

Efficacy of wobble board as a therapeutic tool in diabetic peripheral neuropathy patients: A review study

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Abstract

Introduction: DPN is described as "symmetrical, length-dependent sensorimotor polyneuropathy as a result of chronic hyperglycemia exposure and cardiovascular risk covariates" by the Toronto Consensus Panel on Diabetic Neuropathy. In DPN, postural instability and imbalance are frequently observed. Deficits in proprioception and abnormalities of the motor nerves cause imbalance and poor muscle contraction. Physiotherapists use a variety of methods to evaluate and apply balance rehabilitation therapies. The wobble board exercise teaches about the motor strategies and is linked to the patterns of muscle activation that happen when someone is standing on a wobble board surface that suddenly tilts or translates, which increases ankle proprioception.

Objective: The objective of this review study is to find out the effectiveness of wobble board training in diabetic peripheral neuropathy patients.

Method: An electronic database, title and abstract search was conducted between 2010 and 2022 using Google Scholar, PubMed, Physiotherapy Evidence Database (PEDro) and Cochrane databases. The search terms used were "diabetes mellitus", "type 2 diabetes", "diabetic neuropathy", "diabetic peripheral neuropathy", "balance", "gait", "fall risk", "proprioception", "postural stability", "wobble board training". Articles that assessed effects of wobble board training in DPN patients were included. Studies other than wobble board exercise and published before 2010 were excluded. Studies were double-checked and only full-text articles were used in the review. A total of 14 studies were selected that demonstrated the effectiveness of wobble board exercise in patients with DPN. These studies are explored narratively.

Keywords: Diabetic neuropathy, wobble board, gait, balance, physical therapy.

Introduction

Various problems, including retinopathy, neuropathy, nephropathy, cardiomyopathy, vasculopathy, dermatopathy, and encephalopathy, are linked to chronic diabetes mellitus¹. Diabetic neuropathy (DN) is a prevalent condition characterised by peripheral nerve dysfunction signs and symptoms in a patient with diabetes mellitus (DM) when other potential causes of peripheral nerve dysfunction have been ruled out.² It is the most prevalent and problematic complication of diabetes mellitus (DM), causing the highest rates of morbidity and death as well as a significant financial burden on the provision of diabetes care. More hospitalisations result from this type of neuropathy than from any other diabetic complication, and it is the most prevalent type in developed nations.³

DPN is a major contributor to impairment from gait abnormalities, falls, and foot ulcers and amputation. Neuropathic pain is reported to affect 20–30% of DPN patients. DPN dramatically reduces life quality and raises the expense of diabetes-related healthcare.⁴

Pathophysiology

DPN is described as "symmetrical, length-dependent sensorimotor polyneuropathy attributable to metabolic and microvessel alterations as a result of chronic hyperglycemia exposure and cardiovascular risk covariates" by the Toronto Consensus Panel on Diabetic Neuropathy.⁵

Other theories proposed altered expression of sodium and calcium channels, modifications to the blood vessels supplying the peripheral nerves, glial cell activation in metabolic and autoimmune disorders, and, more recently, central pain mechanisms involving increased thalamic vascularity and an imbalance of the facilitatory/inhibitory descending pathways.⁶

Impact of DPN

Peripheral neuropathy progresses in a distal-to-proximal direction, thus the impacts on strength and balance should become noticeable in the ankle and foot, where vast, myelinated neurons containing motor and sensory units terminate.⁷

In DPN, postural instability and imbalance are frequently observed.⁸ Muscle weakness results from a loss of motor axon activity, but reduced sensory input from the limbs is caused by a lack of sensory nerve function. Deficits in proprioception and abnormalities of the motor nerves cause imbalance and poor muscle contraction. Complex brain and muscular processes synchronised with musculoskeletal functions provide balance and gait.⁹ Impaired function resulting from reduced balance can also negatively affect a patient's quality of life.¹¹

Treatment interventions

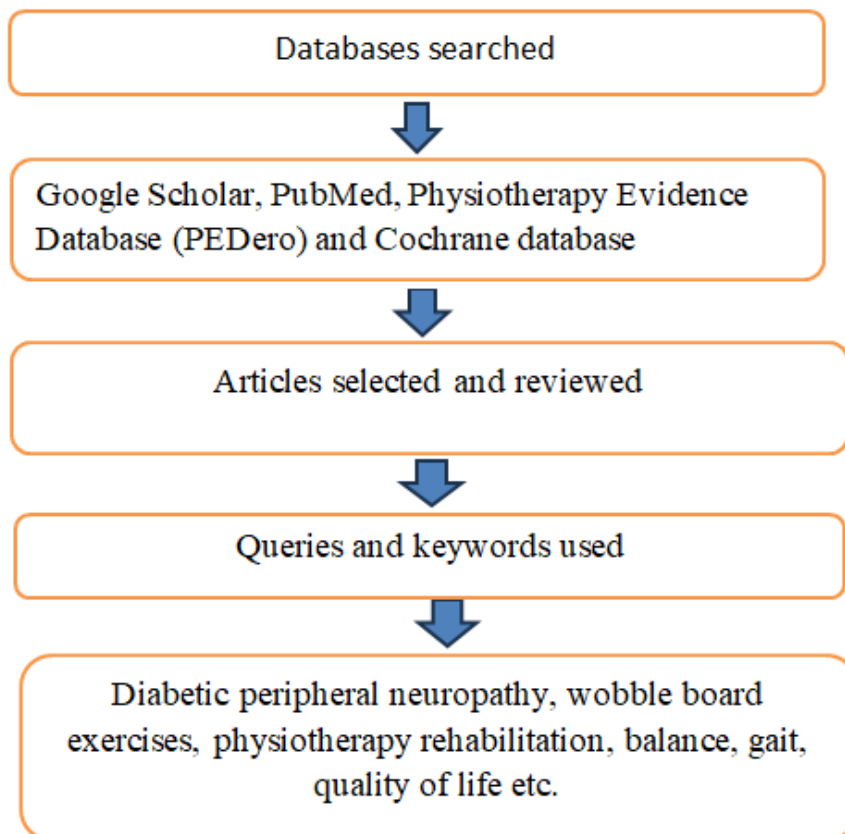
Medication, diet, and exercise are the therapies used to manage diabetes.¹¹ Many pharmacological therapies available to manage symptoms. Some drugs have been proven to work, but their use is frequently restricted by their negative effects.¹² A wealth of research has demonstrated the positive effects of exercise training and physical activity on lipid metabolism, glucose control, and cardiovascular risk factors in people with diabetes.¹³ Patients with type 2 diabetes mellitus who exercise report improvements in their physical fitness, quality of life, anatomic modulation, and neuropathic symptoms.¹⁰ To assist patients with DPN in exercising for extended periods of time, a realistic and secure exercise intervention is required.¹⁴ Physiotherapists use a variety of methods to evaluate and apply balance rehabilitation therapies. A wobble board is one tool that may be used to test balance; it is a platform that is placed on an unsteady surface.¹⁵ Studies have shown that balance-based rehabilitation therapy, which involves using any kind of balance tool—such as a wobble board—increases balance significantly in people with any kind of bodily balance problem.¹⁶

The wobble board exercise teaches about the motor strategies and is linked to the patterns of muscle activation that happen when someone is standing on a wobble board surface that suddenly tilts or translates, which increases ankle proprioception.¹⁷ So this literature review is done to explain the current evidences regarding the effectiveness of wobble board training in diabetic peripheral neuropathy patients.

Objective

The objective of this study is to find out the effectiveness of wobble board training in diabetic peripheral neuropathy patients.

Method:



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Effect of Wobble board exercises in DPN: There are some evidence-based studies that shows the effectiveness of wobble board training in patients with diabetic peripheral neuropathy. Nagwa Ibrahim Reha et al³² study shows that ankle proprioceptive training including Wobble Board exercise are beneficial for improving the Spatiotemporal gait parameters (Walking velocity (cm/sec), step length of dominant limb (cm), step time (sec), cadence (step/ min) and double support time (sec) and risk of falling in patients with DPN. Another author Irshad Ahmad et al²⁵ conducted the study that shows the effect of sensorimotor and gait training involving wobble board exercises and find out that there is increase in conduction velocity of tibial and peroneal nerve, on EMG improved activation around ankle and multifidus muscles, improved proprioception. Similarly Chaitali Shah et al³³ investigated the Multisensory exercise programme over wobbly surface i.e Wobble Board and Multisensory training on compliant surface i.e balance Pad and concluded that exercises on wobble board significantly improve the scores of the 'timed up and go' test, and '6-minute walk' test scores.

Details of included studies involving wobble board exercises:

Author and year	Study design	Type of exercise	Outcome measure
L. Allet et al, 2010 [18]	RCT IG= 35 CG= 36	Gait and balance exercises including wobble board	↑ Speed of walking, Improved Performance oriented mobility ↑ strength of ankle planter flexors ↑ strength of hip flexors ↑ Degree of concern about falling
Mohammad Akbari et al, 2012 [19]	CTS IG- 10 CG- 10	Progressive biodex stability and rocker and 'Wobble-Board' training	↓ stability index ↓ anterior-posterior stability index
Lakshmanan, M, 2012 [20]	Pre- test post- test study design IG- 15 CG- 15	<i>Balance training including wobble board, strength training and general mobility exercise</i>	reduced the fall risk
Basant Hamdy El-Refay et al, 2014 [21]	IG- 15 CG- 15	Range of motion exercises, Muscle strengthening exercises, Balance exercises on balance board and Gait training exercises	↑ in gait velocity, cadence, ankle joint mobility and decreased step time.
Patricia Silva et al, 2015 [30]	EG- 12	somatosensory training on the mean amplitude of the center of pressure which consisted of a circuit composed of 13 stations with different textures including 'Balance Board' to train mid-lateral balance.	reduced the AP oscillation of the COP
Jyoti, Karol et al, 2016 [22]	IG-15 CG-15	Relaxed deep breathing, ROM, Functional balance training, Wobble board training, Gait training and exercises on stability trainer	Improved dynamic balance
Chaitali Shah, 2016 [32]	RCT Group A- 18	Multisensory exercise programme over wobbly surface (Wobble	Significant improvement in scores of the 'timed up and

	Group B- 18	Board) and Multisensory training on compliant surface (balance Pad)	go' test, and '6-minute walk' test scores.
Chiranjeevi Jannu et al, 2017 [33]	Pre- test post-test study design Group A- 25 Group B- 25	stability trainer exercises, wobble board exercises	Improvement on BBS and TUG
Ahmad Irshad et al, 2018 [23]	Pre and post- test experimental design IG- 12 CG- 12	Balance training involving wobble board exercise, wall slides,bridging exercise, prone plank, sit to stand, one leg stance, stance on heels/ toes, tandem stance, Gait training with different pattern of walk	Improved BBS, standing to sitting, transfers, standing with eyes closed, standing with feet together, standing on one leg
Sowjanya Maruboyina et al, 2018 [24]	Pre- test post-test study design Group A- 15 Group B- 15	Wobble board exercise Stability disc exercise	Improvement on BBS and TUG test
Nagwa Ibrahim Reha et al, 2019 [31]	CG- 15 IG- 15	Ankle proprioceptive training including Wobble Board exercise	Improvement on Spatiotemporal gait parameters (Walking velocity (cm/sec), step length of dominant limb (cm), step time (sec), cadence (step/ min) and double support time (sec) and risk of falling
Irshad Ahmad et al, 2020 [9]	CTS IG-19 CG-19	sensorimotor and gait training involving wobble board exercises	↑conduction velocity of tibial and peroneal nerve, On EMG improved activation around ankle and multifidus muscles, improved proprioception
Waheed et al, 2021 [25]	RCT EG- 20 CG- 20	WBV Balance exercise involving sit to stand, one leg stance, tandem stance, Wobble Board exercise, and 30 ⁰ squats.	Improvement in NDS, functional balance, functional mobility, and strength of the lower limb muscles
Nada M Youssef et al 2022 [26]	QE IG- 20	Selected physical therapy program with proprioception training on a Wobble Board, strengthening exercises, flexibility stretching exercises	Improvement on QoLS scale.

Abbreviations: RCT: Randomised Control Trial, IG: Intervention group, CG: Control group, CTS: Controllrd trial study, QE: Quasi experimental, BBS: Berg balance scale, TUG: Timed up and go, QoLS: Quality of Life scale , COP: Center of pressure, NDS: neuropathy disability score, AP: Anteroposterior

Discussion

DPN is a prevalent long-term microvascular problem that causes significant immobility and mortality in its patients.²⁷ DPN is the most prevalent DM-related issue affecting the sensory and motor peripheral nerves.²⁸ When sensory nerve function is compromised, sensory inputs become less sensitive.²⁹ Impaired muscular activity and imbalance are caused by motor nerve diseases and a lack of proprioception. Complex neurological, muscular, and musculoskeletal processes work together to produce balance and gait.⁹ Impaired function can result from reduced balance and has a negative effect on the quality of life for patients.¹¹ This review assessed the current evidence for effect of wobble board training in patients with diabetic neuropathy. The aim of this study is to find out the effectiveness of wobble board training in diabetic peripheral neuropathy patients.

The results of this review showed that wobble board exercises had a benecial effect in DPN patients. For example, Mohammad Akbari, Hassan Jafari et al¹⁹ study showed that that balance training can improve stability

indices in diabetic patients with neuropathy. According to this study findings, diabetic patients who experience peripheral neuropathy and consequent balance problems can achieve better balance and stability through progressive balance training with emphasis on the anterior-posterior neuromuscular elements of stability. Similarly Irshad Ahmad, Shalini Verma et al²⁵ study shows that specific progressive sensorimotor and gait training involving wall slides, bridging exercises, prone plank, sit to stand, wobble board exercises, one leg stance, heel and toe raise, tandem stance gradually progressed to different grades using unstable surface improves proprioception and nerve conduction velocity. Due to better proprioceptive feedback, these interventions provide beneficial changes in the activity of muscles around the ankle and multifidus during postural control and walking in patients with DPN.

Overall, the majority of included studies demonstrated that exercise therapy involving wobble board training significantly effective for treatment of DPN patients.

Conclusion

According to available research, exercise therapy, which includes wobble board training, is safe, doable, and beneficial for individuals with diabetic peripheral neuropathy. Particular exercise regimens, such as range of motion, muscular strengthening, circuit training, stretching, gait, and balance exercises using a wobble board, can help diabetics with peripheral neuropathy with their gait, balance, posture, and other issues.

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Conflict of interest: None

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