

The Whole Body Vibration Comparison with Traditional Tai Chi Exercise on Balance and Muscular Strength in Diabetic Patient with Peripheral Neuropathy

Whole Body Vibration with Exercise on Balance and Muscular Strength in Diabetic

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ABSTRACT

Objective: To determine the effects of Whole-body vibration on balance, and muscular strength in patients of diabetic peripheral neuropathy.

Study Design: Single-blinded randomized clinical trial study.

Place and Duration of Study: This study was conducted at the Rabia Moon Hospital, Karachi from June 2021 to March 2022.

Materials and Methods: The sample size was included 40 individuals. The data collection tools included The Single Leg Stance (SLS) Test, Berg Balance Scale (BBS), Five-times-sit-to stand (FTSTS) test, and Mini-mental scale. Statistical analysis was done at SPSS 21. The Friedman test and ANOVA tests were applied multiple comparisons in between the two groups.

Results: After treatment, the Friedman test and ANOVA revealed p-value less than (<0.05) statistically significant differences in within-group analysis and in between the groups.

Conclusion: This study concluded that Whole-body vibration training is equally effective as Tai Chi Program. and have positive effects on the balance management of the patient, and muscular strength in patient with Diabetic neuropathy.

Key Words: Diabetes neuropathy, whole body vibration, muscle strength.

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INTRODUCTION

DM is a set of metabolic illnesses diagnosed on hyperglycemia and pathophysiology involved the abnormality in either in insulin secretion, insulin action, or both^{1,2}.

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In patients with chronic hyperglycemia, neuropathy and muscular weaknesses are the common complications³. In current practice, type 2 diabetes patients are advised towards the daily physical activity including wall and mild exertion exercise as to improve their physical fitness, it is observed that exercise revealed better metabolic control and glycemic level and control the insulin sensitivity; and also reduced inflammatory markers and the symptoms of neuropathy^{4,5}.

An study conducted in patients with low back pain, the whole-body vibration (WBV) exercise have been demonstrated improve in their pain, increase in their muscle strength, increase in whole body balance control and improved cardiopulmonary activity also observed the bone density in both healthy and clinical populations^{6,7,8}. While the traditional Tai Chai exercise is mind-body practices that have sequence of rhythmical, refined motions that are connected together. The sequences, these training exercises can assist in performing the dual-task components at the same⁹. In addition to these benefits, it lowers levels of stress and enhances cardiovascular endurance as well as aerobic capacity¹⁰. The research on older males conducted by Ding-Hai Yu et al., concluded that 24week Tai Chi exercise intervention had a positive influence on postural balance and control movements¹¹. Another

research revealed that a simplified version of TC along with coordinated-cognitive integration of attention, voluntary motor activities, and postural control, resulted in improvement in their cognitive¹² and the significant value of this training were observed in diabetic as well as elderly populations the balance, walking, step-ups, and bipedal jumps improved¹³.

The main objective of this work was to regulate that which one of these two mentioned rehabilitation protocols observed very effective in treating the patients of diabetes .In Pakistan less literature is available relevant to this WBV technique supportive management in diabetics this study would be adding an evidence based training in our diabetic populations.

MATERIALS AND METHODS

The study design was Single-blinded randomized clinical trial, and the data was collected from Rabia Moon Hospital, Karachi. The duration of the study was 9 months. Total sample size calculated was 40; participants, approximately 20 participants of both gender between the ages of 45 to 70 years of Type II DM, were included in each group of WBV and Tai Chi¹⁴.

Data Collection Tools:

Single leg Stance test: The Single Leg Stance (SLS) Test is utilized to evaluate a subject's static postural control as well as their balance for reducing the risk of falling.¹

Berg Balance Scale (BBS): In 1998, this instrument was originally designed by Berg et al with the highest quality level, for the purpose of providing an effective evaluation of equilibrium^{15,16}. It differentiates between static balance (five things) and dynamic balance (nine things) using its 14 components. On the ordinal scale, each entity receives a score between 0 and 4. The total score is 56, and the higher it goes when the score between 0 and 20 indicates equilibrium and a high risk of falling, whereas a score between 21 and 40 indicates satisfactory equilibrium and a medium risk of falling, and a score between 41 and 56 indicates excellent equilibrium and a low risk of falling^{15,17,18}.

Five-times-sit-to stand (FTSTS) test: The five-time sit-to-stand test, also known as the FTSTS, was used in order to determine the muscular endurance of the lower limbs. The instructor began the exam by saying "Prepared, Set, Go," started a computerized timer when it said "Go," The five completed sit-to-stand cycles were counted out loud. The timer was halted when the individual go back to the same position for the fifth time¹⁷.

Mini-mental scale: It is a 30-point survey which is utilized comprehensively in research as well as clinical settings to evaluate mental disability.

Experimental protocol: Group A (whole body vibration along with balance training group) and Group

B (balance exercises and yang style Tai chi exercises group). The total treatment time was 3 weeks Result parameters were evaluated at baseline, after 3 weeks, then follow up after 1 month. Muscle strength and balance was evaluated at baseline, 4th week and 8th week.

Procedural Techniques: Participants were separated into two groups who received the treatment protocols (Table-1).

RESULTS

The total no. of 40 participants with diabetic peripheral neuropathy were included. The participants were divided into two large groups: group A included 20 in WBV while in group B 20 participant for Tai Chi. The age distributions observed in the 4 sub-divisions of the participants were from the age groups of 45-50 years were showed 59% of the total participants, the ages of 51-55 years showed 20.5% of the population, the age ranges of 56-60 years were showed 12.8% of the participants and the age ranges of 61-65 were revealed only 7.7% of the participants. The mean age of the total participants selected for the study was 56.21 ± 34 years. The mean ages of the Tai Chi were 51.45±5.18% while the mean ages of WBV revealed 51±5.94% of the participants.

Table No. 1: Exercise protocols in WBV and Tai Chi.

GROUP A (WBV)	GROUP B (TAI CHI EXERCISE)
Exploratory Group got WBV : The Balance practices incorporated as: <ul style="list-style-type: none"> • Twofold leg position with one eyes was opened and eyes was shutter with 10 Reps * 3 minutes • Side by side stroll for 3 minutes • Sideways stroll for 3 minutes • One leg holding position for 1 moment with 5 Breaths, with 30 sec rest span 	Control group received Balance exercises include: <ul style="list-style-type: none"> • Twofold leg position with eyes open and eyes shut 10 Reps * 3 minutes • Tandem stroll for 3 minutes • Sideways stroll for 3 minutes • Single leg position for 1 moment with 5 Reps, with 30 sec rest span
WHOLE BODY VIBRATION: The Subject remained in this posture with remained their feet shoeless and their shoulder width apart while gazing at the front. This platform provided a continued alternate vibratory activity.	Yang style Tai chi exercise which consist of following positions: <ol style="list-style-type: none"> 1. Hold the ball ward off 2. Grasping the sparrows tail left 3. Grasping the sparrows tail Right

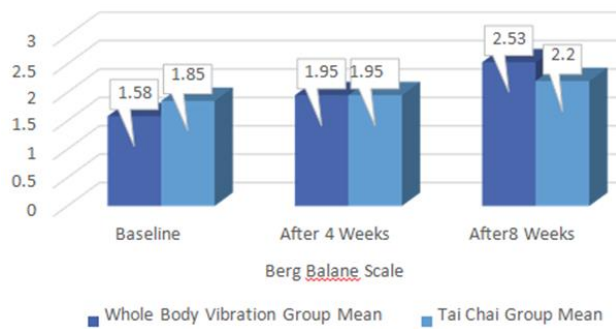


Figure No. 1: The graphical representation of ANOVA in between the WBV and Tai Chi groups comparison of Berg Balance scale

For other parameters non-parametric tests were applied after the normality analysis. The Friedman test for comparing the mean values within the different groups (at baseline, after 4 and 8 weeks) of WBV group and Tai Chi Groups for the Berge Balance scale revealed a highly significant p-value of 0.00 for WBV and for Tai Chi Group revealed the p-value 0.04

Observations of the Sit to Stand Test, for the intergroup comparison of WBV group revealed the Friedman Test statistical p-value of 0.00 as well as the Tai Chi intergroup comparison also showed a highly significant p-value of 0.00. The Friedman test was applied for

intergroup analysis of MNSI of WBV showed the highly significant p-value of 0.05 and Tai Chi intergroup showed the p-value of 0.04.

The multiple mean comparisons between the different groups of WBV and Tai Chi the ANOVA revealed the highly significant values of Berg Balance scale, Sit to Stand Test(Figure1 and 2 respectively), MNSI as table No. 2.

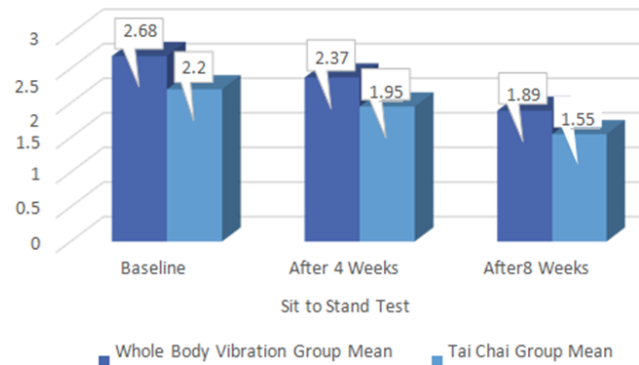


Figure No. 2: The graphical representation of ANOVA comparison between the WBV and Tai Chi for Sit to Stand Test

Table No. 2: ANOVA for MNSI between WBV and Tai Chi groups.

Variable	Whole Body vibration Group			Tai Chi Group		
	Mean ± SD	Mean Difference	P-Value	Mean ± SD	Mean Difference	P-Value
MNSI	Baseline	1.00 ± 0.00	0.21	1.00 ± 0.00	0.21	0.00
	After 4 Weeks	1.21 ± 0.042	0.16	1.00 ± 0.00	0.16	
	After 8 Weeks	1.37 ± 0.49	0.37	1.00 ± 0.00	0.37	

Table No. 02: Repeated Measuer ANOVA Test (Parametric-Inter Group Analysis for MNSI Scale

DISCUSSION

The goal of this study is to find out how Whole-Body Vibrations affect the ability of people with diabetic peripheral neuropathy and improve their balance and strength. Initially there was no impact of WBV on the balance, or strength in diabetic peripheral neuropathy patients either even after the 4 week time period, however, after a period of 8 weeks, there was a considerable improvement in the participants' performance in the whole-body vibration group, resulted a significant difference in the intra group analysis. In literature a randomized control trial study was carried out in Spain revealed the effects of whole-body vibrations on the 159 elderly people majority were female and average age was 82 years that showed a strong supportive findings that engaged in whole-body vibration improve the muscular strength¹⁹. It is suggested that exercises that involve whole-body

vibration produce beneficial effects as compare to the stationary exercises. These benefits include enhanced balance and gait, in addition to functional mobility¹⁹. Another study regarding the benefits of 10 weeks of whole-body vibration (WBV) of 75 women participants of elderly age revealed, that WBV training can induce a very effective adaptation, useful for counteracting the loss of muscle strength associated with sarcopenia²⁰. WBV exercise increases the muscle strength of the knee and hip extensors induced by quadriceps hypertrophy. This is in agreement with the findings of the most recent study, which showed that WBV training increases both muscular mobility and strength²⁰. The purpose of this randomized controlled trial was to investigate the impact that training with whole-body vibration (WBV) had on the isometric and explosive muscle strength as well as the muscle mass of males over the age of 60. WBV exercise has the potential to

stop or even reverse the muscle loss that comes with aging (sarcopenia)²¹.

It has been observed that the Diabetic patients in their later years had increased risk of falling and a randomized control study was carried out at Sahmyook University, revealed the static and dynamic balance of the WBV group improved statistically significant as compared to the control group¹⁴.

Meta-analyses have revealed that sarcopenia prevalence is two to three times higher in patients with diabetes than in patients without diabetes²². Practicing Tai Chi is an effective low-tech strategy for improving movement in terms of balance and gait intergroup analysis also revealed significant effect in neuropathy, the practice of Tai Chi was found to promote functional mobility. A case-control study was carried out in order to acquire an idea of the impact that Tai Chi exercises on the balance of elderly people who suffer from Alzheimer's disease. The Tai Chi group demonstrated a greater amount of improvement than the other groups did when they were tested on their ability to move rhythmically forward and backward⁹. Another study on healthy older men participated in a 24-week study to evaluate the effects of a Tai Chi exercise routine on their response times, balance, and flexibility (RT). In line with our findings, an exercise program consisting of 24 weeks of Tai Chi led to improvements in balance control among older persons²³.

CONCLUSION

This study concluded that Whole-body vibration training is equally effective as Tai Chi Program. Each treatment holds on positive effects on the balance management of the patient, and muscular strength, in the patients of diabetes suffering from peripheral neuropathy.

Recommendations: Upcoming work on this domain should be focused to study the effects of WBV and Tai-Chi on a larger scale so that the results can be generalized. Data should be collected from different clinical setups. Additional studies should be conducted with similar treatment along-with advanced technological and radiological considerations in individuals.

Author's Contribution:

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Final Approval of version:	Quratulain Zia

Conflict of Interest: The study has no conflict of interest to declare by any author.

REFERENCES

- Petersmann A, Müller-Wieland D, Müller UA, Landgraf R, Nauck M, Freckmann G, et al. Definition, classification and diagnosis of diabetes mellitus. *Exp Clin Endocrinol Diabetes* 2019;127(S 01):S1–7.
- Robinson CC, Barreto RP, Plentz RD. Effects of whole body vibration in individuals with diabetic peripheral neuropathy: a systematic review. *J Musculoskelet Neuronal Interact* 2018;18(3): 382-84.
- Domínguez-Muñoz FJ, Villafaina S, García-Gordillo MA, Hernández-Mocholi MÁ, Collado-Mateo D, Adsuar JC, et al. Effects of 8-week whole-body vibration training on the HbA1c, quality of life, physical fitness, body composition and foot health status in people with T2DM: A double-blinded randomized controlled trial. *Int J Environ Res Public Health* 2020;17(4):13-17.
- Singleton JR, Smith AG, Marcus RL. Exercise as therapy for diabetic and prediabetic neuropathy. *Current Diabetes Reports* 2015;15(12):1–8.
- Singleton JR, Marcus RL, Lessard MK, Jackson JE, Smith AG. Supervised exercise improves cutaneous reinnervation capacity in metabolic syndrome patients. *Ann Neurol* 2015;77(1): 146–53.
- Rees SS, Murphy AJ, Watsford ML. Effects of whole-body vibration exercise on lower- extremity muscle strength and power in an older population: a randomized clinical trial. *Physical Therapy* 2008;88(4):462–70.
- delPozo-Cruz B, Hernandez Mocholi MA, Adsuar JC, Parraca JA, Muro I, Gusi N. Effects of whole body vibration therapy on main outcome measures for chronic non-specific low back pain: a single-blind randomized controlled trial. *J Rehabil Med* 2011;43(8):689–94.
- Gomes-Neto M, de Sá-Caputo D da C, Paineiras-Domingos LL, Brandão AA, Neves MF, Marin PJ, et al. Effects of whole-body vibration in older adult patients with type 2 diabetes mellitus: a systematic review and meta-analysis. *Can J Diabetes* 2019; 43(7):524–9.
- Lin YC, Hsu WC, Chen CH, Wang CW, Wu KPH, Wong AM. Simplified Tai Chi 6-Form Apparatus for Balance in Elderly People with Alzheimer's Disease. *J Med Biol Eng* 2019;39(5):682–92.
- Kuramoto AM. Therapeutic benefits of Tai Chi exercise: research review. *WMJ-Madison* 2006; 105(7):42.
- Yu DH, Yang HX. The effect of Tai Chi intervention on balance in older males. *J Sport Health Sci* 2012;1(1):57-60.

12. Lam LC, Chau RC, Wong BM, Fung AW, Lui VW, Tam CC, et al. Interim follow-up of a randomized controlled trial comparing Chinese style mind body (Tai Chi) and stretching exercises on cognitive function in subjects at risk of progressive cognitive decline. *Int J Geriatr Psychiatr* 2011;26(7):733-40.
13. Lee K, Lee S, Song C. Whole-body vibration training improves balance, muscle strength and glycosylated hemoglobin in elderly patients with diabetic neuropathy. *Tohoku J Exp Med* 2013;231(4):305-14.
14. Ko MC, Wu LS, Lee S, Wang CC, Lee PF, Tseng CY, et al. Whole-body vibration training improves balance control and sit-to-stand performance among middle-aged and older adults: a pilot randomized controlled trial. *Eur Rev Aging Phys Act* 2017;14:1-1.
15. Henson J, Dunstan DW, Davies MJ, Yates T. Sedentary behaviour as a new behavioural target in the prevention and treatment of type 2 diabetes. *Diabetes Metab Res Rev* 2016;32:213-20.
16. Villafaina S, Collado-Mateo D, Fuentes JP, Merellano-Navarro E, Gusi N. Physical exercise improves heart rate variability in patients with type 2 diabetes: a systematic review. *Current Diabetes Reports* 2017;17(11):1-8.
17. Mann S, Beedie C, Balducci S, Zanuso S, Allgrove J, Bertiato F, et al. Changes in insulin sensitivity in response to different modalities of exercise: a review of the evidence. *Diabetes Metab Res Rev* 2014;30(4):257-68.
18. Karstoft K, Pedersen BK. Exercise and type 2 diabetes: focus on metabolism and inflammation. *Immunol Cell Biol* 2016;94(2):146-50.
19. Sitjà-Rabert M, Martínez-Zapata MJ, Vanmeerhaeghe AF, Abella FR, Romero-Rodríguez D, Bonfill X. Effects of a whole body vibration (WBV) exercise intervention for institutionalized older people: a randomized, multicentre, parallel, clinical trial. *J Am Med Dir Assoc* 2015;16(2):125-31.
20. Machado A, García-López D, González-Gallego J, Garatachea N. Whole-body vibration training increases muscle strength and mass in older women: a randomized-controlled trial. *Scand J Med Sci Sports* 2010 ;20(2):200-7
21. Bogaerts AC, Delecluse C, Claessens AL, Troosters T, Boonen S, Verschueren SM. Effects of whole body vibration training on cardiorespiratory fitness and muscle strength in older individuals (a 1-year randomised controlled trial). *Age and Ageing* 2009;38(4):448-54.
22. Chen LK, Woo J, Assantachai P, Auyeung TW, Chou MY, Iijima K, Jang HC, Kang L, Kim M, Kim S, Kojima T. Asian Working Group for Sarcopenia: 2019 consensus update on sarcopenia diagnosis and treatment. *J Am Med Dir Assoc* 2020;21(3):300-7.
23. Yu DH, Yang HX. The effect of Tai Chi intervention on balance in older males. *J Sport Health Science* 2012;1(1):57-60.