

# Vibration Training

Does it benefit physical fitness?

Siân Allison

## Introduction and History

- Whole Body Vibration (WBV), also known as Vibration Training.
- Exercises are performed whilst standing on a specially designed vibrating platform.
- First applications to aid human performance were developed in ancient Greece. (A saw covered in cotton)
- 40 years ago – vibration technology first developed by Russian Space Agency. (11)
- Russian sport/Olympic teams – track and field, gymnastics, rowing, and ballet. (11)
- Late 1980's – International sport science community took interest.
- Training used for fitness, sport, health, and rehabilitation. (11)

# What is vibration?

- Vibration is a mechanical stimulus characterised by an oscillatory motion. The biomechanical parameters determining its intensity are the:
  - **Amplitude** – The extent of the oscillatory motion determines the amplitude (peak to peak displacement, in mm) of the vibration.
  - **Frequency** - The repetition rate of the cycles of oscillation determines the frequency of the vibration (measured in Hz).
  - **Magnitude** – The acceleration indicates the magnitude of the vibration.

(4)

## Vibration Equipment and Training Variables



### Frequency (Hz)

A higher frequency increases the forces being generated and thereby the loading of the musculoskeletal system.

### Amplitude (mm)

A higher amplitude increases the extent of the movement and thereby increases training intensity.

### Duration (secs or mins)

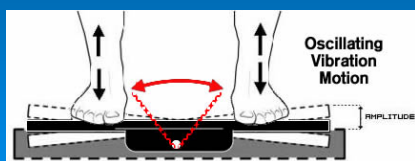
Length of each bout of training.

### Position

Can be static or dynamic, working through a variety of ranges of motion

### External loading

Additional loading via dumbbells or barbells, for example, can be used.



(11)

## Typical Training Volume

- Frequency → 15 to 44 Hz.
- Displacements → 3-10mm.
- Duration → 40 – 240 secs.
- Repetitions → 3 to 10.
  
- Acceleration → 3.5 to 15g  
(where  $g$  is the Earth's gravitational field or  $9.81 \text{ m}\cdot\text{s}^{-2}$ . Therefore, vibration causes a disturbance to the gravitational field during the time-course of the vibration intervention.)

(11)

## Claimed health benefits

- 10mins of WBV is equivalent to 1hr of resistance training
- Decrease appearance of cellulite
- Accelerate weight loss and reduction of body fat
- Increase bone density, reduce muscle wasting
- Increase circulation
- Enhance explosive strength
- Increase flexibility, mobility, coordination, balance and ROM
- Increase blood circulation and glucose metabolism at a cellular level
- Improve cellular oxygen and nutrient delivery which slows the ageing process
- Stimulates lymph drainage and oxygenation, as well as improving collagen production
- Increase Basal Metabolic Rate
- Assists pain management and reduce different types of pain, eg. Lower back
- Speed training recovery
- Improve muscle strength and performance
- Reduce effects of stress, increases natural release of endorphins
- Increase absorption of supplements
- Reduces arterial-plaque "Arteriosclerosis"
- Enhances conventional training results and reduces training time

## Mechanisms of action

- Recruits nearly 100% of a muscle's fibres. Whereas only 40-60% recruitment is associated with resistance training activities. Enhance fast twitch muscle fibres. (11)
- Increased excitation of peripheral and central structures (pre-activation of the musculoskeletal system, resulting in improved readiness for the training stimulus) (7)
- Increased synchronisation of motor units (7)
- Stimulation of GTO (golgi tendon organs), inhibiting activation of antagonist muscles. (7)
- Stimulates muscular blood flow. (11)
- Increased hormonal secretion. (7)
- Variations of neurotransmitter concentrations (dopamine, serotonin). (7)
- Excitation of sensory receptors such as muscle spindles, leading to improvements in the stretch reflex cycle. (7)
- Improvement in bone density due to an increase in testosterone and human growth hormone.

## Acute Effects

- Increased muscular power, flexibility, strength, balance and hormone release. (10)
- WBV exercise has been shown to acutely enhance strength and power capabilities in well trained subjects. (4)
- WBV applied for 10 minutes shown to improve vertical jumping ability, increase concentrations of testosterone and growth hormone, and decrease cortisol concentrations in recreationally active subjects. (4)
- Acute increases in knee extension maximal strength and vertical jumping height after 4 min of WBV. (4)
- Long durations of acute WBV, 7 min, have led to an acute decrease in vertical jumping ability in well trained subjects. (4)
- Acute reductions in maximal voluntary knee extension force. (4)
- Some studies have not shown any change in serum concentrations of growth hormone, insulin-like growth factor 1, and free and total testosterone. (4)
- Owing to the differences in WBV protocols used in different studies, it is difficult to ascertain the acute effects of the WBV intervention on the neuroendocrine and neuromuscular systems. (4)

## Chronic Effects

- 10 days of WBV resulted in an increase in average jumping height and power output during repeated hopping in active subjects. (4)
- Chronic exposure to WBV (3 session/wk, for 2-6 months) has been reported to elicit increases in isometric (16.6%, 24.4%) and isokinetic (8.3%, 9.0%) knee extensor strength similar to those observed after moderate-intensity resistance training programs (dynamic leg press and leg extensor exercises (10-20 RM, 3 x wk) of the same duration and frequency.(5)(10)
- WBV did not affect maximal voluntary contraction and voluntary activation of leg extensors in untrained students. (4)
- Nine days of WBV had no effect on jumping ability, sprinting, and agility tests in sport science students. (4)

## Current Literature Review

- Review: M. M. Nordlund and A. Thorstensson.  
*'Strength Training effects of whole-body vibration?'*
  - 12 articles met criteria and reviewed
- Results
  - 8 out of 10 jump performance studies, and 5 out of 8 studies assessing changes in lower limb strength, demonstrated improvements after WBV.
  - Only 5 articles used control groups performing identical exercises.
  - Of these, only one article reported increased jump and strength performance → studied untrained women.
- Conclusion
  - WBV appears to have no or only minor additional effects on muscle strength and jump performance as compared with performing the same exercises without WBV.

## Inconsistency in Literature

- Difference in control groups
- Type of vibration platform used
- Frequency and amplitude settings
- Trained or untrained individuals
- Variables measured; weight loss, muscular power

## Who can benefit from vibration training?

- WBV has been used to improve the symptoms of Parkinson's disease - tremor, rigidity, balance, postural stability. Improvements were seen as quickly as 10-60 mins after the intervention and lasted for 2-48 hrs. Training involved 3-5sets, 45-60secs with 30-60secs recovery at 4-7 Hz. (7)
- Research in the US has shown that WBV may be effective in the rehabilitation of patients with spinal cord dysfunction. (7)
- Initial studies indicate that WBV may have a positive impact on proprioceptive control of posture in stroke patients. Subjects showed an increase in their weight-shifting speed while maintaining the precision of movement. (7)
- Article by The Times, indicates that WBV may help to increase bone density in sufferers of osteoporosis. (9)

## Summary

- Further study is needed to determine the effects of vibration training on physiology.
- Studies have shown that vibration training does not benefit beyond the results seen from traditional strength training protocols, and therefore it is not recommended as a substitute to weight training.
- Vibration Training may be more beneficial to those who cannot take part in other forms of exercise i.e. The elderly, those recovering from strokes etc.

## Looking to the future

### Breaking News

---

#### **Vibrating saddle is key to comfort, says pelvic floor expert**

11:52, Nov 7th 2005

Paul Probst of Minneapolis will soon be bringing to market a saddle with an inbuilt oscillation device. This "stimulates neuro/musculo-skeletal structures, reducing soreness and rejuvenating muscles and anatomy around the sitting haunches," says Probst, who has 20 years of experience with patented urological medical devices. Oscillation technology is already used in sports training and Probst says his vibrating saddle, six months away from post-prototype sampling, alleviates bum discomfort and prevents erectile dysfunction.

- Vibrating saddle <http://www.bikebiz.co.uk/news/23902/Vibrating-saddle-is-key-to-comfort-says-pelvic-floor-expert>

# References

1. Abercromby, A.F.J., W.E. Amonette, C.S. Layne, B.K. McFarlin, M.R. Hinman, W.H. Paloski. **Variation in Neuromuscular Responses during Acute Whole-Body Vibration Exercise.** *Med. Sci. Sports Exerc.* 39(9):1642-50, 2007.
2. Bautmans, I., E. Van Hees, J-C. Lemper, T. Mets. **The feasibility of whole body vibration in institutionalised elderly persons and its influence on muscle performance, balance and mobility: a randomised controlled trial.** *BMC Geriatrics.* 22:5, 17, 2005.
3. Cardinale, M. and C. Bosco. **The Use of Vibration as an Exercise Intervention.** *Exerc. Sport Sci. Rev.* 31(1):3-7, 2003.
4. Cardinale, M. and J. Wakeling. **Whole body vibration exercise: are vibrations good for you?** *Br. J. Sports Med.* 39: 585-589, 2005.
5. Delecluse, C., M. Roelants, and S. Verschueren. **Strength increase after whole body vibration compared with resistance training.** *Med. Sci. Sports Exerc.* 35:1033-1041, 2003.
6. Fagnani, F., A. Giombini, A. Di Cesare, F. Pigozzi, V. Di Salvo. **The Effects of a Whole-Body Vibration Program on Muscle Performance and Flexibility in Female Athletes.** *American Journal of Physical Medicine & Rehabilitation.* 85(12): 956-962, 2006.
7. Grantham, N. 2006. **Vibration Platform: New training aids Good Vibrations?** <http://www.sportsinjurybulletin.com/archive/vibration-platform.htm> [Accessed 3 September 2007].
8. Nordlund, M.M., and A. Thorstensson. **Strength training effects of whole-body vibration?** *Scand. J. Med. Sci. Sports.* 17: 12-17, 2007.
9. Roberts, M. 2007. **Working it – Good vibrations?** [http://women.timesonline.co.uk/to/life\\_and\\_style/women/diet\\_and\\_fitness/article1690222.ece](http://women.timesonline.co.uk/to/life_and_style/women/diet_and_fitness/article1690222.ece) [Accessed 1 October 2007].
10. Roelants, M., C. Delecluse, M. Goris, and S. Verschueren. **Effects of 24 weeks of whole body vibration training on body composition and muscle strength in untrained females.** *Int. J. Sports Med.* 25:1-5, 2004.
11. Shepherd, J. **All shook up – can vibration training enhance sport performance?** <http://www.pponline.co.uk/encyc/vibration-training-and-performance-33404> [Accessed 3 September 2007].
12. Torvinen, S., P. Kannus, H. Sievanen, et al. **Effect of a vibration exposure on muscular performance and body balance. Randomised cross-over study.** *Clin. Physiol. Funct. Imaging* 22:145 – 152 2002.