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Research Paper Review

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Whole-body vibration training improves balance, muscle strength and glycosylated hemoglobin in elderly patients with diabetic neuropathy

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ABSTRACT

Elderly patients with diabetes and peripheral neuropathy are more likely to experience falls. However, the information available on how such falls can be prevented is scarce. We investigated the effects of whole-body vibration (WBV) combined with a balance exercise program on balance, muscle strength, and glycosylated hemoglobin (HbA1c) in elderly patients with diabetic peripheral neuropathy. Fifty-five elderly patients with diabetic neuropathy were randomly assigned to WBV with balance exercise group, balance exercise (BE) group, and control group. The WBV and BE groups performed the balance exercise program for 60 min per day, 2 times per week, for 6 weeks. Further, the WBV group performed WBV training (up to 3 × 3 min, 3 times per week, for 6 weeks). The control group did not participate in any training. The main outcome measures were assessed at baseline and after 6 weeks of training; namely, we assessed the postural sway and one leg stance (OLS) for static balance; Berg balance scale (BBS), timed up-and-go (TUG) test, and functional reach test (FRT) for dynamic balance; five-times-sit-to-stand (FTSTS) test for muscle strength; and HbA1c for predicting the progression of diabetes. Significant improvements were noted in the static balance, dynamic balance, muscle strength, and HbA1c in the WBV group, compared to the BE and control groups ($P < 0.05$). Thus, in combination with the balance exercise program, the short-term WBV therapy is beneficial in improving balance, muscle strength and HbA1c, in elderly patients with diabetic neuropathy who are at high risk for suffering falls.

ANALYSIS

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Background Information
Each year, one-third of individuals aged 65 and over experience a fall, 10-15% of which result in serious injury (1). These incidents necessitate a period of recovery that involves prolonged immobilization, while the fall itself exerts a significant psychological impact, often resulting in a subsequent fear of falling. As a result, patients' mobility and ability to perform their normal activities of daily living (ADLs) can be severely compromised.

Patients with chronic disease are more prone to serious damage and complications after a fall, a fact which is prevalent in elderly diabetic patients, as they are more likely to suffer from peripheral

neuropathies as a consequence of their illness. The increased postural deficits suffered by this group of patients decrease their ability to physically react to sudden or rapid postural changes, which may increase in fall risk (2). As such, exercises that improve posture and balance are theoretically beneficial for this group.

Whole-body vibration (WBV) training has been utilized for many rehabilitation purposes, including improving balance and muscle strength. It has shown potential as a modality to increase lower limb strength, bone density and functional mobility, in addition to limiting falls (3). It has not, to date, been evaluated in diabetic patients. Therefore, the purpose of this study was to determine the effects of WBV training on balance and strength in elderly patients suffering from diabetic neuropathy who are at high risk of falls.

PERTINENT RESULTS

- A total of 55 diabetic patients were included in the study and randomly assigned to one of three groups: WBV training plus balance exercises (n=19), balance exercises (BE) alone (n=18) or control (n=18).
- One subject from the WBV group withdrew due to an insufficient participation rate; 2 subjects in the BE group were excluded because of incident fractures; and 2 in the control group were excluded because of home relocation.
- HbA1c levels, used as a predictor of diabetes progression, showed significant improvement in the WBV group but not in the BE or control groups ($p < 0.05$). HbA1c was decreased by 0.8% in the WBV group whereas the comparator groups' HbA1c levels actually increased by 0.2%. *(EDITOR'S NOTE: this decrease is considered to be clinically meaningful as well, especially after such a short intervention period. Although more research is required, continuation of such a program may offer additional reductions in HbA1c levels.)*
- Postural sway, balance and functional abilities all showed significant improvement in the WBV group as compared with the BE or control groups ($p < 0.05$).
- Muscle strength improved in the WBV group as compared to the BE and control groups ($p = 0.001$).

CLINICAL APPLICATION & CONCLUSIONS

WBV, in combination with balance exercises, improved HbA1c levels, balance and muscle strength in a group of elderly patients suffering from diabetic peripheral neuropathy. Clinically meaningful improvements were noted in postural sway, a strong predictor of fall risk (a very important determinant of health in an aging population). Improvements were also noted in static balance, with WBV associated with significant increases in one-leg stand time and Timed-Up and Go Test times (TUG, a test of functional ability). WBV was also associated with an increase in lower-limb muscle strength, which itself is closely correlated with fall risk (4).

These findings must be mitigated by the fact that long-term exposure to WBV has been shown to have potentially dangerous side effects, including low back pain and muscle fatigue. It has also been shown to affect the digestive system, the female reproductive organs and the peripheral veins (5, 6). As such, it is important to consider safety protocols when developing exercise programs for elderly patients. Overall, WBV may be valuable for some patients but contraindicated in others, requiring a logical, individualized approach to prescription of this intervention. As more research emerges, we may obtain a clearer picture of which patients benefit most from this type of intervention.

STUDY METHODS

Patient Demographics
95 patients were recruited for inclusion, of which 60 met the inclusion criteria.

Inclusion Criteria
- At least 65 years of age
- At least one of the following: 2 or more falls during the previous 12 months, one fall plus a TUG test result of > 15 seconds, or recurrent unexplained falls

Exclusion Criteria
- Any musculoskeletal, neurological or vision impairment
- Vestibular diseases with a diabetes-related etiology
- Dementia

WBV Training
Subjects stood upright on a platform and were vibrated in a 110 degree squatting position at an initial frequency of 15 Hz (amplitude 2 mm), increasing to 30 Hz over a 6-week period. WBV training sessions consisted of 3, 3-minute sessions with 1-minute intervals. Training sessions occurred approximately 3 times each week.

Balance Exercise
Balance exercise consisted of a 10 minute warm-up period followed by a 40 minute session of static training, comprised of heel-toe raises with head movement and dynamic exercises involving walking, step-ups and bipedal jumps. A 10 minute warm-down ended each exercise session.

HbA1c Testing
To evaluate diabetes progression, HbA1c – a form of hemoglobin that identifies the average plasma glucose concentration over prolonged periods of time – was evaluated by measuring the value of total HbA1c, measured using low-pressure cation exchange chromatography.

Posture & Balance
Posture and balance were measured via a combination of tests, including: postural sway using a force platform; one leg stance; Berg balance scale; functional reach test; timed-up and go test and the five-times-sit-to-stand test.

STUDY STRENGTHS/WEAKNESSES

Limitations
- The sample size was quite small, limiting our ability to extrapolate these results. We still need more research on this!
- The study was not double-blinded. Although the assessments were conducted by an assessor blinded to the treatment groups, due to the nature of the interventions, participant blinding was not possible.
- No long-term follow-up data was available after the initial intervention period.

Strengths
- The authors utilized an appropriate WBV protocol and included an exercise program known to improve balance.
- The use of 2 intervention groups and a control group allowed for comparison of WBV and balance exercises against inactive controls.
- The use of several clinical tests of balance and functional ability improved the robustness of the findings and mimicked typical practice patterns.

Additional References:

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