Effects of Whole Body Vibration and Assisted Standing on Bone Mineral Density, Body Fat, and Lean Tissue Mass of an Individual with a Spinal Cord Injury

Ronald Davis, Charlotte Sanborn, David Nichols, Texas Woman's University,
Eric Dugan, Ball State University, Muncie, IN and David Bazett-Jones, University of Wisconsin-Milwaukee. rdavis4@twu.edu

INTRODUCTION

Persons with spinal cord injuries (SCI) are susceptible to osteoporosis and an increase risk of lower limb fractures. Concerns over bone mineral density (BMD) loss must be minimized for individuals with SCI in order to help address a higher quality of life. This study attempted to measure the changes in BMD using two interventions (standing, and total body vibration) for a person with a SCI.

LITERATURE REVIEW

It is well documented that persons with spinal cord injuries are susceptible to osteoporosis and an increase risk of lower limb fractures. Several intervention strategies have been identified to address the issue of bone mineral density loss in those with spinal cord injuries (i.e. functional electrical stimulation, cycle ergometry, calcium supplementation) to include assisted standing (Giangregorio & Blimkie, 2002; Poole, Warburton, and Reeve, 2005; Jones, Legge, and Goulding, 2002). However, results using assisted standing have been inconclusive in the promotion of bone mineral density for this population. Whole Body Vibration has been documented to positively affect bone density of the hip in postmenopausal women (Verschueren, et al. 2004) and has been suggested for use for persons with lower body impairments (Maimoun, et al., 2006).

To date there have been no studies examining the effects of vibration on bone mineral density of those with spinal cord injuries.

PURPOSE

Therefore the purpose of the study was to determine what effects of whole body vibration and assistive standing had on bone mineral density and other health-related variables (tissue mass, body fat) of an individual with a spinal cord injury

METHODS AND PROCEDURES

A female subject with an incomplete spinal cord injury at thoracic 10 participated in three 10 week intervention phases. Pre/post measures for each phase using dual-energy x-ray absorptiometry (DXA) for total body BMD were made.

Phase 1 was May to July, Phase 2 was September to December and Phase 3 was January to May. There was a 7 week intersession with no activity between each new intervention phase.

Whole body vibration was provided by a Power Plate vibration platform and an Easy Stander 5000 was used for assisted standing.

METHODS and PROCEDURES (CONT'D)

Phase 1 Standing only

Phase 2 Partial Standing

Phase 3 Combined Standing and WBV

RESULTS AND DISCUSSION

Legs	57	52.2	-4.8	-8.42%
Total body	47.7	44.7	-3.0	-6.00%
Lean Tissue Mass				
Legs (g)	6,860	10,895	4,035	58.82%
Total body (g)	28,760	30,393	1,633	5.68%

Phase 3 – Combined Standing & WBV

% fat				
Legs	52.9	53	+.1	.19%
Total body	44.7	42.2	-2.5	-5.5%
Lean Tissue Mass				
Legs (g)	7,604	11,125	3,521	31.65%
Total body (g)	29,838	30,790	952	3.19%

All three interventions positively impacted health-related components (body composition and lean muscle mass) which are supported by the literature.

A consistent pattern was identified for all three intervention phases (1, 2 and 3) related to positive changes in body composition and lean muscle mass. Both of these changes support the idea that muscle tissue is increasing and fat tissue is being reduced.

Delecluse, Roelants, and Verschuren (2003) suggest that the use of WBV to promote strength gains in a therapeutic context may be attractive to sub-populations such as elderly or those with disabilities. Whole body vibration generates a mechanical stimulus that is transmitted throughout the entire body and reaches sensory receptors (i.e. muscle spindles). When activated, the muscle spindles excite the alpha motoneurons to initiate muscle contraction (Garatachea et al., 2007).

Perhaps the most exciting finding resulted from the effects of the intervention of Phase 3 (standing combined with simultaneous WBV). This was the only Phase that recorded positive changes in BMD for a 10 week period. During this Phase the standing device was placed over the vibration platform allowing the participant's feet to rest directly on the surface of the Power Plate. By positioning the participant with SCI on the platform a greater load was created which might have enhanced the vibration throughout the entire body. It would appear this load was enhanced by this positioning.

BIBLIOGRAPHY

Giangregorio, L., and Blimkie, C., (2002). Skeletal adaptations to alterations in weight-bearing activity: A comparison of models of disuse osteoporosis. *Sports Medicine*, 32(7), 459-476. **Poole, K., Warburton, E., and Reeve, J**. (2005). Rapid long-term bone loss following stroke in a man with osteoporosis and atherosclerosis. *Osteoporosis International*, 16, 302-305. **Jones, L, Legge, M., and Goulding, A**., (2002). Intensive exercise may preserve bone mass of the upper limbs in spican cord injured males but does not retard demineralization of the lower body. *Spinal Cord*, 40, 230-235. **Delecluse, C., Roelants, M., and Verschueren, S.**, (2003). Strength increase after whole-body vibration comared with resistance training. *Medicine and Science in Sports and Exercise*, 35(6), 1033-1041. **Garatachea, N., Jimenez, A., Bresciani, G., Marino, N., Gallego-Gonzalez, J., and de Paz, J**. (2007). The effects of movement velocity during squatting on energy expenditure and substrate utilization in whole-body vibration. *Journal of Strength and Condition Research*, 21(2), 594-598. **Verschueren, S., Machteld, R., Delecluse, C., Swinnen, S., Vanderschueren, D., and Boonen, S**., (2004). Effect of 6-month whole body vibration training on hip density, muscle strength, and postural control in postmenopausal women: A randomized controlled pilot study. *Journal of Bone and Mineral Research*, 19(3) 353-363. **Maimoun, L., Fattal, C., Micallef, J., Peruchon, E., and Rabischong, P.** (2006). Bone loss in special cord-injured patients: from physiopathology to therapy. *Spinal Cord* 44, 203-210. Jordan, M., Norris, S., Smith, D., and Herzong, W. (2005). Vibration Training: An overview of the area, training consequences, and future considerations. *Journal of Strength and Conditioning Research*, 19(2), 459-466.

TWU Kinesiology Department