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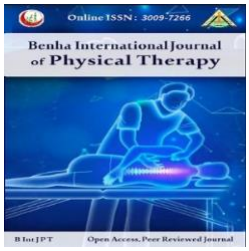

Original research

Effect of Whole-Body Vibration on Quality of Life in Diabetic Postmenopausal Women

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Abstract

Background: Menopause is characterized by reduced androgens produced by ovaries, which negatively affect women's health, including metabolism and quality of life (QoL) and sexual function. **Purpose:** This investigation aimed to examine the impact of whole-body vibration on the quality of life of postmenopausal diabetic women. **Methods**: The investigation involved forty postmenopausal women (ranging in age from fifty to sixty-five) who had diabetic neuropathy. They were separated into 2 equal groups randomly: Group A (study group): received whole body vibration (WBV) and balancing exercise. Group B (the control group) received the same balancing exercises as Group A. For twelve weeks, the treatment was administered 3 times per week. The Menopause-Specific Quality of Life Questionnaire (MENQOL questionnaire) assessed the quality of life before and after the treatment. **Results:** The MENQOL increased significantly within both groups (p = 0.001); however, the MENQOL of group B was significantly higher than that of group A **.Conclusion:** WBV has additive beneficial effects on balance but not on quality of life in diabetic postmenopausal women.

Keywords: whole-body vibration, quality of life, diabetic postmenopausal

Introduction

A metabolic disease with a high prevalence in both industrialized and developing countries, diabetes persists at a global level. Nearly 463 million persons aged 20–79 were diagnosed with diabetes worldwide in 2019, and diabetes has caused 4.2 million fatalities. In addition, it is estimated that one in five adults with diabetes is over the age of sixty-five [1]**.** Diabetes mellitus (DM) is defined by hyperglycemia resulting from insufficient insulin production and/or activity, and it is classified as one of various metabolic disorders [2].

Sarcopenia and changes in metabolic rate are symptoms of a general decline in multi-organ performance that occurs with age [3]. The ability to store, defend, and adapt is diminished when these changes impact homeostatic systems and organic response, which can happen under physical and mental stress [4]. Damage to macromolecules' structure and function due to oxidative stress makes them vulnerable to the onset of pathogenic processes, which is caused by an imbalance between free radical levels and antioxidant potential (a result of vitamin and antioxidant deficiencies) [5]. DM is one of these processes that stands out due to its high mortality and morbidity

rates, its link to the rise of polypharmacy, and the dangers of interactions that are particularly prevalent among the elderly [6].

The impact of diabetes extends beyond metabolic complications; it significantly affects patients' quality of life (QoL), particularly in postmenopausal women. This demographic is more vulnerable to the adverse effects of diabetes due to hormonal changes that exacerbate metabolic dysregulation and increase the risk of cardiovascular diseases, osteoporosis, and functional decline [7]. The World Health Organization (WHO) defines quality of life as "the extent to which an individual's experience meets or exceeds their expectations concerning the aforementioned dimensions of well-being" [8]. In diabetic patients, factors such as chronic pain, reduced mobility, and psychological distress contribute to lower health-related quality of life (HRQoL)[9].

Reduced estrogen levels, which occur naturally with aging, lead to a gradual loss of muscular mass, strength, and bone density, a process known as menopause [10]. WBV training is considered a safe, effective, as well as low-cost exercise that can be well-tolerated by previously sedentary patients [11].

WBV training has emerged as a potential non-pharmacological intervention for improving physical function and QoL in various populations, including those with metabolic disorders. WBV involves the transmission of mechanical oscillations through the body, leading to neuromuscular activation and physiological adaptations that may benefit musculoskeletal health, balance, and circulation [12]. Previous studies have demonstrated that WBV training can improve glycemic control, reduce neuropathic pain, and enhance physical performance in diabetic patients [13].However, limited research has specifically examined its effects on postmenopausal women with diabetes, highlighting a gap in the literature that warrants further investigation.

This research aims to assess the impact of WBV training on the QoL of diabetic postmenopausal women. By evaluating physical function, metabolic parameters, and psychological well-being, this research seeks to provide insights into the potential role of WBV as a complementary therapy in diabetes management. Understanding the effectiveness of WBV in this population could contribute to developing more comprehensive, patient-centered approaches to diabetes care, ultimately improving health outcomes and overall well-being[14].

The most common complication of diabetes is the emergence of diabetic peripheral neuropathy (DPN), which affects the somatic sensory (including nociceptors) and motor nerves and autonomic nerves due to chronic hyperglycaemia[15]. Diabetic peripheral neuropathy (DPN) is the presence of symptoms and/or signs of peripheral nerve dysfunction in people with diabetes after the exclusion of other causes [16]. Damage to the sensory and motor nerves can severely impair myofiber innervation and perfusion, causing muscle atrophy and balance impairments, which is of even greater concern for older adults already at an elevated risk of developing sarcopenia and falling[17]. Muscle deterioration within the leg and foot can lead to muscle dysfunction, reduced mobility, and increased risk of disability, ulceration, and amputation[1]. In most cases, falls and related injuries impair the quality of life and result in physical limitations, anxiety, loss of confidence, and fear of falling[18]. Management of DPN focuses mainly on symptom management through pharmacological interventions because there are no effective therapeutics that target the underlying neuropathies[19]. Physical fitness, balance, and neuromuscular exercises are important to improve mobility and balance and prevent falling during daily activities[1,18,20]. Physical fitness is further expanded to include the six skill-related components (i.e., agility, balance, coordination, power, reaction time, and speed) typically associated with the population being discussed having compromised physical abilities and many of the skill-related components[21]**.** These programs challenge the sensory, cognitive, and musculoskeletal systems while addressing balance constraints such as orientation in space, changes in direction, and the speed or height of the center of mass during static and dynamic situations resembling ADL[22].

Growing evidence demonstrates the efficacy of resistance exercise to promote overall metabolic health in individuals with T2D through improvements in glycosylated haemoglobin (HbA1c) and insulin sensitivity, particularly in the early stages of T2D among those with a lower body mass index[23]. Whole-body vibration training (WBVT) has been studied as an intervention for

DPN pain management. WBVT most commonly involves individuals exercising on a vibrating platform and has been proposed as an alternative to traditional strength training. The vibrations created from the platform mechanically generate rapid changes in the muscle-tendon complex length, which, in turn, stimulates repetitive, reflexive contractions of the muscle, subsequently leading to increased muscular fitness[24]. WBVT has been shown to have favourable effects on muscle function, flexibility, oxygen uptake, body composition, and blood pressure[25].

WBV has its positive effects on bone mineral density and blood circulation in the ionthe in lower extremities. Concerning the effects on muscle performance, WBV was reported to improve vertical jumping, muscular contractile ability properties, and muscle strength[26]. It is, therefore, believed that the positive effects of WBV on muscular performance should help to enhance the balancing ability[27].

Methods

Study Design

The research is designed as a prospective randomized controlled trial

Study Participants

Forty diabetic postmenopausal women were examined by a gynaecologist before participating in this study. Patients were selected in the study if they suffered from peripheral neuropathy as a result of diabetes, their ages varied from 50 to 65 years, their body Mass Indices (BMI) were ≤ 30kg/m2, and they were medically stable. Exclusion criteria for participation in the investigation involved the following conditions: inner ear disturbance, musculoskeletal issues, active tuberculosis or malignancies, implanted cardiac rhythm devices, hypo- or hyperparathyroidism, renal disease, liver disease, or chronic illness.

Randomization

A computer-based randomization procedure was utilized to divide all patients into two equal groups, A and B. After randomization, no one dropped out of the study.

Interventions

Group (A): involved 20 postmenopausal women with diabetic neuropathy who received WBV and balancing exercise (3 times per week for 12 weeks).

Group (B): involved 20 postmenopausal women with diabetic neuropathy who received the same balancing exercises as group A (3 times per week for 12 weeks).

Outcome measures:

Quality of life assessment:

The MENQOL questionnaire was utilized to evaluate the QOL of each woman in both the A and B therapy groups both before and after the program. Questions 1–3 cover vasomotor symptoms, questions 4–10 cover psychosocial symptoms, questions 11–26 cover physical symptoms, and questions 27–29 cover sexual symptoms. The questionnaire is divided into four parts. On the scale from 0 (no symptoms at all) to 6 (very severe symptoms), the questionnaire can be scored in a variety of ways[28].

Although the majority of researchers have suggested studying the reliability and validity of the Menopause Specific Quality of Life Questionnaire (MENQOL) in diverse cultural contexts, it remains a valid and useful tool for evaluating menopausal symptoms in women [29].

Treatment procedures:

Each woman who took part in the trial completed an informed consent form after receiving a thorough explanation of the assessment and treatment processes.

WBV: All women in group (A) received WBV and balance board training three times per week for three months.

Parameters:

During the WBV, the patient was subjected to WBV, a teeterboard-like device that alternates between vertical and horizontal vibrations at a frequency of 5 to 30 Hz and an amplitude of 0 to 5.3 mm (medial to distal). By varying the foot position from 1 to 3, the amplitude could be regulated. A bigger position resulted in a greater amplitude. Before the process, the research assistant went over the Galileo 900's operation and any potential safety concerns.

Patient's position:

The patient was instructed to stand on the WBV device while holding a hand support for the elderly woman. The vibrating platform was in a 100 to 110° squat position, and the oscillating platform was operated at 20Hz in the second foot position with nude feet for 15 minutes each day, three days a week, for three months. All subjects' peculiar or uncomfortable complaints during the WBV treatment were recorded [30].

Balance training exercises treatment:

All women in both groups (A & B) received balance training exercises on a balance ball, half ball, and balance board exercises three times per week for 3 months.

Statistical analysis:

Data analysis was carried out utilizing the Windows version of the Statistical Package for the Social Sciences (SPSS) 25. We used a significance level of 0.05. When comparing group-to-group subject characteristics, an unpaired t-test was used. Researchers used mixed-effects MANOVA to examine MENQOL before and after therapy, within and across groups, and as a function of both time and treatment.

Results

Baseline characteristics:

Both groups were homogenous before the treatment as there were no significant variations in demographic and clinical variables (age, weight, height, BMI, and HbA1c) among groups at baseline, as shown in Table (1).

Table 1. Comparison of age, weight, height, BMI, and HbA1c among groups A and B:

	Group A study group	**Group B control group**	**MD**	**t- value**	**p-value**	**Sig**
	± SD $\overline{X}$	**± SD** $\overline{X}$				
Age (years)	59.50 ± 4.41	58.45 ± 4.26	1.05	0.77	0.45	**NS**
Weight (kg)	90.50 ± 6.44	88.60 ± 3.32	1.9	1.17	0.25	**NS**
Height (cm)	161.05 ± 5.92	159.60 ± 3.90	1.45	0.91	0.37	**NS**
BMI (kg/m²)	34.86 ± 0.69	34.80 ± 1.26	0.06	0.18	0.86	**NS**
HbA1c (%)	8.92 ± 1.20	8.97 ± 1.37	-0.05	-0.12	0.90	**NS**

Effect of treatment on MENQOL:

The overall effect of mixed MANOVA was significant for the interaction effect of treatment and time (p = 0.001).

Within-group comparisons:

Group A: There was a significant increase in QoL in group A post-treatment contrasted with pretreatment (MD=-12.6, p = 0.001). (Table 2).

Group B: There was a significant increase in QoL in group B post-treatment contrasted with pretreatment (MD=-6.3, p = 0.001). (Table 2).

Comparison between groups:

Group A (the study group) had a significantly higher quality of life after therapy, although there was no variance between the groups before treatment. (Table 2).

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Table 2. Mean MENQOL pre and post-treatment of groups A and B.

MENQOL	Pre ±SD $\overline{X}$	Post ±SD $\overline{X}$	MD	% of change	p-value	Sig
Group A study group	70.30 ± 3.48	83.20 ± 4.29	-12.9	18.35	0.001	**S**
Group B control group	69.60 ± 4.56	75.90 ± 5.40	-6.3	9.05	0.001	**S**
MD	0.7	7.3				
p-value	0.59	0.001				
Sig	**NS**	**S**				

Discussion:

This research aimed to investigate the impact of WBV on the well-being of diabetic women who were undergoing menopause. The results showed that both groups (A and B) had significantly higher MENQOL levels after therapy in contrast to before treatment. However, when comparing the two groups after treatment, group A (the study group) had a significantly higher score (p= 0.001).

In a systematic analysis investigating the effects of WBV on strength and quality of life in healthy aged individuals, Pessoa et al.[31]found that WBV had mixed findings, which are partially supported by this study. Strength, power, vertical jump, timed get-up-and-go, and quality of life have all been proven to improve significantly in certain studies. In particular, they found that WBV improved functional ability and overall quality of life for the elderly by strengthening their muscles. Nevertheless, WBV only improved physical functioning when it came to quality of life.

Furthermore, the findings corroborate those of De Aguiar et al.[32], who performed a comprehensive evaluation of the impact of WBVE on the functional capacity of postmenopausal women. After menopause, WBVE improves functional status in postmenopausal women, according to their review. To alleviate sarcopenia-related symptoms after menopause, WBVE has been suggested as a non-pharmacological treatment alternative. It boosts postmenopausal women's functional capacity, balance, and muscle strength, and it's safe, practical, and effective, therefore, it's recommended as an intervention for age-related functional decline[33].

The impact of WBV training on HRQoL in geriatric women was studied.We randomly assigned 37 women, with an average age of 82.4 ± 5.7 years, to either the WBV group or the control group after recruiting them. There were no statistically significant improvements in HRQoL or other health-related outcomes (such as fall risk, life satisfaction, or cognitive status) in the WBV group following eight months of training. These results are consistent with the current study's conclusion that WBV had no greater effect on HRQoL than the control intervention[14].

Both groups' MENQOL scores improved considerably following the intervention, while the WBV group's improvement was substantially greater than the control group's. These findings corroborate those of earlier research that looked at how WBV affected postmenopausal women's functional mobility as well as balance[34]. Nevertheless, while balance and muscle function

showed significant gains, psychological and social domains of QoL did not exhibit substantial changes, reinforcing the need for holistic approaches that address both physical and mental well-being in diabetic postmenopausal patients.

The findings are in agreement with Santin-Medeiros et al.[32], who reported that WBV training improved functional outcomes but did not lead to a significant change in HRQoL. Methodological differences among studies could explain the variation in results. Factors such as training duration, intensity, and patient adherence play crucial roles in determining outcomes. Additionally, the presence of diabetic complications, particularly peripheral neuropathy, may have influenced the degree of QoL improvement[33].

The efficacy of WBV training over the long term, both alone and in conjunction with other therapeutic modalities, in improving QoL outcomes should be the focus of future studies. Further investigation on the possible advantages of WBV as an adjunctive treatment for diabetes may be possible with larger samples and lengthier intervention durations.

Conclusion:

The results of this research suggest that postmenopausal diabetic women can experience an improvement in their quality of life through WBV training.

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