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Review

Effectiveness of physiotherapy interventions on motor impairments In diabetic neuropathy - A Literature Review



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	Abstract
Published on: 23 Apr 2025	<p>Diabetic Neuropathy is one of the major complications of diabetes mellitus which mainly affects lower limbs in patients with diabetes. Around 450 million people worldwide are suffering with this disease and number may rise to 628 million people by 2045. It is the dysfunction and damage in peripheral nerves in people with diabetes. These neuropathies are characterized by a progressive loss of nerve fibre function. It is the common complication of diabetes mellitus which is estimated to affect upto 51% of patients with both type 1 and type 2 diabetes mellitus. This review is intended to analyze the motor impairments in Diabetic Neuropathy and evaluate the efficacy of physiotherapy interventions. A review of literature study was done searching electronic databases including PubMed, Google Scholar, Scopus, and Web of Science. Research conducted from 2014 to 2024 that examines the motor impairments and physiotherapy treatments was incorporated. Studies examining prevalence, risk factors, physiotherapy treatment methods, and reviewed. Research focusing on pharmaceutical or surgical treatments was not included. Research shows the motor impairments in Diabetic Neuropathy. The most frequently impacted areas were the lower limbs Physiotherapy treatments, such as Range of motion exercises(ROM), Muscle strengthening exercises, Endurance exercises, Exercises for improving Static and Dynamic balance postural adjustment exercises, had notably gained mobility improvement. Research indicates that integrating physiotherapy interventions yields optimal results in management of Diabetic Neuropathy.</p>
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	Keywords: Diabetic Neuropathy, Physiotherapy Interventions, Motor Impairments

INTRODUCTION

One of the most frequent side effects of diabetes is diabetic neuropathy. This consequence manifests in patients as extreme pain, increased risk of damage or wound and amputation, loss or reduction of senses, tingling

in the hands or feet, hot flashes during menopause, increased instability and balance, and performance issue.^[1] It is commonly recognised that diabetic neuropathy causes people with diabetes to operate less functionally.

The integrity of intrinsic muscles and tiny joints is impacted by the development of DPN. The development of deformities, increased plantar pressures, and an increased risk of plantar ulceration are all primarily caused by these effects. These changes impair the foot's dynamic stability, resulting in insufficient mobility for activities of daily living.^[2]

Reduced proprioceptive sense, decreased ankle mobility and range of motion, and decreased muscle strength, particularly in the ankle and foot plantar and dorsiflexors, have all been found in individuals with diabetic neuropathy.^[12] These findings can result in altered functional gait and mobility as well as decreased balance or postural stability. activities for diabetic peripheral neuropathy are still debatable, particularly in relation to specific weight-bearing activities and suggested safety measures. Reduced sole feeling and balance issues are caused by diabetic peripheral neuropathy (DPN), which raises the risk of falls and their associated socioeconomic expenses.^{[4][5]}

Physiotherapy's role in diabetic care is to minimise issues associated to diabetes, preserve functional ability, and lessen the effects of immobilisation. In order to support intramuscular glycogenolysis, muscle tension during exercise increases blood glucose capture.^[7] Resting muscle uses circulating insulin to post prandially absorb glucose in order to restore glycogen reserves. Both mechanisms enhance the muscle's ability to absorb glucose following exercise.^[14]

The negative effects on DPN patients should be taken into account in addition to the positive effects of resistance and balancing exercises that have been shown in certain studies.^[11] For instance, the foot cannot function as a shock absorber and may lose its capacity to sustain normal plantar pressures when joint motion is restricted. This implies that the workout surface must to be taken into account.^[10]

The purpose of this literature review is to examine and evaluate the best available data as well as knowledge gaps on the impact of physiotherapy interventions on motor impairments in diabetic neuropathy.

Need of the study

A major side effect of diabetes mellitus is diabetic neuropathy, which damages peripheral nerves and causes motor impairments like muscular weakness, decreased coordination, balance issues, and abnormalities in gait. These disabilities raise the risk of falls and disability by having a substantial negative influence on mobility, functional independence, and quality of life. For people with diabetic neuropathy, physiotherapy techniques such as strength training, balance exercises, gait training, and neuromuscular re-education have been proposed as ways to enhance motor function. However, there is a lack of consensus on the most effective physiotherapy approaches and their long-term benefits in managing motor impairments associated with diabetic neuropathy.

Objective of the study

The evidence currently available on the impact of physiotherapy interventions on motor impairments in diabetic neuropathy will be specifically examined in this review of the literature.

Materials and methods

Study Design

The current study examines the effectiveness of physiotherapy therapies and the motor impairments associated with diabetic neuropathy using a systematic review methodology.

Methods of Search

A comprehensive search was conducted across numerous electronic databases, such as PubMed, Google Scholar, Scopus, and Web of Science. Among the relevant keywords utilised in the search were "motor impairments in diabetic neuropathy," and phrases related to therapies, such as "physiotherapy interventions."

The PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) criteria serve as the foundation for this literature review.

Inclusion Criteria

- Publications from randomised controlled trials that particularly examine how exercise affects people with diabetic neuropathy will be included in this study.
- Only English-language publications will be taken into account.
- Full-text papers rather than abstracts or summaries will be included in the study.
- The articles were published between 2014 and 2024;
- The age range is 40 to 70 years;
- Both sexes are included.

Exclusion Criteria

- Articles written in languages other than the local tongue were left out.
- Narrative review; papers from other types of literature were not included.
- Articles released before 2014 were not included.

- Research that has nothing to do with the given keywords.
- Research involving people who are 80 years of age or older or under 40.

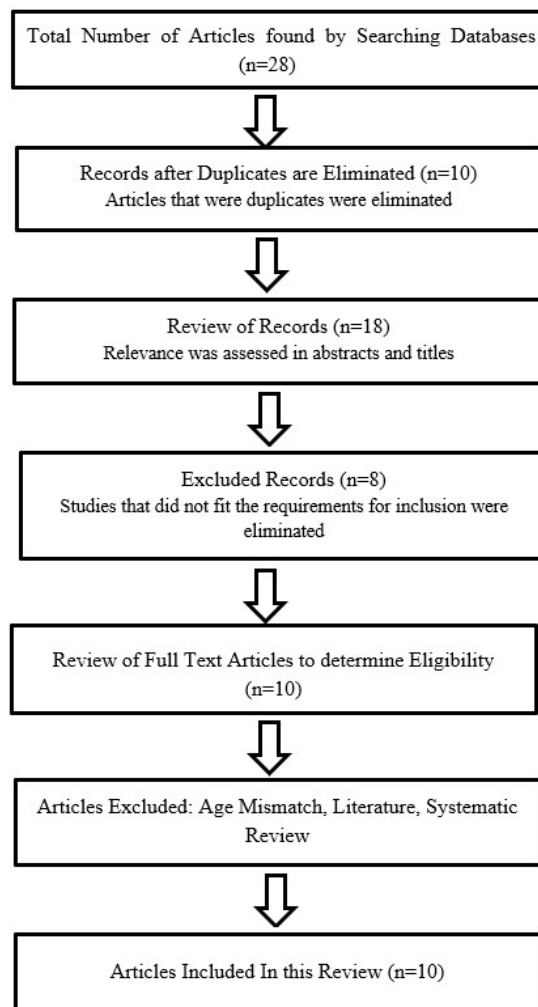
Sample Size

After searching for "Diabetic Neuropathy," "Motor Impairments," and "physiotherapy management," a total of 28 articles were found. These studies were retrieved from databases such as Web of Science, Scopus, Google Scholar, and PubMed. After the inclusion and exclusion criteria were applied, 10 papers that were relevant to physiotherapy therapies for diabetic neuropathy were shortlisted. For this review, 10 of these papers were selected.

METHODOLOGY

The evidence was collected from online papers found using various search engines, such as PubMed, Google Scholar, and other journals on Diabetic Neuropathy. To find pertinent publications, a customised search was performed using keywords such "Diabetic Neuropathy," "Motor Impairments," and "exercise." In order to collect accurate and up-to-date information from all around the world for the last ten years, the time frame was set as 2014–2024. 10 articles in all have been found to satisfy our precise inclusion and exclusion criteria. For the purpose of analysis and additional research, all ten articles were acquired in their entirety. For improved understanding, the results are presented in a tabular manner after being obtained from all articles using a methodical process.

Flow Chart



Review of literature: The characteristics of extracted article have been listed in Table 1.

S. No	Author Year	Total No Of Samples	Duration Of The Study	Protocol	Outcome Measures	Result
1	Cristina D Sartor et al 2014	26	12Weeks	The 12-week intervention consists of two sessions lasting 40–60 minutes each. Range of motion of the foot and ankle, Muscle Strengthening of the foot and ankle, Improve the performance of the foot and ankle through functional exercises, Improve walking abilities and foot rollover training.	Loading Variables ,Kinetic and Kinematic Variables , Foot and ankle muscle function , Functional tests for foot and ankle , Activities Specific Balance Confidence (ABC) scale , Michigan Neuropathy screening instrument questionnaire	Foot rollover was slightly altered by the combination of functional foot and ankle activities, strengthening, and stretching. The heel, lateral forefoot, hallux, and toes—foot regions known to show decreased engagement in patients with DPN saw pressure displacement.
2	Mi Mi Thet Mon Win et al 2019	104	8 Weeks	Eight 10-minute hand activities (wrist stretching, finger tapping, finger circling, tendon gliding, thumb circling) and four foot exercises (foot tapping, V-shape formation, ankle rotation, and tennis ball rolling) were performed three days a week.	Activities of daily living by Patient Neurotoxicity Questionnaire, Monofilament and vibration test, and behavioral rating scale and Visual Analog Scale, Physical function of the hand and foot	The motor score and certain everyday life activities, including climbing stairs and doing work or chores, improved considerably more in the exercise group. Patients suffering from diabetic neuropathy can benefit from these exercises to enhance limb function.
3	Kavita Venkatraman , Bee Choo Tai 2019	143	8 Weeks	Exercises for range of motion Exercises to strengthen muscles include active movements against resistance (with a theraband) at the knee, ankle, forefoot, and toe joints. Static balance exercises include single-leg stance, tandem-leg stance, and toe-and-heel stance. Dynamic balance exercises include the tandem walk, sideways walk, and backward walk.	SF-36v2 , EQ-5D-5L Index score, Timed up and Go Test , Five Times Sit to stand , Functional Reach , Static Balance , Ankle Muscle Strength , Knee ROM	In people with DPN, short-term structured strength and balance training led to long-lasting gains in functional status at six months; however, the extent of these improvements did not seem to be significant enough to affect total HRQoL. In order to affect these people's HRQoL, longer-term and more intensive therapies could be required

4	Irshad Ahmad, Sahlini verma 38 , Majumi M. Noohu et al 2019	8Weeks	Each session included a 10-minute warm-up, 50–60 minutes of activity, and a 5- to 10-minute cool-down. (a) standing up on an unstable balance board with both eyes open; (b) standing up on an unstable balance board with both eyes closed; and (c) walking on a treadmill at a self-paced rate while holding a hand.	Proprioception(Pedalo Sensamove balance test pro with Miniboard), Nerve conduction Studies , Electromyography , Balance Assessment	Proprioception and nerve conduction velocity are enhanced by specific progressive sensorimotor and gait training. These therapies help patients with DPN by improving proprioceptive feedback, which in turn improves the activity of the ankle and multifidus muscles during postural control and walking.
5	Seyedeh Hoda Seyedizadeh 24 et al 2020	8Weeks	Spend fifteen minutes warming up. Using bodybuilding equipment, resistance training exercises include the chest press, wide-grip lat pulldown, barbell curl, lying triceps press, leg extension, lying leg curls, sit-up, and push-up. 8–12 Repetition Resting for 3 to 5 minutes Interval running for three minutes, followed by a 30-second rest, is an aerobic training method.	6 Min walk test , 30 sec bicep curl test , Rikli and jones Chair Stand test	The key to enhancing the quality of life for those with peripheral neuropathy in type 2 diabetes is moderate-intensity aerobic exercise.

6	Karolina S.Khan , Krishna Overgaard,Hatice Tankisi et al 2022	109	12Weeks	Leg presses, bench presses, pull-downs, knee flexion and extension, ankle plantar and dorsal flexion, abdominal crunches, and back extensions were among the upper- and lower-body workouts. Prior to each resistance training session, participants warmed up for ten minutes at a moderate effort on a stationary ergometer bicycle.	Muscle strength in terms of the peak torque of the knee and ankle extensors and flexors, and IENFD. 6 min walk test (6MWT), five-time sit-to-stand test (FTSST) and postural stability index obtained by static posturography.	PRT helped people with DPN increase their knee extensor and flexor muscle strength to a level that was similar to that of people with type 2 diabetes who did not have DPN and healthy control people. Motor function improved as a result of PRT.
7	Eliska Vratna , Jitka Husa´ kova et al 2022	38	12 Weeks	Three times a week Collective Activation, In the supine posture, alternate between dorsal and plantar flexion. movement of the ankle joint, flexion of the dorsal and plantar surfaces when seated, stretching of the toe flexors, strengthening the surae of the triceps, Training for stability Perceptual awareness	International Physical Activity Questionnaire (IPAQ), with joint mobility detected by goniometry, muscle strength by dynamometry, and fitness using the Senior Fitness Test (SFT).	For individuals with DPN in remission, an age-appropriate structured intervention exercise program can enhance biomechanical characteristics such muscle strength, fitness, and the flexibility of some major joints without raising the risk of recurrence.
8	Vasileios Lepesis, Joanne Paton et al 2023	61	6 Weeks	Two-weekly bilateral ankle and first MTP joint mobilisations, along with a six-week at-home stretching regimen. Every week, the physiotherapist visually assessed the stretching technique. It is advised to perform two consecutive static stretches for 20 to 30 seconds each day to target the gastrocnemius, soleus, and plantar fascia.	Amplitude of Ankle Dorsiflexion by Cartesian Optoelectronic Dynamic Anthropometer(CODA), Stride Length, Forefoot PPP, Forefoot to rear foot pressure ratio(F/R ratio), Postural Sway, Functional reach test	For individuals with DPN, a 6-week program that combines home-based stretches with ankle and first MTP joint mobilisations is effective in improving static measures of range.

9	Ronaldo H. Cruvinel-Júnior1 62 , Jane S. S. P. Ferreira1 et al 2024	12Weeks	Eight functional, stretching, and strengthening exercises for the extrinsic and intrinsic foot muscles were included in each 20–30 minute session.	Brazilian version of the Michigan Neuropathy Screening Instrument (MNSI-BR),Fuzzy score ,foot-pain and foot-function scores from the Brazilian version of the Foot Health Status Questionnaire (FHSQ-BR),EuroQoL (EQ-5D3L)questionnaire27	This study showed that SOPeD significantly reduced the severity and symptoms of DPN, as well as foot discomfort and function.
10	Sidra Khurshid,Aruba Saeed, 50 Muhammad Kashif et al 2025	8Weeks	The 40-minute workout was done three times a week for a total of eight weeks. ROM exercises: Hip, knee, and ankle passive to active ROM exercises Strengthening muscles by performing double knee lifts alternately while seated Progress from sitting to standing, weight squats to chairs with and without assistance, and more Weight shifts supported by balance, heel rises, calf and toe raises, and transitions from a seated to an unsupported stand-in posture Stretching activities	Berg balance scale (BBS), functional reach test (FRT), time up and go test (TUG), 10 min walk test (10-MWT), and Numeric pain rating scale (NPRS).	When compared to traditional workouts, the study found that multisystem exercises significantly improved individuals with diabetic peripheral neuropathy's mobility, walking speed, balance, and postural stability while also reducing discomfort.

DISCUSSIONS

This literature review's main goal was to compile and classify studies that addressed how exercise interventions, such as range-of-motion exercises, can reduce motor deficits in diabetic neuropathy. Building Muscle Exercises for balance Stretchings Training for endurance Resistance exercise Ankle and foot exercises on the web Exercises involving many systems and treadmill training

We have located 28 papers in various respectable journals that match our keywords. We were able to compile 10 articles in the form of randomised controlled trials (RCTs) from 2014 to 2024 after closely reviewing the inclusion and exclusion criteria. We'll examine these articles in more detail. Compared to review papers, randomised controlled trials (RCTs) were chosen because they included workout programs and the author's viewpoints or conclusions.

All 10 selected articles had a distinct exercise routine tailored to fit their individual needs. Older patients made up the age group chosen for this investigation. This decision was made in light of new data showing that older adults are more vulnerable to diabetic neuropathy than middle-aged people. We found that every one of the ten publications we analysed had a positive effect. Additionally, when individuals receive a combination intervention as opposed to a single intervention, the impact is maximised.

The study lasted between 6 and 12 weeks, which is thought to be enough time to lessen the motor deficits. It is clear that a prolonged exercise training session would benefit the participant considerably more.

The Activities of Daily Living by Patient Neurotoxicity Questionnaire is the most commonly used outcome measure. Scale of pain and intensity of neuropathy Analogue visual scale The hand and foot's physical functions Timed up and go tests Test of functional reach Test of Pedalo Sensamove Balance NCV EMG Berg balance scale 6-minute walk test The chair stand test by Rikli and Jonas IENFD FTSST, or five-time sit-to-stand test Pressure ratio between the front and rear feet using a Cartesian Optoelectronic Dynamic Anthropometer (CODA) NPRS.

Utilising questionnaires Questionnaire on Foot Health Status SF 36v2 EQ-5D-5L index score Questionnaire 27 for EQ-5D-3L

In 2014 Cristina D Sartor et al conducted a study on Effect of Strengthening Stretching and functional training on foot function in patients with diabetic neuropathy which lasted for 12 weeks and involved Range of motion exercise, Muscle strengthening, Functional exercises Results showed Improvement in foot function by Foot and ankle exercises in patients with Diabetic neuropathy.^[1]

In 2019 Mi Mi Thet Mon Win et al conducted the study on Hand and Foot Exercises for Diabetic Neuropathy which lasted for 8 weeks and involved Hand and foot exercises. Results showed significantly stronger improvement in motor score and specific activities of daily living.^[2]

Kavita Venkatraman Bee choo Tai conducted study in 2019 on Short Term Strength and Balance Training does not improve Quality of life but improves functional status in individuals with diabetic peripheral neuropathy which last for 8 weeks and involved Range of Motion(ROM) exercises Muscle Strengthening exercises and Exercises improving Static and Dynamic balance. Results showed Short term strength and balance training resulted in sustained improvement.^[3]

In 2019 Irshad Ahmad et al conducted study on Sensorimotor and gait training improves proprioception nerve function and muscular activation in patients with diabetic neuropathy which last for 8 weeks involved Bilateral stance on unstable surface with both eyes closed and open and Treadmill walking. Results showed Sensorimotor and gait training improves proprioception and nerve conduction velocity and provide beneficial changes in activity of muscles.^[4]

Syedeh Hoda et al conducted a study in 2020 on Effects of combined exercise training on serum kinesiin and physical function in type 2 diabetic patients with Diabetic peripheral neuropathy which last for 8 weeks involved Resistance training and Aerobic training. Results showed Moderate intensity aerobic exercise is corner stone in improving quality of life in individuals with diabetic neuropathy.^[5]

In 2022 Karolina S khan et al conducted a study on Effects of progressive resistance training in individuals with Diabetic neuropathy which last for 12 weeks involved Resistance exercises. Results showed PRT led to improvement in muscle strength in individuals with diabetic neuropathy.^[6]

Eliska Vratna et al conducted a study in 2022 on Effect of 12 week interventional exercise program on muscle strength mobility and fitness in patients with diabetic neuropathy which lasts for 12 weeks included joint mobilization circumduction plantar and dorsi flexion on ankle Strengthening and stretching Results showed Structured exercise program can improve biomechanical parameters flexibility of larger joints and muscle strength in patients with diabetic neuropathy.^[7]

In 2023 Vasileios Iepesis et al conducted study on Effect of foot and ankle mobilization combined with home stretches in patients with diabetic neuropathy which last for 6 weeks involved Mobilization and Stretchings. Results showed Combining mobilization and home stretches is effective in people with DPN.^[8]

Ronaldo H Cruvinel et al conducted study in 2024 on Affordable web based foot ankle exercise program proves effective for Diabetic neuropathy which last for 12 weeks involved Stretching and strengthening. Results showed SOPeD resulted in significant improvement in foot function in DPN symptoms and severity.^[9]

In 2025 Sidra khurshid et al conducted study on Effects of Multisystem exercises on balance and postural stability mobility walking speed and pain in patients with diabetic neuropathy which last for 8 weeks involved Range of motion (ROM) exercises muscle strengthening exercises Balance and Stretching Result showed Significant improvement in balance and postural stability and mobility in Diabetic neuropathy.^[10]

According to this evaluation of the literature, exercise is essential for older adults with diabetic neuropathy to maintain a healthy lifestyle. Every group showed improvements, according to the data. We recommend doing more research on this subject, such a systematic review or scoping study. Additional randomised controlled trials (RCTs) concentrating on motor and sensory deficits as well as fitness programs carried out by various researchers could be used to carry out this investigation.

CONCLUSION

According to this evaluation of the literature, exercise is essential for older adults with diabetic neuropathy to maintain a healthy lifestyle. Every group showed improvements, according to the data. We recommend doing more research on this subject, such a systematic review or scoping study. Additional randomised controlled trials (RCTs) concentrating on motor and sensory deficits as well as fitness programs carried out by various researchers could be used to carry out this investigation.

Limitations And Recommendations

The lack of publications found in the last ten years limited the scope of the scoping review. This suggests that the issue of diabetic neuropathy is not well understood or the subject of much investigation. We did not use any additional training aids or investigate alternative types of diabetic neuropathy; instead, we focused solely on range-of-motion exercises and muscle strengthening and endurance training on a treadmill training. This may be the most plausible reason why there are fewer articles. More RCTs on diabetic neuropathy are advised, and we would like to suggest that our paper serve as a basis for future studies in determining the therapies for diabetic neuropathy.

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