Volume 3, Number 3, 2026
Pages 885-892
Bioscience Insights
ISSN: 3080-3489 (Print)
ISSN: 3080-3497 (Online)
BiosciInsights.com

COMPARATIVE EFFECTS OF TASK ORIENTED EXERCISES AND TACTILE STIMULATION ON BALANCE AND FUNCTIONAL MOBILITY IN PATIENTS WITH LOWER LIMB PERIPHERAL NEUROPATHY: A RANDOMIZED CONTROLLED TRIAL

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https://doi.org/10.5281/zenodo.23661570

Article Information

Article History

Received:	June 19, 2026
Revised:	August 19, 2026
Accepted:	September 07, 2026
Available Online:	October 26, 2026

Keywords:
Peripheral Neuropathy, Task Oriented Exercises, Tactile Stimulation, Balance Performance, Gait Performance

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Abstract

The peripheral neuropathy affecting the lower limbs reduces plantar sensation and propensity, and increases the falls risk. There is a lack of a head-on comparison between task-oriented exercises, and tactile stimulation. A total of 60 lower-limb peripheral neuropathy patients (age 40 to 65 years) were randomly allocated to two physiotherapy clinics of Multan, Pakistan, into two different groups: Group A, task-oriented exercises combined with conventional physical therapy, and Group B, tactile stimulation combined with conventional physical therapy for 6 weeks four times weekly. Berg Balance Scale (BBS) and Timed Up and Go test (TUG) were used to measure balance and functional mobility before and after. There were significant differences in both scores for both groups (all $p < .001$) even though baseline and post intervention scores were not different between groups, Group A had larger gains for both scores when compared to Group B: BBS (7.47 vs. 4.37 points) and TUG (4.15 vs. 2.24 s; both between group differences $p < .001$). Both groups received standard physical therapy, and thus results only show relative improvements, as the mean BBS score remained in the low fall risk range in Group A and moderate range in Group B. Future well-designed studies with a common intervention arm should be conducted.

INTRODUCTION

In peripheral neuropathy, the unusual injury of the fibers conducting sensations, motion and (occasionally) nutrition to the extremities, typically the feet and lower legs, develops. Diabetes is the most researched cause among the others; toxic exposure, chronic renal disease, hereditary neuropathies and chronic alcohol use (Castelli et al., 2020). The prevalence of diabetic peripheral neuropathy in people with diabetes reported from 30% to as high as 73% (Shin et al., 2021; Cheng et al., 2022).

These deficiencies manifest themselves as instability. Adults with neuropathy have increased sway in their postures and slower walk speeds than age matched healthy controls (Lai et al., 2025), depend more on vision than age matched healthy controls (Viseux, 2020) and also have an increased risk of falling (Reeves et al., 2021; Shin et al., 2021). The plantar mechanoreceptors are responsible for the sensation of pressure, ground reaction force and surface properties; and postural control is driven by vestibular, visual and somatosensory feedback, meaning that a loss of plantar information will decrease the information available to postural control (Guzmán-Muñoz et al., 2026; Hu et al., 2026; Oddsson et al., 2020).

Exercises play a pivotal role in neuropathy rehabilitation, with systematic review demonstrating improvements in mobility, balance, and walking (Melese et al., 2020; Akbari & Naimi, 2022). The review of 29 randomized trials indicated benefits but was largely for a combination of aerobic, strength and balance training (Hernández-Secorún et al., 2021). In a diabetic neuropathy trial of 18 patients, performing the task-oriented exercise alone along with the physiotherapy for three weeks, resulted in a greater improvement of berg balance scale and falls efficacy scale (Patil et al., 2021).

The second line of research focuses on the sensory deficiency itself. Findings regarding tactile stimulation at the foot, however, are varied, as wearing a wearable sensory prosthesis helped to improve gait velocity in individuals with neuropathy and high fall risk after 10 weeks (Oddsson et al., 2020), after six months of mechanical tactile stimulation of the lower leg, gait improved in older adults with neuropathy (Hsu et al., 2022), and eyes closed balance was influenced, together with the increase in gait velocity, after an acute trial of vibrating insoles in diabetic peripheral neuropathy (DPN) (Orlando et al., 2024).

There have been only a few direct comparisons of these approaches. There was also small, nonsignificant balance improvement in virtual reality and cognitive training, with the combination of whole-body vibration (WBV) and cognitive training performing best (in one trial) and all arms improving with routine physiotherapy (Alonso-Enríquez et al., 2023; Niajalili et al., 2026). Thus, there is no direct evidence from a clinician's perspective to show preference for exercise with a task or physical stimulation. It was a comparison matching-caning the two techniques both with standard (conventional) physical therapy with the null hypothesis that there was no significant difference in the groups, and the alternative hypothesis that there was a significant difference.

Methods

This was a two-group parallel randomized controlled trial which was done for four months at Sports & Trauma Centre and Shahzad Physiotherapy Clinic in Multan, Pakistan. The study was approved by an institutional review board prior to enrollment, and adhered to the Declaration of Helsinki (World Medical Association, 2013). The purpose, procedures, advantages and disadvantages were explained to the participants, and they were given the option to stop at any point, with their identity only being known by coded numbers.

The participants consisted of adults (40-65 years old) who had lower-limb peripheral neuropathy and clinical balance or gait dysfunction who were ambulatory with or without assistance and had consented. Other exclusion criteria included diabetes-related complications limiting exercise (i.e. severe heart disease, foot ulcers), diabetes-related complications that would interfere with instructions (i.e. cognitive impairment) and physiotherapy or rehabilitation for gait and/or balance during active participation in the study. Purposive sampling was employed in both the clinics. Using a G*Power calculation for an independent samples t test (effect size = .5, α = .10, power = .64) resulted in a sample size of 60 participants (30 per group). Post baseline was followed with a ‘sealed envelope' method to be followed by the analysis of data from 30 participants in each group (60 participants in total).

The treatment was identical and the groups of both types were treated four times a week over 6 weeks and each session lasted 30-40 minutes, comprising the same conventional physical therapy treatment of pain management, range of motion, strengthening and balance exercises. Conventional and task oriented-based exercises (traditional PT) and exercises were combined with additional training of weight shifting, transfers, and stepping using sit to stand, three sets of 10 repetitions of step ups onto a low platform, and three sets of 10 repetitions walking over small floor obstacles performed by Group A over 20 to 30 minutes per session. In the Group B (tactile stimulation plus conventional physical therapy) technique, the therapist's stimulation consisted of the same sensory receptors as in Group A, including light brushing and stroking of the plantar surface, rhythmic tapping, gentle rubbing of the foot and ankle and the application of manual rubbing together with texture stimulation, applied continuously for approximately 30 minutes while the participant was seated or lying in a supine position, stimulating the plantar sensory receptors involved in balance and postural control.

The outcomes were assessed pre-and post the 6-week program. The BBS is a 14-item test of static and dynamic balance tasks that was used to assess balance with high intra-rater and inter-rater reliability (Miranda-Cantellops & Tiu, 2021). The higher the score, the higher the risk for falling and the lower the score, the lower the fall risk; total falls risk score of 0-20 points is high, 21-40 is moderate, and 41-56 is low (Joa, 2024). FMD was evaluated and quantified using a widely accepted FMD assessment (TUG), which records in seconds the time the participant takes to stand up from the 45 cm chair, walk 3 m, turn, return, and sit down from the "Go" command to the time when they sit back down (Ortega-Bastidas et al., 2023; Hsieh et al., 2020). The TUG is not a gait mechanics assessment, but rather an assessment of gait function.

The Shapiro-Wilk test was used for normality and data were analyzed in SPSS version 26. Paired samples t tests were used to detect change within groups and independent samples t tests were used to compare groups on baseline scores, post intervention scores, and change scores. The significance level was $\alpha = .10$. The between group difference in change and Cohen's d were computed using the group means and standard deviations and then the 95% confidence interval was obtained. Improvement was defined as an increase in BBS and/or a decrease in TUG.

Results

Formally, there was no difference between the mean age of Group A (51.90, SD = 5.32) and Group B (52.23, SD = 5.60), and there were more men than women in Group A (66.7%) and Group B (53.3%). The Shapiro-Wilk Tests of the 4 outcome variables were not significant in either group (all $W \geq .963$ and $p \geq .376$). Significant improvements in balance and functional mobility were obtained in both programs (Table 1).

Table 1Within Group Changes in BBS and TUG from Baseline to Post Intervention

Outcome	Baseline *Mean* (*SD*)	Post intervention *Mean* (*SD*)	Improvement	*t* (29)
Group A (Task-oriented exercises plus conventional physical therapy)				
BBS	33.87 (4.13)	41.33 (4.43)	7.47	39.26
TUG (s)	18.75 (3.14)	14.60 (3.60)	4.15	16.23
Group B (Tactile stimulation plus conventional physical therapy)				
BBS	34.97 (5.02)	39.33 (5.11)	4.37	14.88
TUG (s)	18.05 (3.22)	15.81 (3.21)	2.24	13.94

Note. BBS = Berg Balance Scale (higher is better); TUG = Timed Up and Go (lower is better). All $p < .001$.

At baseline and after intervention both groups did not differ significantly either in terms of the outcomes (Table 2, Figure 1). Improvement scores were different. Group A improved significantly more than Group B on both the BBS (difference 3.10 points, 95% CI [2.40, 3.80], d = 2.29) and the TUG (difference 1.91 s, 95% CI [1.31, 2.51], d = 1.63), as Table 2 and Figure 2 show.

Table 2 Between Group Comparison of Baseline, Post Intervention, and Improvement Scores

Outcome	Group A (Task-oriented exercises plus conventional physical therapy), *Mean* (*SD*)	Group B (Tactile stimulation plus conventional physical therapy), *Mean* (*SD*)	*t* (58)	*p*
BBS, baseline	33.87 (4.13)	34.97 (5.02)	0.93	.358
BBS, post	41.33 (4.43)	39.33 (5.11)	1.62	.111
BBS, improvement	7.47 (1.04)	4.37 (1.61)	8.86	< .001
TUG (s), baseline	18.75 (3.14)	18.05 (3.22)	0.85	.398
TUG (s), post	14.60 (3.60)	15.81 (3.21)	1.37	.175
TUG (s), improvement	4.15 (1.40)	2.24 (0.88)	6.33	< .001

Note. Values of t are absolute values from independent samples tests.

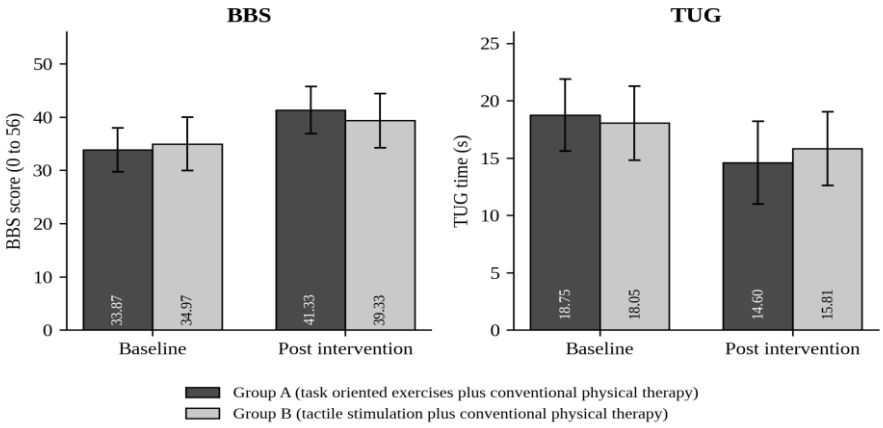


Figure 1 Mean BBS and TUG Scores Before and After the Intervention

Note. Error bars show standard deviations.

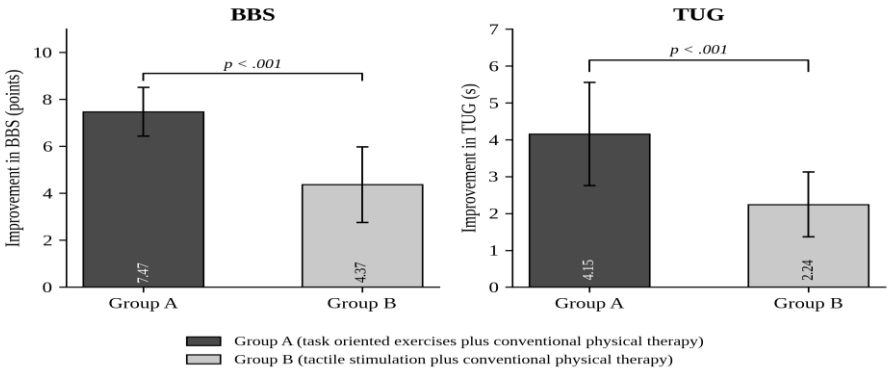


Figure 2 Mean Improvement in BBS and TUG Scores by Group

Note. Error bars show standard deviations.

All the participants in this study, both groups, had mean BBS scores within the moderate fall risk category (Joa, 2024) at baseline. The mean (41.33) of the Group A after the intervention was in the low-risk area while the mean (39.33) of the Group B was in the moderate risk area. Data for the individual participants were not available so the number of participants for whom the range changed is not known.

Discussion

Both increased functional mobility and balance, and task-oriented exercise resulted in greater gains, but conventional physical therapy was associated with both sets of gains. The advantage must be read seriously as, despite no significant difference in scores before and after intervention, improvement score has indicated that there is an advantage to be gained. Standard deviations for improvement were 2.4 times as large as those for post intervention scores on both scores, creating a more sensitive comparison of improvement because of the relatively large differences between individuals in post intervention scores, and relative uniformity of improvements. Group A also began somewhat behind on both measures, but moved forward and ended up higher, thus offering results in terms of change, not equality, and thus the differences in the post intervention period were not significant, and don't indicate that the programs are equivalent.

The increase in the larger gains in the post task exercise is consistent with theory of motor learning. The repeated sit to stand and step up and obstacle tasks rehearsed weight shifting, controlled stepping and adaptation to environmental demands similar to the demands of sit-to-stand, stepping up, and stepping/or walking during the BBS and TUG, respectively and general conditioning may have contributed. This aligns with the findings reported by Patil et al. 2021 that task-oriented exercises improved BBS scores in DN, and Kaushik et al. 2023 which reported that home based functional exercises improved BBS, TUG, and functional reach in older adults with DN, and a meta-analysis by Ji et al., 2026 that exercise shortened TUG time and increased BBS scores. The difference between those studies is that they were designed to compare exercise to standard care or other exercise programs, while the present study compared exercise to sensory input.

The results from the tactile stimulation group suggest the belief that extra sensory information is beneficial in a situation where plantar feedback is reduced. Sensory augmentation resulted in improved gait velocity in neuropathy in high fall risk patients (Oddsson et al., 2020); vibrating insoles acutely increased walking speed and decreased eyes closed balance (Orlando et al., 2024). Although tactile stimulation was applied, these sensory training did not include manual application, thus transfer to the present intervention is still not confirmed.Manual application of tactile stimulation compared to conventional therapy did not result in improved plantar sensation, proprioception, balance or walking velocity for the hemiparesis groups (Tikac et al., 2025), nor did it lead to higher BBS scores than conventional therapy for diabetic neuropathy (Naz et al., 2025).

The smaller improvement with tactile stimulation might be due to what the tactile component of the stimulus provides. In addition to enriching the sensory component of sensorimotor control, tactile input may co-stimulate the rehearsal of motor strategies for rising, stepping and turning, as indicated in both the tactile exercises and a meta-analysis of how much BBS improved following exercise as opposed to therapeutic modalities, sample size was small (Ji et al., 2026).

The p values are more informative when compared to clinically more significant results, such as the Group A finding mean crossing the 41-point boundary between moderate and low fall risk (Joa, 2024). The approaches do not need to be mutually exclusive as they work on various parts of the sensorimotor system, and sensorimotor plus gait training also enhanced proprioception, nerve function, muscle activation and postural stability in diabetic peripheral neuropathy (Ahmad et al., 2020). This does not tell us whether task-directed exercise with tactile stimulation works better than the tactile stimulation alone or the task-directed exercise alone.

Limitations

There are a few limitations in this research. All the participants had baseline treatment (strengthening and balance training) with no group having baseline treatment alone. Improvement cannot therefore be attributed to the additional impacts of one-to-one support by either group and it is difficult to separate out learning effects, natural variation and baseline treatment's own effects. A comparison is made to relative and not absolute benefit.

The additional programs were also different, the therapist applied stimulation was not indicated and there was no specification of the parameters of the tactile stimulation (pressure, tapping speed), which hampers the replication. No blinding procedure was reported and assessed performance measures were either timed or observed, leaving them vulnerable to the expectation effects when the assessor(s) knows the allocation.

The sample of 60 subjects was obtained from two clinics in a given city. The power of .64 is less than conventional power of .80, and the significance level of .10 is more liberal than the usual .05, however, all the effects that figured as significant had $p < .001$ and thus the significance is unrelated to the liberal criterion. The flow of participants from the target (66) to the 60 analyzed is not reported in detail. The mean scores of improvements were not adjusted for baseline scores. The six-week program was the maximum length of follow-up; duration of effect can't be assessed because it was not recorded and gait was presumed only through the TUG and not measured using spatiotemporal parameters. Extension of the specific causes to other causes is still unclear as the etiology of neuropathy was not mentioned and most of the literature supporting the topic is from those with diabetic peripheral neuropathy.

Conclusion

To sum up, Task-oriented exercises significantly enhanced balance and functional mobility compared to tactile stimulation alone and both forms of intervention were added to standard PT to enhance functional mobility and balance in adults with peripheral neuropathy in their lower limbs, showing greater improvement post-TOE. There are no apparently statistically significant differences in the final score, but it may be an improvement that attracts the edge. Confirmation will require larger trials including only a conventional therapy arm, blinded assessment, and longer follow up; gait measures will be included in the larger trials as will falls, which should be recorded.

REFERENCES

Ahmad, I., Verma, S., Noohu, M. M., Shareef, M. Y., & Hussain, M. E. (2020). Sensorimotor and gait training improves proprioception, nerve function, and muscular activation in patients with diabetic peripheral neuropathy: A randomized control trial. *Journal of Musculoskeletal & Neuronal Interactions, 20*(2), 234–248.

Akbari, N. J., & Naimi, S. S. (2022). The effect of exercise therapy on balance in patients with diabetic peripheral neuropathy: A systematic review. *Journal of Diabetes & Metabolic Disorders, 21*(2), 1861–1871. https://doi.org/10.1007/s40200-022-01077-1

Alonso-Enríquez, L., Gómez-Cuaresma, L., Billot, M., Garcia-Bernal, M. I., Benitez-Lugo, M. L., Casuso-Holgado, M. J., & Luque-Moreno, C. (2023). Effectiveness of virtual reality and feedback to improve gait and balance in patients with diabetic peripheral neuropathies: Systematic review and meta-analysis. *Healthcare, 11*(23), Article 3037. https://doi.org/10.3390/healthcare11233037

Castelli, G., Desai, K. M., & Cantone, R. E. (2020). Peripheral neuropathy: Evaluation and differential diagnosis. *American Family Physician, 102*(12), 732–739.

Cheng, Y., Cao, W., Zhang, J., Wang, J., Liu, X., Wu, Q., & Lin, Q. (2022). Determinants of diabetic peripheral neuropathy and their clinical significance: A retrospective cohort study. *Frontiers in Endocrinology, 13*, Article 934020. https://doi.org/10.3389/fendo.2022.934020

Guzmán-Muñoz, E., Montalva-Valenzuela, F., Garcia-Carrillo, E., Castillo-Paredes, A., López-Gil, J. F., Narrea Vargas, J. J., Yáñez-Sepúlveda, R., & Concha-Cisternas, Y. (2026). Postural balance and human movement: An integrative framework for mechanisms, assessment, and functional implications. *Journal of Clinical Medicine, 15*(7), Article 2588. https://doi.org/10.3390/jcm15072588

Hernández-Secorún, M., Vidal-Peracho, C., Márquez-Gonzalvo, S., Corral-de-Toro, J., Müller-Thyssen-Uriarte, J., Rodríguez-Sanz, J., Lucha-López, M. O., Tricás-Moreno, J. M., & Hidalgo-García, C. (2021). Exercise and manual therapy for diabetic peripheral neuropathy: A systematic review. *Applied Sciences, 11*(12), Article 5665. https://www.mdpi.com/2076-3417/11/12/5665

Hsieh, C.-Y., Huang, H.-Y., Liu, K.-C., Chen, K.-H., Hsu, S. J.-P., & Chan, C.-T. (2020). Subtask segmentation of Timed Up and Go test for mobility assessment of perioperative total knee arthroplasty. *Sensors, 20*(21), Article 6302. https://www.mdpi.com/1424-8220/20/21/6302

Hsu, C. L., Manor, B., Iloputaife, I., Oddsson, L. I. E., & Lipsitz, L. (2022). Six month lower-leg mechanical tactile sensory stimulation alters functional network connectivity associated with improved gait in older adults with peripheral neuropathy: A pilot study. *Frontiers in Aging Neuroscience, 14*, Article 1027242. https://doi.org/10.3389/fnagi.2022.1027242

Hu, X., Zeng, Z., & Wang, L. (2026). Effects of an eight-week composite plantar sensory exercise on postural stability in older adults: A randomised controlled trial. *Journal of Exercise Science & Fitness, 24*(2), Article 200451. https://doi.org/10.1016/j.jesf.2026.200451

Ji, Y., Liang, M., & He, W. (2026). The effects of non-pharmacological treatments on the balance function of patients with diabetic peripheral neuropathy: Systematic review and meta-analysis. *Journal of Diabetes & Metabolic Disorders, 25*(2), Article 212. https://doi.org/10.1007/s40200-026-02025-z

Joa, K. L. (2024). Outcome measurement in balance problems: Berg Balance Scale. *Annals of Rehabilitation Medicine, 48*(2), 103–104. https://doi.org/10.5535/arm.240029

Kaushik, A., Shukla, A., & Mohanty, M. (2023). Effectiveness of home-based activities on functional balance and mobility of Indian older adults with diabetic neuropathy. *International Journal of Health Sciences and Research*.

Lai, Y.-R., Chiu, W.-C., Ting, C.-P., Chiang, Y.-F., Lin, T.-Y., Chiang, H.-C., Huang, C.-C., & Lu, C.-H. (2025). Postural sway serves as a predictive biomarker in balance and gait assessments for diabetic peripheral neuropathy screening: A community-based study. *Journal of NeuroEngineering and Rehabilitation, 22*(1), Article 123. https://doi.org/10.1186/s12984-025-01644-6

Lee, M.-H., & Lee, D.-Y. (2025). Effects of task-oriented training on gait outcomes and balance in individuals with stroke: A systematic review and meta-analysis of randomized controlled trials. *Journal of Clinical Medicine, 14*(24), Article 8766. https://www.mdpi.com/2077-0383/14/24/8766

Melese, H., Alamer, A., Hailu Temesgen, M., & Kahsay, G. (2020). Effectiveness of exercise therapy on gait function in diabetic peripheral neuropathy patients: A systematic review of randomized controlled trials. *Diabetes, Metabolic Syndrome and Obesity, 13*, 2753–2764. https://doi.org/10.2147/dmso.S261175

Miranda-Cantellops, N., & Tiu, T. K. (2021). Berg balance testing. In *StatPearls*. StatPearls Publishing.

Naz, S., Jamil, A., Ashraf, S., Tauqeer, S., & Akram, S. (2025). Proprioceptive training and conventional physical therapy on balance and quality of life in patients with diabetic peripheral neuropathy: A randomized controlled trial. *Asia Pacific Journal of Health Management, 20*(3), 1–10. https://doi.org/10.24083/apjhm.v20i3.3863

Niajalili, M., Sadeghi, S., Baghban, A. A., Khademi Kalantari, K., & Naimi, S. S. (2026). Comparative effects of cognitive training with whole-body vibration vs. traditional physiotherapy on balance and plantar sensation in diabetic neuropathy. *Journal of Bodywork and Movement Therapies, 46*, 1–9. https://doi.org/10.1016/j.jbmt.2025.10.042

Oddsson, L. I. E., Bisson, T., Cohen, H. S., Jacobs, L., Khoshnoodi, M., Kung, D., Lipsitz, L. A., Manor, B., McCracken, P., Rumsey, Y., Wrisley, D. M., & Koehler-McNicholas, S. R. (2020). The effects of a wearable sensory prosthesis on gait and balance function after 10 weeks of use in persons with peripheral neuropathy and high fall risk: The walk2Wellness trial. *Frontiers in Aging Neuroscience, 12*, Article 592751. https://doi.org/10.3389/fnagi.2020.592751

Orlando, G., Brown, S., Jude, E., Bowling, F. L., Boulton, A. J. M., & Reeves, N. D. (2024). Acute effects of vibrating insoles on dynamic balance and gait quality in individuals with diabetic peripheral neuropathy: A randomized crossover study. *Diabetes Care, 47*(6), 1004–1011. https://doi.org/10.2337/dc23-1858

Ortega-Bastidas, P., Gómez, B., Aqueveque, P., Luarte-Martínez, S., & Cano-de-la-Cuerda, R. (2023). Instrumented Timed Up and Go test (iTUG): More than assessing time to predict falls: A systematic review. *Sensors, 23*(7), Article 3426. https://doi.org/10.3390/s23073426

Park, J. H., Benson, R. F., Morgan, K. D., Matharu, R., & Block, H. J. (2023). Balance effects of tactile stimulation at the foot. *Human Movement Science, 87*, Article 103024. https://doi.org/10.1016/j.humov.2022.103024

Patil, Y., Singaravelan, R., & Borkar, T. P. (2021). Effects of task-oriented exercises on improving the balance, minimizing the risk of fall in patients with diabetic neuropathy: A comparative study. *Indian Journal of Public Health Research & Development, 12*(4), 409.

Reeves, N. D., Orlando, G., & Brown, S. J. (2021). Sensory-motor mechanisms increasing falls risk in diabetic peripheral neuropathy. *Medicina, 57*(5), Article 457. https://doi.org/10.3390/medicina57050457

Shin, K. J., Kang, J. W., Sung, K. H., Park, S. H., Kim, S. E., Park, K. M., Ha, S. Y., Kim, S. E., In Lee, B., & Park, J. (2021). Quantitative gait and postural analyses in patients with diabetic polyneuropathy. *Journal of Diabetes and Its Complications, 35*(4), Article 107857. https://doi.org/10.1016/j.jdiacomp.2021.107857

Tikac, G., Altug, F., Unal, A., & Baskan, E. (2025). Lower limb sensory training improves functional capacity in hemiparesis: A single-blinded randomized controlled trial. *Neurological Sciences, 47*(1), Article 60. https://doi.org/10.1007/s10072-025-08688-5

Viseux, F. J. F. (2020). The sensory role of the sole of the foot: Review and update on clinical perspectives. *Neurophysiologie Clinique, 50*(1), 55–68. https://doi.org/10.1016/j.neucli.2019.12.003

World Medical Association. (2013). World Medical Association Declaration of Helsinki: Ethical principles for medical research involving human subjects. *JAMA, 310*(20), 2191–2194. https://doi.org/10.1001/jama.2013.281053