Controlled Whole Body Vibration to Decrease Fall Risk and Improve Health-Related Quality of Life of Nursing Home Residents

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Objectives To investigate the effects of whole body vibration in the elderly.

Design Randomized controlled trial.

Setting Nursing home.

Participants Forty-two elderly volunteers.

Interventions Six-week vibration intervention plus physical therapy (PT) (n=22) or PT alone (n=20).

Main Outcome Measures We assessed gait and body balance using the Tübingen test (maximum scores of 12 for gait, 16 for body balance). 28 for global score), motor capacity using the Timed Up & Go (TUG) test, and health-related quality of life (HRQOL) using the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36).

Results After 6 weeks, the vibration intervention group improved by a mean ±standard deviation of 2.4±2.3 points on the gait score compared with no change in the control group (P<.001). The intervention group improved by 3.5±1.1 points on the body balance score compared with a decrease of 0.5±1.2 points in the control group (P<.001). TUG test time decreased by 11.0±8.8 seconds in the treated group compared with an increase of 2.5±8.8 seconds in the control group (P=.001). The intervention group had significantly greater improvements from baseline on 8 of 9 items on the SF-36 compared with the control group.

Conclusions Controlled whole body vibration can improve elements of gait risk and HRQOL in elderly patients.

Key Words Accidental falls; Elderly; Quality of life; Rehabilitation; Vibration.


IN COMMUNITY-DWELLING elderly people, falls and fall-related injuries appear to be independent determinants of functional decline. At least 30% of people over the age of 60 years feel each year and this proportion increases to 40% after age 75. 1,2 Resulting functional limitations significantly predict costs related to physician visits, hospitalizations, mortality, and nursing home admissions. 3,4 Falls, and even the fear of falling, could also affect health-related quality of life. 5,6 Because muscle weakness and impaired balance are associated with an increased risk of falls in the elderly, 7,8 an intervention to prevent these conditions could potentially reduce the frequency of falls. 9,10 Controlled whole body vibration is a type of physical therapy (PT) thought to activate muscles via reflexes. Clinical studies suggest that controlled mechanical whole body vibration may improve muscular performance 11,12 and body balance 8 in young, healthy adults. In a 4-month randomized trial of young, healthy, nonobese adults, 13-14 minute whole body vibration treatments transiently improved lower-extremity muscle performance and body balance. 15 In a randomized controlled trial (RCT), a 10-day whole body vibration regimen (28Hz, amplitude: 10mm; sustained in 2-min. intervals) significantly enhanced the explosive power of the lower extremities thought of jump, mechanical power of jump in physically active subjects. 16 To our knowledge, only 1 study has examined the effects of controlled whole body vibration in elderly people. That study evaluated a 2-month vibration regimen (7Hz, amplitude: 7-14mm; 3-72min; 3 times/wk) for geriatric patients; an 8% decrease in time to rise from a chair was observed in the vibration group compared with no change in the controls. 17 The study did not evaluate the effects of the vibration regimen on specific risk factors for falls. We performed a prospective RCT to determine whether controlled whole body vibration and PT are more effective than PT alone in elderly nursing home residents. Our primary goal was to assess the effect of regimens on muscular performance and body balance, which are known risk factors for falls in elderly people. Our secondary goal was to investigate the effects of controlling whole body vibration exercises on HRQOL.

METHODS

Participants Forty-two volunteer nursing home residents aged 63 or 98 years (mean ±SD, 81.9±6.9) were recruited from a nursing home in Liege, Belgium. Residents were eligible for the study if they were ambulatory and had no major cognitive disorders that would affect their ability to complete a questionnaire. Patients with a high risk of rheumatoid arthritis or a history of hip or knee joint replacement were excluded. The patients were randomized to one of the intervention groups that received a standard PT regimen or PT alone (Fig 1).

Arch Phys Med Rehabil Vol 86, February 2006
Table 1: Baseline Characteristics of Nursing Home Residents Randomized to Whole Body Vibration Plus PT Versus PT Only

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Physical function</th>
<th>Social function</th>
<th>Role-physical</th>
<th>Role-emotional</th>
<th>Mental health</th>
<th>Vitality</th>
<th>Pain</th>
<th>General health</th>
<th>Health change</th>
<th>Timed test score</th>
<th>Balance (14)</th>
<th>Gait (16)</th>
<th>Total (28)</th>
<th>TUG test time (s)</th>
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</thead>
<tbody>
<tr>
<td>84.0±5.9</td>
<td>27.5±11.8</td>
<td>63.2±18.6</td>
<td>53.8±33.7</td>
<td>48.0±34.6</td>
<td>47.8±15.2</td>
<td>39.2±16.2</td>
<td>56.3±7.6</td>
<td>54.0±11.8</td>
<td>46.3±23.2</td>
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<td>73.5±6.9</td>
<td>30.8±30.8</td>
<td>66.5±22.1</td>
<td>53.9±34.6</td>
<td>50.9±42.1</td>
<td>47.4±24.1</td>
<td>40.0±26.4</td>
<td>50.1±31.6</td>
<td>56.3±25.7</td>
<td>38.5±17.3</td>
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<tr>
<td>63.4±8.4</td>
<td>21.3±16.0</td>
<td>68.5±22.0</td>
<td>60.2±31.0</td>
<td>56.6±20.8</td>
<td>48.3±16.7</td>
<td>32.1±16.2</td>
<td>58.9±19.2</td>
<td>54.2±8.8</td>
<td>43.8±15.5</td>
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<tr>
<td>78.9±6.9</td>
<td>31.8±30.8</td>
<td>66.5±22.0</td>
<td>53.9±34.6</td>
<td>50.5±22.1</td>
<td>47.4±24.1</td>
<td>40.0±26.4</td>
<td>50.1±31.6</td>
<td>56.3±25.7</td>
<td>38.5±17.3</td>
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</table>

**NOTE**: Values are mean ± SD.

Arch Phys Med Rehabil Vol 86, February 2005
Table 2: Change in SF-36 Scores after 5 Weeks in the Whole Body Vibration Group and Control Group (ITT analysis)

<table>
<thead>
<tr>
<th>SF-36 Scores</th>
<th>Whole Body Vibration Group</th>
<th>Control Group</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>I=20</td>
<td>C=20</td>
<td></td>
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<tr>
<td>Physical function</td>
<td>18.5±13.9</td>
<td>24.4±11.0</td>
<td>&lt;0.001</td>
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<tr>
<td>Social function</td>
<td>19.2±17.6</td>
<td>23.4±17.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Role-physical</td>
<td>36.3±32.0</td>
<td>52.7±29.6</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Role-emotional</td>
<td>31.7±38.1</td>
<td>1.7±34.2</td>
<td>0.2</td>
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<tr>
<td>Mental health</td>
<td>13.1±17.1</td>
<td>2.5±17.3</td>
<td>0.93</td>
</tr>
<tr>
<td>Vitality</td>
<td>5.0±15.7</td>
<td>-0.8±12.5</td>
<td>0.003</td>
</tr>
<tr>
<td>Pain</td>
<td>11.2±22.5</td>
<td>-3.6±9.9</td>
<td>0.001</td>
</tr>
<tr>
<td>General health</td>
<td>11.3±14.9</td>
<td>-8.7±16.8</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Health change</td>
<td>7.5±20.7</td>
<td>0.0±11.6</td>
<td>0.8</td>
</tr>
</tbody>
</table>

NOTE: Values are mean ± SD.

**Statistical Analysis**

Quantitative variables were expressed as mean ± standard deviation (SD), and qualitative variables were reported as absolute or relative frequencies. Differences in baseline characteristics between the 2 groups were assessed using the Mann-Whitney U test or Pearson chi-square test when appropriate. Changes in scores for balance, grip, motor capacity, or HRQOL after 5 weeks of treatment were assessed using the Mann-Whitney U test. Both intention-to-treat (ITT) and per-protocol analyses were performed. For the ITT analysis, patients who dropped out of the study were included in the analysis at 6 weeks. If they refused, we used their last available data for the analysis. All analyses were performed with the Stata 16.0 software. Results were considered statistically significant when p values were less than 0.05.

**RESULTS**

Of the 42 study participants, 32 patients were randomized to the vibration group and 20 to the control group. Baseline characteristics of the 2 groups are summarized in Table 1. In the ITT analysis, the treatment group was older than the control group (mean, 84.5y vs 78.5y, P<0.01) and had a higher mean baseline TUG test score (50.17±17.3, P<0.01), but all other baseline measures were equal in the 2 groups. In the treatment group, 16 (72.7%) completed the final analysis at 6 weeks, but 20 were included in the ITT analysis. In the control group, all the patients completed the 6-week analysis.

After 6 weeks of treatment (18 sessions), with an ITT analysis, the vibration intervention group showed significantly greater improvement compared with controls on 8 of 9 items from the SF-36 (Table 2). Improvement in the grip quality as assessed by the Timmert test was also observed in the treatment group (score increase, 2.4±2.3) compared with no change in the control group (P<0.001). Body balance score improved by 3.5±2.1 points in the vibration group compared with a 0.3±1.2-point decline in the control group (P<0.01). The global score of the Timmert test increased by 5.0±3.7 points in the treatment group compared with a decrease of 0.3±1.3 points in the control group (P<0.001) (Fig 2). After 6 weeks, the treatment group showed a decrease of 11.0±8.6 seconds in their time to perform the TUG test, compared with an increase of 2.6±8.8 seconds in the control group (P<0.001) (Fig 3).

There were 5 adverse effects observed in 4 patients (4.5%) in the treatment group who were classified as minor adverse events (AEs). There were no serious adverse events (SAEs) or withdrawals due to AEs. No serious adverse events occurred in the control group.

**DISCUSSION**

Our study is the first to suggest that a controlled whole body vibration intervention can improve gait, body balance, motor capacity, and self-rated HRQOL in elderly nursing home residents. Controlled whole body vibration improved the participants' muscle strength and balance, which are known risk factors for falls.3,4 At baseline, the intervention group had a mean Timmert global score of 14.928, which was below the threshold (19.58) previously associated with an increased risk of falls.2 After 18 sessions of whole body vibration, this group slightly surpassed the threshold (mean score increased to 20.5±28). The vast majority of falls are multifactorial, with predisposing lower extremity and musculoskeletal factors and environmental precipitants.6 Our intervention addresses all these risk factors and improves the balance and motor capacity of patients in the treatment group.
The benefits of controlled vibration could be explained in part by the effects on muscular performance. Most trials of controlled whole body vibration and muscular performance have been conducted in young adults. In 1999, Bosch et al. showed that a single vibration training (20Hz; amplitude, 10mm; for 10min in 50-60 intervals) resulted in a significant, though temporary, increase in muscle strength in the lower extremities of female volleyball players. Similar increases in maximal and explosive, arm and leg strength have been shown in men, post-12 studies; however, not all studies. Long-term effects of vibration-loading on muscles have also been shown, increases in jump height and isometric extension strength of lower extremities have been reported in some
tipus. In the elderly population, an 18% increase in the time to rise from a chair was observed in the vibration group compared with stable values in the control group. Although we did not directly assess muscular performance in the present study, we used the TUG test, which could be considered a surrogate assessment of muscle function. Our results showed significant reduction in the time to perform the TUG test. An increase in body balance could also explain the improvement in this test result. Torstveit et al. previously reported a 15% improvement in body balance, assessed by a stability platform, after a single 4-minute vibration in young, healthy subjects.

Our study also showed that an intervention using a controlled whole body vibration could substantially improve self-rated global health in elderly patients. The SF-36 has emerged since the early 1990s as a widely accepted, valid, and reliable tool to assess HRQoL. Nearly all items in this instrument improved with the vibration intervention, nearly the physical function measure correlated well with the TUG test. Only the total change item in the SF-36 did not show a change from baseline in the treatment group. This is understandable because this question compares current health with health status 1 year before.

After randomization and before intervention, age and the TUG test differed between the 2 groups. Patients with greater age have been expected to experience a more rapid decrease in their QoL. Despite their older age, members of the treatment group showed substantially greater improvements compared with controls. Controlled whole body vibration appeared to be safe and was well tolerated by the elderly study participants.

CONCLUSIONS

Short training sessions using controlled whole body vibration 3 times a week for 6 weeks improved gait, body balance, motor capacity, and self-reported QoL in elderly nursing home residents. Larger studies with longer follow-up are needed to assess the lasting impact of these benefits.

References


Suppliers:

a. Galileo 900; Orthometrix Inc, 506 Corporate Park Dr, Ste 102, White Plains, NY 10604.

b. Starflex Inc, 300 E 14th St, Tulsa, OK 74104.