

History & Science behind Whole-Body Vibration

Brief History

As a therapy, whole body vibration (WBV) was explored by Russian scientist Vladimir Nazarov, who tested vibration on cosmonauts in an effort to decrease the loss of muscle and bone mass in space.

As there is minimal gravitational force in space, muscles and bones are not loaded as they normally are on earth. Cosmonauts (and astronauts) in space lose their muscular strength very quickly (muscle atrophy), which is why they are not able to easily walk when they come back to earth. The decrease of bone density increases the risk of bone fractures, so it's not safe to stay in space for extended periods. As a result they were forced to return to earth rather quickly.

More information on this can be found online.

What Is Vibration Training

The use of vibration equipment is expanding quickly. It is now widely used in physical therapy, rehabilitation and professional sports, but it is also increasingly used for beauty and wellness applications.

Whole-body vibration platforms enable the user to train various skeletal muscles, and trigger other body reactions. The effects are used in sports, fitness, aesthetics, rehabilitation and medical therapies

Several hundred peer-reviewed papers have been published on the effects of WBV, and the number of research studies conducted every year is accelerating. Effects described in the studies include: muscle strength and toning, cellulite reduction, improved bone density, heightened secretion of hormones associated with exercise, and depressed response of hormones associated with stress. Several inventions regarding whole body vibration devices have also been patented.

There are currently many whole body vibration machine brands and types of machine available. These vary in quality, design specifications and manufacturing materials. **Some machines are able to provide the benefits that are described in the studies, others do not.**

As apparent from its name, in WBV, the entire body is exposed to vibration, as opposed to local vibration (Biomechanical Stimulation, BMS), where an isolated muscle or muscle group is stimulated by the use of a vibration device.

Whole body vibration is implemented through the use of a vibrating platform on which exercises can be performed. The vibrations generated by the motors underneath the platform are transmitted to the person on the machine. The intensity and the direction of these vibrations are essential for their effect.

How Does it Work?

As apparent from its name, in WBV, the entire body is exposed to vibration, as opposed to local vibration (Biomechanical Stimulation, BMS), where an isolated muscle or muscle group is stimulated by the use of a vibration device. Whole body vibration is implemented through the use of a vibrating platform on which exercises can be performed. The vibrations generated by the motors underneath the platform are transmitted to the person on the machine. The intensity and the direction of these vibrations are essential for their effect.

In order to elicit a stretch reflex in the muscles, the major contributing factor to the training results that can be achieved with vibration platforms, the up-down movement is the most important. However, the training frequency (Hz) is also one of the most important factors involved. Prof. Bosco was the first scientist to prove that every person has his own muscle frequency.

The z-axis (up and down) has the largest amplitude and is the most defining component in generating and inducing muscle contractions.

Mechanical stimulation generates acceleration forces acting on the body. These forces cause the muscles to lengthen, and this signal is received by the muscle spindle, a small organ in the muscle. This spindle transmits the signal through the central nervous system to the muscles involved.

Due to this subconscious contraction of the muscles, many more muscle fibers are used than in a conscious, voluntary movement (*Issurin & Tenenbaum 1999* [9]). This is also obvious from the heightened EMG activity (*Bosco et al. 1999* [10], *Delecluse et al. 2003* [11]).

Immediate and Short-Term Training Effects

More motor units (and the correlating muscle fibers) are activated under the influence of vibration than in normal, conscious muscle contractions. Due to this, muscles are incited more efficiently (*Paradisis & Zacharogiannis 2007* [12]; *Lamont et al. 2006* [13]; *Cormie et al. 2006* [14]; *Bosco et al. 1999* [10], *2000* [15]; *Rittweger 2001* [16], *2002* [17]; *Abercromby et al. 2005* [18]; *Amonette et al. 2005* [19]).

The immediate effect of WBV is therefore that the muscles can be used quickly and efficiently, rendering them capable of producing more force. However, this process will only be effective if the stimulus is not too intense and does not last too long, because otherwise performance will diminish due to fatigue.

Another immediate effect of WBV is an improvement of circulation. The rapid contraction and relaxation of the muscles at 20 to 50 times per second basically works as a pump on the blood vessels and lymphatic vessels, increasing the speed of the blood flow through the body (*Kersch-Schindl et al. 2001* [20]; *Lohman et al. 2007* [21]). Subjects often experience this as a tingling, prickling, warm sensation in the skin. Both Stewart (*2005* [22]) and Oliveri (*1989* [23]) describe the appearance of vasodilatation (widening of the blood vessels) as a result of vibration.

Long-Term Training Effects

In order to have any effect on the body in the long term it is vital that the body systems experience fatigue or some sort of light stress. As in other kinds of training, when the body is overloaded repeatedly and regularly, the principle of supercompensation applies. This principle is the cause of the body adapting to loading. In other words: performance will increase.

This effect has been proven several times in scientific research for both young and elderly subjects (*Roelants et al. 2004* [24], *Delecluse et al. 2003* [11], *Verschueren et al. 2004* [25], *Paradisis et al. 2007* [26]).

The only placebo-controlled study to date (*Delecluse et al. 2003* [11]) concluded "specific Whole Body Vibration protocol of 5 weeks had no surplus value upon the conventional training program to improve speed-strength performance in sprint-trained athletes". Therefore there is no clear indication that the vibrations actually do have added value when performing static exercises.

From research into the structural effects of vibration training it can be deduced that the increased strength resulting from WBV training can definitely be compared to the results that can be attained with conventional methods of training. But there are indications that better results may be achieved with WBV in the area of explosive power (*Delecluse et al. 2003* [11]).

Another important difference between conventional training methods and WBV is that there is only a minimum of loading. No additional weights are necessary, which ensures that there is very little loading to passive structures such as bones, ligaments and joints. That is why WBV is highly suited to people that are difficult to train due to old age, illness, disorders, weight or injury.

On the other hand, it is also highly suitable for professional athletes who want to stimulate and strengthen their muscles without overloading joints and the rest of the physical system (Cochrane et al. 2005 [27]; Mahieu et al. 2006 [28]).

Other than its influence on the muscles, WBV can also have a positive effect on bone mineral density. Vibrations cause compression and remodeling of the bone tissue (*Mechanostat* [29][30][31][32]), activating the osteoblasts (bone building cells), while reducing the activity of the osteoclasts (cells that break bone down). Repeated stimulation of this system, combined with the increased pull on the bones by the muscles, will increase bone mineral density over time.

It is also likely that improved circulation and the related bone perfusion due to a better supply of nutrients, which are also more able to penetrate the bone tissue, are contributing factors (Verschuere et al. 2004 [25], Jordan 2005 [33], Olof Johnell & John Eisman, 2004 [34], Rubin et al. 2004 [35]).

Furthermore the Berlin Bedrest Study (BBR) proved that 10 minutes of vibration training 6 times a week prevented muscle and bone loss in total bedrest over 55 days (Rittweger et al. 2004 [3], Felsenberg et al. 2004 [4], Bleeker et al. 2005 [5], Blottner et al. 2006 [36]).

In preventing falls and the bone fractures that often result from them, enhancing bone mineral density is not the only important issue. Increased muscle power, postural control and balance are also factors worthy of consideration. Studies involving elderly subjects have shown that all of these issues can be improved using whole body vibration (Roelants et al. 2004 [24], Bautmans et al. 2005 [37], Bogaerts et al. 2007 [38], Kawanabe et al. 2007 [39]).

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