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Review Article

Effectiveness of Physiotherapy Intervention for Elderly People with Diabetic Neuropathy: A Review Study

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ABSTRACT

Introduction: Diabetic neuropathy (DN) is one of the most complex and progressive disorders, characterized by symmetrical distal degeneration of peripheral nerves, resulting in features of pain and sensory loss. This study aimed to find out the effects of physiotherapy intervention on physical function, balance, and postural control of persons with DN.

Materials and Methods: A computerized electronic search was performed using PEDro, Pubmed, CINAHL, and EMBASE with keywords including physiotherapy intervention, physical exercise, rehabilitation techniques, balance training, diabetic neuropathy, and diabetic peripheral neuropathy. The inclusion criteria consisted of studies that were randomized clinical trials, crossover trials, or controlled trials published in the English language from 2015 to 2021, identifying DN as the primary concern, and physiotherapy intervention as one of the treatment options.

Results: The primary search of the database turned up an entire set of 58 studies, among which 11 studies were selected as potentially meeting the inclusion criteria. Ultimately, four studies were retained for the final results of the review. The evaluations provided evidence to suggest that physiotherapy has positive effects on subjects with diabetic peripheral neuropathy.

Conclusion: After reviewing, it has been revealed that balance and strength training are applicable for improving balance, gait, and physical function in DN patients.

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Introduction

Longstanding diabetes mellitus (DM) promotes diabetic peripheral neuropathy (DPN) in the subjects, which alters their daily activities performance [1]. DM is one of the most frequent ongoing diseases, with a rise in worldwide prevalence [2]. It is one of the most widely recognized and long-term complications of diabetes that deteriorates over the long run [3]. Diabetes neuropathy (DN) may be the most complex and progressive disorder, portrayed by symmetrical distal degeneration of peripheral nerves, resulting in features of pain and sensory loss [4]. Diabetes is the fourth leading cause of death in developed countries and one of the most common endocrine disorders of the twenty-first century. Over the last ten years, it has increased by roughly 50%, and by 2030, it is expected to double [5, 6].

The neuropathy also affects postural stability, leading to impaired balance and a risk of falls in the subjects [1]. Individuals with DN have balance problems even with open eyes and are susceptible to falling [7]. In diabetic patients, additional risk factors for falls are delayed response to sudden changes in posture and recovery times are also delayed [8]. When there is a progression within the condition, it should cause increased postural influence, gait deviations, unusual neuromuscular control, and an increased response period [9]. It is one of the largest global public health emergencies of the 21st century. Approximately 415 million elderly persons have DM and, by 2040, this number will ascend to about 642 million people [10].

Physiotherapy rehabilitation is commonly suggested as an efficient technique in the management of peripheral neuropathies, valuable to boost the patients' physical disability and improve their quality of life [11]. Physical exercise has improved neuropathic symptoms, balance, and proprioception [12]. Strength training can give huge practical advantages and improvement in general health and well-being [13]. Strength training prompts the strength, anaerobic endurance, size, and shape of skeletal muscles [14]. Physical exercise has a positive effect on improving the symptoms of peripheral neuropathy [15].

Neuropathy represents the most frequent complication in patients with DM [16]. The most common causalities are a sedentary lifestyle, low levels of physical activity, and obesity [17]. The prevalence of peripheral in the whole population of diabetics is 13% –68% [18]. Pain intensity and frequency disturb sleep and rest, reduce work energy, and thus impair the overall quality of life [19]. DN patients might think of balance and proprioception during daily exercises [20]. This balance impairment in patients with DN is dominant during stair descents [21]. This study aimed to assess the consequences of physical therapy intervention for diabetic neuropathy patients.

Materials and Methods

Search strategy

This study gathered the electronics platform and databases including PubMed, Physiotherapy Evidence Database (PEDro), CINAHL, and experta medica databank (EMBASE) being searched using a combination of search terms related to ("physical therapy" OR "physical exercise" OR "rehabilitation" OR "balance training") AND ("elderly" OR "aged") AND ("diabetic neuropathy" OR "diabetic peripheral neuropathy"). The inclusion criteria consisted of articles that were randomized control trials (RCT), crossover trials, or controlled clinical trials published in the English language from 2015 to 2021, identifying DN as the primary concern and physiotherapy intervention as one of the treatment options (Figure 1).

Study selection

The initial analysis was performed based on the title and abstract. The title and abstracts were displayed and identified the relevant studies. When the title and abstracts were unclear, the relevant full-text articles were read carefully according to the inclusion and exclusion criteria.

Eligibility criteria

The following criteria were used to include a study for the review: Randomized control or clinical or crossover trial, diabetic peripheral neuropathy, studies from 2015-2021, PEDro scale score of 5 or more, and only studies in the English language. The exclusion criteria were as follows: Abstract published papers, conference papers, qualitative, observational studies, and non-English articles.

Quality appraisal

Critical appraisal of included studies was conducted independently with the PEDro scale to score the individual quality of each selected study.

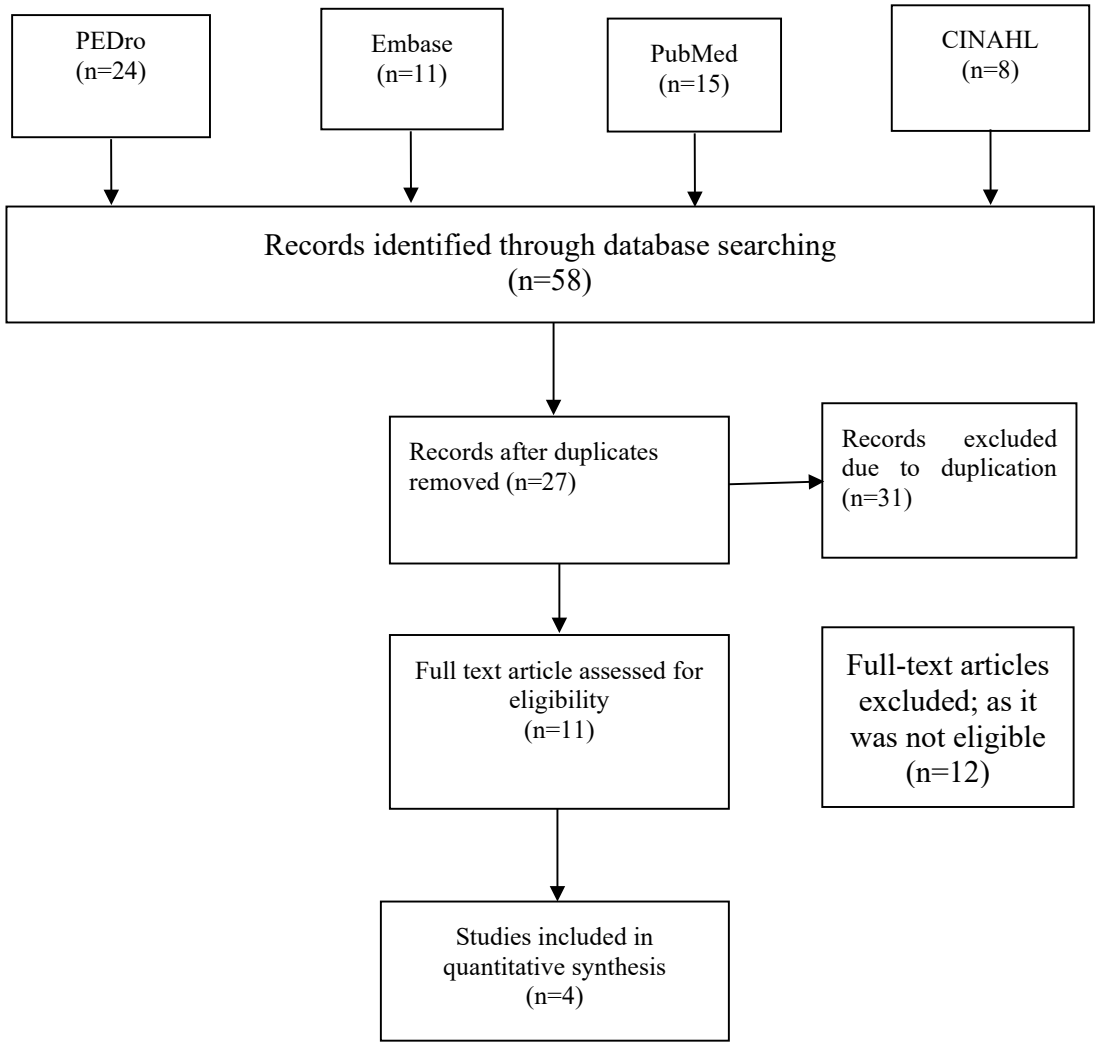

Figure 1. PRISMA flowchart

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Synopsis of articles

We have evaluated the results of a few RCTs to find out the efficacy of physical therapy intervention for senior citizens with diabetic neuropathy. Table 1 provides the summaries of four scholarly studies.

Results

This review consists of four RCTs to evaluate the effectiveness of physiotherapy exercise as a rehabilitation protocol for patients with DPN where they have taken almost 35-40 participants in each study which comprise 192 participants in total. The overall quality of the trials was moderate, and mentioned below based on the PEDro scale. Table 2 gives an analysis of the quality assessment through PEdro score analysis.

This study provides evidence of the efficacy of physiotherapy techniques in improving the balance and physical function of individuals with DPN. The PEDro scoring system was used to score these RCTs and also used to appraise the perfection of the study. Results displayed that aerobic exercises, proprioception exercises, and core stability show marked improvements in the balance of DN patients [1, 22]. Aquatic physical therapy displayed an effect on the gait and balance dysfunctions of DN [11]. Balance training would improve postural stability and balance in elderly patients with DN [4].

Discussion

The present study was designed to evaluate the effects of physical therapy intervention for patients with DN. The PEDro scale was used to evaluate the article's methodological quality. The ranges of the PEDro scores

Table 1. Outcome measurement, interventions, and Results of the articles

Author	Objectives	Participant	Inclusion Criteria	Study Design	Intervention		Duration	Tools	Result	Impression	PEDro Score	Journal Name, Country, and Year
					Experimental	Control						
Pavana at al. (2021) [1]	To assess and compare the effects of core stability exercise on balance and proprioception in diabetic neuropathy subjects.	80 patients EG (n=20) CG (n=20)	Subjects diagnosed with Type 2 DM and DPN Subjects willing to sign the consent paper Subjects 40 to 60 years and the ability to walk independently Subjects with mild to moderate neuropathy	Comparative randomized parallel open-label study	Proprioception exercise: Exercises comprised balance in one leg, backward leg swings with knee flexion, forward leg swings with knee extension, toe, and heel walking, cross-body leg swings on both sides, partial squat, single leg squatting, then progress one leg balance and side lunge.	Core Stability exercise: Exercises comprised bridging and plank exercises on knee and elbow, cat curl exercise, abdominal crunch and oblique crunches, fallout, and seated marching exercise, lean and twist exercise.	EG was done for 45 minutes with 1 minute rest for every 5 minutes and CG was done for 60 minutes with 2-minute rest each exercise for 3 times/ week for 6 weeks.	Berg balance scale (BBS) Toronto clinical neuropathy scoring system sheet	The results showed a significant improvement within group A and group B (P<0.001) but there is no significant improvement between both the groups (P>0.05).	Proprioception exercise and core stability exercise are worthwhile in improving the balance in subjects with DPN.	5/10	Indian Journal of Physiotherapy and Occupational Therapy India 2021
Kiani et al. (2018) [22]	To evaluate the efficacy of balance training procedure on postural stability of diabetic neuropathy patients.	38 patients EG (n=18) and CG (n=20)	Having the age of 40 and above, DM history of 1 or more years, stable blood glucose level.	RCT	Experimental group: Received warm-up by stretching and flexibility exercises for 5 minutes, Treadmill walking for 6 minutes, Stationary bicycle for 6 minutes.	Control group: Stable to unstable (BOS) base of support: Bipedal to semi-tandem, tandem to single-leg stance In surface: From broad to low surface, changes the speed for static balance and reaching activities.	Traditional balance training was provided for 30 minutes, 3 times per week up to 6 weeks.	Berg balance scale, functional reach test, Romberg test and backward release test & nerve conduction studies.	The Mean±SD for BBS, FRT, and RTBRT were found to be significant (P<0.05) in the aerobic treatment group as compared to the traditional balance exercises group.	Aerobic exercises show marked improvements in the balance of diabetic neuropathic patients as compared to simple balance exercises.	5/10	Journal of Medical Science Poland 2018

Author	Objectives	Participant	Inclusion Criteria	Study Design	Intervention		Duration	Tools	Result	Impression	PEDro Score	Journal Name, Country, and Year
					Experimental	Control						
Zivi et al. (2017) [11]	To compare the effects on gait and balance of aquatic physiotherapy vs on land physiotherapy inpatient rehabilitation technique for diabetic peripheral neuropathies.	40 patients AP (n=18) and LP (n=20)	Diagnosed DPN of any etiology, the present motor deficit in the lower extremities and the ability to maintain the upright position and can walk independently	Parallel-group, single-center, single blind RCT.	Land Physiotherapy: 1) Relaxation and breath control 2) Balance and posture control exercises 3) Gait exercises	Aquatic physio therapy: A heated (32°C) swimming pool for the experimental group and training was run by an expert physiotherapist in aquatic therapy.	4-week rehabilitation program composed of daily sessions of conventional physiotherapy and 3 sessions/week of specific treatment (aquatic vs. on-land).	BBS, dynamic gait index neuropathic pain scale (NPS), overall neuropathy limitations scale (ONLS), FIM, Conley and medical research council scale score.	Aquatic therapy could be considered as an alternative strategy to conventional physiotherapy.	Aquatic physical therapy displayed an effect analogous to the land-based rehabilitation on gait and balance dysfunctions of DN.	7/10	Clinical Rehabilitation United Kingdom 2018
Eftekhar-Sadat et al. (2015) [4]	To evaluate the efficacy of balance training on postural stability of diabetic neuropathy patients.	34 patients EG (n=17) and CG (n=17)	Diabetes type 2 patients between 50–70 years old with moderate or severe DN on the Toronto scale, ability to stand and walk independently, and body mass index (BMI) <30 were included.	RCT	Experimental group: Received physiotherapy similar to the control group as well as postural stability training with the biodex balance system	Control group: Received physiotherapy with infrared and transcutaneous electrical nerve stimulation (TENS) modalities	Provide for 30 minutes, 3 times a week for 10 sessions.	TUG test, BBS, & FRPS tests	Balance training with BBS improved TUG, especially the risk of falling significantly in the experimental group and could be used as a useful device in treating DN patients with postural instability and risk of falling.	Balance training would improve postural stability & balance in elderly patients with DN.	6/10	Therapeutic Advances in Endocrinology and Metabolism USA 2015

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Abbreviations: AP: Aquatic physiotherapy; BBS: Berg balance scale; BMI: Body mass index; BOS: Base of support; CG: Control group; DGI: Dynamic gait index; DN: Diabetic neuropathy; DPN: Diabetic peripheral neuropathy; FIM: Functional independence measurement scale; FRT: Functional reach test; FRPS: Fall risk and postural stability test; EG: Experimental group; LP: Land physiotherapy; ONLS: Overall neuropathy limitations scale; RCT: Randomized clinical trial; TUG: Timed up and go test: NPS: Neuropathic pain scale.

Table 2. Quality assessment through the PEDro scale

Author (Year)	PEDro Scale Items											Total Score
	1	2	3	4	5	6	7	8	9	10	11	
Pavana at al. (2021) [1]	+	+	-	-	-	-	-	+	-	+	+	5
Kiani et al. (2018) [22]	+	+	-	+	-	-	-	-	-	+	+	5
Zivi et al. (2017) [11]	+	+	+	-	-	-	+	+	+	+	+	7
Eftekhar-Sadat et al. (2015) [4]	+	+	+	+	-	-	-	-	-	+	+	6

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were between 5 to 7. One of the four selected articles had a high quality, while the other three had a moderate quality. There was variance in the tools of outcome measurement utilized to appraise patients with DN in the four articles.

The first RCT study was conducted to assess and compare the effects of core stability exercise on balance and proprioception in DN subjects. The experimental group was provided with proprioception exercises and the control group was provided with core stability exercises. Both groups were provided with an intervention for 3 times a week for 6 weeks. The outcome measurements were done by the Berg balance scale (BBS), and Toronto clinical neuropathy scoring system sheet. The results showed that the significant improvement within group A and group B ($P<0.001$) but there was no significant improvement between the groups ($P>0.05$). The proprioception exercise and core stability exercise are worthwhile in improving the balance in subjects with DPN [1]. The dynamic postural control and enhancement of muscular activity help to maintain the balance in subjects with DN [23]. Another study found that proprioceptive exercises have a significant betterment in maintaining balance compared to backward gait training in subjects with DN [24].

The second RCT study revealed the efficacy of a balance training program on the postural stability of diabetic patients. The intervention group obtained a warm-up followed by flexibility and stretching exercises. The control group received exercise only in stable to unstable support, static balance, and reaching activities. Each group received exercise sessions for 30 minutes, three times each week, for a total of six weeks. The outcome measurements were BBS, functional reach test, Romberg test, backward release test, and nerve conduction studies. The aerobic exercise group showed a more significant improvement than the traditional balance group regarding balance and functional activity for DN patients. Aerobic exercises showed marked improvements in the balance and postural control of diabetic neuropathic patients as compared to simple balance exercises [22]. A similar sort of study revealed a significant betterment in the effects of aerobic exercises and helped postural control for the subjects with DPN [25].

The third RCT study was determine to compare the effectiveness of gait and balance of aquatic physiotherapy versus land physiotherapy inpatient rehabilitation technique for DPN. The land physiotherapy group obtained relaxation, breath control, balance, posture control exercises, and gait practices. In aquatic therapy, the temperature of the swimming pool was 32°C. The experimental group training was run by an expert physiotherapist. The intervention was given for a 4-week rehabilitation program composed of 3 daily sessions per week for both groups. Afterward, outcome evaluations were done through BBS, DGI, NPS, FIM scale, ONLS, Conley scale, and medical research council scale score. Aquatic physiotherapy showed an effect comparable to that of land-based rehabilitation on the gait and balance dysfunctions of DN [11]. Furthermore, the temperature of a hydrotherapy pool helped muscular relaxation and lessened pain conceptualization [26]. Another study revealed that aquatic physiotherapy demonstrated beneficial effects on gait and balance for patients with neurological disease [27].

The fourth RCT study was conducted to evaluate the efficacy of a balance training program on the postural stability of diabetic patients. The control group received physiotherapy with infrared and TENS modalities. The experimental group obtained physiotherapy similar to the control group as well as postural stability exercise with the biodex balance system. Both groups were provided with an intervention for 30 minutes, 3 times a week for 10 sessions. The outcome measurements were timed up and go (TUG) test, BBS, and fall risk and postural stability (FRPS) tests. Balance training with BBS improved

TUG, especially the risk of falling significantly in the experimental group, and could be used as a useful device in treating DN patients with postural instability and a risk of falling. The result revealed that balance training improved postural stability and balance in elderly patients with DN [4]. One study stated that the risk of falls increases in DN patients due to delayed response and recovery time [8]. The balance training had beneficiary effects on postural control on patients with DN [28].

After reviewing, it has been revealed that at least a 4-week program with 3 times per week with 2-3 intervals on each exercise prolonged from 30 to 45 minutes might have a greater effect on the balance and strength program as an effective practice for improving balance, gait, and physical function in DPN patients. There were limited available published articles on physiotherapy intervention on balance, postural control, and physical function of patients with DN. Further studies are also needed to evaluate the specific effectiveness of physiotherapy intervention especially balance, proprioceptive training, strength training, aquatic physiotherapy, and core stability exercise for improving physical function, postural control, balance, and gait patterns. Also, it was a challenge for low-middle-income countries like Bangladesh to easily access valid and specific scholarly review articles.

Conclusion

The results of this review of the literature evidence that balance and strength training is effective on physical function and balance in individuals with DN, but there is still a controversy for DN treatment. Finally, it can be recommended that balance and strength training is applicable for improving balance, gait, and physical function in DN patients.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles are considered in this article.

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Authors' contributions

All authors equally contributed to preparing this article.

Conflict of interest

All authors declared no conflict of interest.

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