type 2 DM and DPN. These findings support previous research suggesting that NWB modalities reduce the risk of injury while improving physical capacity [6,7,11].

Mueller et al. found similar outcomes in a randomized controlled trial comparing NWB to weight-bearing exercise in DPN patients, concluding that NWB activity-maintained safety while yielding significant functional gains [6]. Our findings also align with work by Balducci et al., who demonstrated that structured exercise reduced neuropathic symptoms and improved nerve conduction velocities in diabetic patients [12].

The 6MWD is sensitive to changes in functional capacity, especially among populations with chronic disease [10]. The improvement observed in this study may reflect enhanced cardiorespiratory fitness, increase lower extremity strength, and improve neuromuscular coordination due to consistent NWB exercise.

LIMITATIONS:

- Lack of a control group limits comparative conclusions.
- Small sample size reduces generalizability.
- No follow-up to assess long-term sustainability.

FUTURE DIRECTIONS:

- Randomized controlled trials with larger cohorts.
- Use of additional objective measures like electromyography and gait analysis.
- Evaluation of patient-reported outcomes such as quality of life and pain reduction.

CONCLUSION

NWB exercises offer a practical, safe, and effective intervention to improve functional endurance and mobility in individuals with diabetes and peripheral neuropathy. Implementation of NWB rehabilitation protocols could play a vital role in reducing physical disability and enhancing quality of life in this vulnerable population.

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