

Acute Effects of Whole-Body Vibration on Lower Body Flexibility and Strength

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Abstract

Whole-body vibration (WBV) is a neuromuscular training method designed to improve muscle strength and mobility that has become an increasing popular mode of alternative training in European athletes. **Purpose:** The purpose of this study was to examine the acute effects of WBV training on flexibility, heart rate, and peak isokinetic torque. **Methods:** Twenty healthy adults (12 males, 8 females), untrained to WBV, participated in this study. All participants stood upright on a vibration platform for a total of 6 minutes. Vibration frequency was gradually increased during the first minute to a frequency of 26 Hz, which was maintained for the remaining five minutes. Immediately prior to and following the 6 min of WBV, the subjects participated in assessments of heart rate, low back and hip-joint flexibility and isokinetic torque. Heart rate was measured using a portable heart rate monitor. Low back and hip-joint flexibility was determined using a sit-and-reach box test. Peak isokinetic torque of knee extension and flexion were measured by means of a motor driven dynamometer with velocity fixed at 120 degrees/sec. Pre- and post comparisons were made using Students paired t-tests. **Results:** Analyses revealed significant increases in flexibility (31.9 ± 7.9 vs. 27.3 ± 8.5 cm, $p < 0.05$) and in heart rate response (93.8 ± 11.8 vs. 78.8 ± 11.0 bpm, $p < 0.05$) following WBV. Peak torque of knee extension increased significantly (167.7 ± 39.7 vs. 158.9 ± 34.0 Nm, $p < 0.05$) as did peak torque of knee flexion (92.1 ± 27.2 vs. 85.4 ± 23.9 Nm, $p < 0.05$). The average torque of knee extension and knee flexion significantly increased (56.5 ± 11.4 vs. 52.8 ± 11.7 Nm and 39.5 ± 11.6 vs. 35.4 ± 9.5 Nm, respectively, $p < 0.05$). **Conclusion:** The findings of this preliminary study suggests WBV training may elicit acute improvements in flexibility, heart rate and peak isokinetic torque.

Methods

Twenty healthy persons (12 males, 8 females) (age 28.8 ± 8.9 yr; body mass 76.9 ± 20.2 kg; height 174.6 ± 9.6 cm) volunteered to participate in this study. Each participant stood upright on the vibration platform Galileo™ 2000, White Plains, NY, for a total of six minutes. The subjects stood on this platform with each foot 16cm on either side of the rotation axis. Vibration frequency was gradually increased during the first minute from 0 to 26 Hz and maintained at that frequency for the remaining five minutes. The WBV training was performed with the subjects standing with their whole foot on the vibration platform with minimal bend in the knees. All subjects wore rubber soled athletic shoes during the WBV training.

Immediately prior to, and following, the six minutes of WBV training, the subjects participated in heart rate assessment, a Sit-and-Reach Box test and isokinetic evaluations of knee extension and flexion. Heart rate was continuously monitored using a Polar 610i™ Heart Rate Monitor (Polar Electro Oy, Finland). The Sit-and-Reach Box test, an indication of low back and hip-joint flexibility, was performed as recommended by the ACSM's Guidelines For Exercise Testing and Prescription, 6th Ed.(9). Isokinetic torque was measured by means of a motor driven isokinetic dynamometer Biodex System 2, (Shirley, NY.), with velocity fixed at 120 degrees/second. Subjects performed one set of five concentric flexion/extension movements. Peak and average torque were determined in the repetition having the greatest peak torque. The knee extension movement was initiated at a joint angle of 90 degrees and terminated at 160 degrees.

Pre- and post-test values were compared statistically using ANOVAs for repeated measures. Significance level was set at $P < 0.05$.

Results

Results indicated that WBV training produced significant increases in heart rate response, flexibility, and peak and average torque ($p < 0.05$).

	PRE	POST
HR (beats · min ⁻¹)	78.7 ± 11.0	93.8 ± 11.8 *
FLEXIBILITY (cm)	27.3 ± 8.5	31.9 ± 7.9 *
PEAK TORQUE (Extension) (Nm)	158.9 ± 34.0	167.7 ± 39.7 *
PEAK TORQUE (Flexion) (Nm)	85.4 ± 23.9	92.1 ± 27.2 *
AVERAGE TORQUE (Extension) (Nm)	52.8 ± 11.7	56.5 ± 11.4 *
AVERAGE TORQUE (Flexion) (Nm)	35.4 ± 9.5	39.5 ± 11.6 *

* denotes values are statistically significant $P < 0.05$

Conclusion

The findings of this preliminary study suggest WBV training may elicit acute increases in heart rate response, low back and hip-joint flexibility and peak isokinetic torque. It is evident that more research on WBV is needed to explain the physiological and neurological mechanisms of muscle strength and/or power gain as well as increased flexibility. It is recommended that future research efforts examine how the acute effects to WBV compare with those to other modes of warm up and to various exercise training modalities.

References

- Bosco, C., et al. Adaptive responses of human skeletal muscle to vibration exposure. *Clin. Physiol.* 19 (1999) 2; 183-87.
- Bosco, C., et al. Hormonal responses to whole body vibration in man. *Eur. J. Appl. Physiol.* 81 (2000); 449-454.
- Bosco, C., et al. The influence of whole body vibration on jumping performance. *Biol. Sport* 15:157-164, 1998.
- Delecluse, C., Roelants, M. and Verschuren S. Strength increase after whole-body vibration compared with resistance training. *Med. Sci. Sports Exerc.* Vol.35, No. 6 pp.1033-1041, 2003.
- Rittweger, J., et al. Acute physiological effects of exhaustive whole-body vibration exercise in man. *Clin. Physiology* 20(2); 134-142.
- Torvinen, S. et al. Effect of vibration exposure on muscular performance and body balance. Randomized cross-over study. *Clin. Physiol. & Func Im* (2002) 22, 145-152.
- Rittweger, J. et al. Treatment of chronic lower back pain with lumbar extension and whole-body vibration exercise. *Spine* v27, n17, pp1829-34.
- Runge, M., Rohfeld, G. and Rensiek, E. Balance training and exercise in geriatric patients. *J Musculoskel Internet* 2000; 1:54-58.
- American College of Sports Medicine. *Guidelines for Exercise Testing and Training of the American College of Sports Medicine.* 6th Ed. Baltimore, MD: Williams & Wilkins, 2000, pp 85-88.

Introduction

Whole-body vibration (WBV) is a neuromuscular training method designed to increase muscular strength and mobility that has been a popular mode of alternative training in European athletes. WBV has also recently been examined in various research fields, including sports and exercise sciences (1-6), chronic pain management (7), and geriatrics (8). Preliminary research suggests WBV training increases muscular power and vertical jump in healthy adults (1-6). Additional research indicates WBV may alleviate chronic lower back pain (7) and increase balance and muscular power in geriatric patients (8).

Whole-body vibration is thought to elicit muscular activity via stretch reflexes (3,4). The Galileo™2000 (White Plains, NY.) was developed to mechanically stimulate muscles at specific frequencies, typically 25-30 Hz, causing the muscles to contract and relax by natural reflex, 25-30 times per second. The Galileo™2000 functions in a one-directional, oscillating pattern based on the concept of a center fulcrum and an alternating up/down motion.

Presently, the extent of clinical research into the acute effects of WBV is limited. Thus, the purpose of this investigation was to examine the acute response of WBV on lower body flexibility and muscular strength.

