Collection of 13 Studies on Vibration Training

English translation from German

1. Osteoporosis prevention study

Influence of 6 months of vibration training on bone density in healthy people (Effect of 6-month Vibration Training on Hip Density)

Author	Steven Boonen, MD, PhD
Location	Leuven University Center for Metabolic Bone Diseases, Belgium
Duration	6 months

Study: 70 subjects aged between 58 and 74 years were divided into three groups. 25 subjects formed the Power-Plate group, 22 subjects trained with conventional strength training, and 23 subjects formed the control group. The Power-Plate group performed static and dynamic squats on the Power-Plate without additional weight. The conventional strength-training group performed dynamic leg-press training. The control group did not train during these 6 months.

Result: The Power-Plate group not only stopped osteoporosis but increased bone density by 0.93% over the 6-month period. The conventional strength-training group lost 0.58% bone density during this period. The control group lost 0.60% bone density during this period.

- Power-Plate group = 6 months = +0.93%
- Conventional group = 6 months = -0.58%
- Control group = 6 months = -0.60%

2. Influence of 6 months of vibration training on the degree of cellulite

Author	Dr. med. Horst Frank, dermatologist
Location	Sanaderm Skin Clinic, specialist clinic for skin diseases and allergology, Bad Mergentheim
Duration	6 months

Study: 55 subjects aged between 25 and 45 years were divided into three groups. 24 subjects formed the Power-Plate group, 31 subjects trained with a combination of endurance training and Power-Plate, and 5 subjects formed the control group. The Power-Plate group performed static exercises on the Power-Plate without additional weight; the average treatment duration was 10 minutes, 2.5 times per week. The combination group performed cardio training in addition to Power-Plate; the total duration of each training session was 45 minutes, 2.5 times per week. The control group did not train during these 6 months.

Result: The degree of cellulite in the Power-Plate group decreased by an average of 25.68%; total treatment time over 6 months was 11 hours. In the group with additional cardio training, the degree of cellulite decreased by 32.30%; total training time over 6 months was 40 hours. No change occurred in the control group. In this context, it is interesting to compare the improvement with the time required.

- Power-Plate = 11 hours = 25.68%
- Cardio + Power-Plate = 40 hours = 32.30%

3. Comparison of strength increase between whole-body vibration training and resistance training

Strength Increase after Whole-Body Vibration Compared with Resistance Training

Authors	Christophe Delecluse, Machteld Roelants, Sabine Verschueren
Location	Exercise Physiology and Biomechanics Laboratory; Laboratory of Motor Control; Faculty of Physical Education and Physiotherapy; Department of Kinesiology, Katholieke Universiteit Leuven, Belgium, 2003
Duration	12 weeks

Study: This study examined and compared the effect of vibration training and resistance training on the thigh muscles. 67 untrained women (21.4 +/- 1.8 years) participated in the study. The whole-body vibration group (WBV, N=18) and the placebo group (PL, N=19) trained with static and dynamic exercises for the knee extensor muscles on a vibrating platform. The resistance-training group (RES, N=18) trained the knee extensors with dynamic leg-press and leg-extension exercises. All groups trained 3 times per week. The control group (CO, N=12) did not train at all. Isometric and dynamic strength of the knee extensor muscles was measured. Explosive strength was measured by drop jumps.

Result: Isometric and dynamic strength development of the knee extensors increased significantly in the whole-body vibration group ($P < 0.001$) (16.6 +/- 10.8%). The placebo group showed no increase. The whole-body vibration group trained on the platform with accelerations from 2.28 g to 5.09 g, while the placebo group trained with accelerations of 0.4 g. The whole-body vibration group was the only group to show gains in drop jumps (7.6 +/- 4.3%). The resistance-training group also achieved significant changes (14.4 +/- 5.3%).

4. Influence of vibrations on the muscles in rehabilitation using Power-Plate

Author	Anna Maria Trimmel
Location	Academy of Physiotherapy, Graz State Hospital, 2003
Duration	5 weeks

Study: 12 subjects trained in two groups: a Power-Plate group and a conventional-training group. The average age was 35.75 years. Each subject completed 9 training sessions. Maximum-strength measurements were performed in the first, fourth, and ninth training sessions. The subjects in both groups completed two exercises: the first was the lunge, and the second was a squat. The conventional-training group performed the exercises dynamically; the Power-Plate group performed them statically.

Result: At the first measurement, average maximum strength was 51.6 kg in the Power-Plate training group and 63.6 kg in the conventional-training group. At the final measurement, the Power-Plate training group reached an average value of 116.6 kg, while the conventional-training group reached 113.1 kg. The Power-Plate training group had an average muscle-strength increase of 126.7%, and the conventional group 78.1%. The Power-Plate training group achieved an average maximum-strength increase of 65 kg, while the conventional group achieved 49.6 kg. In percentage terms, this means that Power-Plate training was 31% more effective than conventional training. Power-Plate training places no additional load on the back and shoulders. In the Power-Plate group, pain had completely disappeared by the interim measurement.

- Power-Plate group = 5 weeks = 126.7%
- Conventional group = 5 weeks = 78.1%
- Result: Power-Plate group = 31% more effective

5. Adaptations of human skeletal muscle after whole-body vibration training

Adaptive responses of human skeletal muscle to vibration exposure

Author	Carmelo Bosco, PhD
Location	University of Rome, Italy
Duration	Single 10-minute session

Study: The question of this investigation was how the skeletal muscles of well-trained athletes respond to a single whole-body vibration training session. Six female volleyball players (age: 19.5 +/- 2.1 years) participated in the investigation. One-legged dynamic leg-press exercises were performed on an appropriate machine. Average velocity, acceleration, average force, and average power were measured in relation to training weights. The athletes stood with one foot on the vibrating platform, while the other leg was lifted off the floor. They were exposed to vibration 10 times for 60 seconds, with a 60-second pause between treatments.

Result: After whole-body vibration training, the legs that stood on the vibrating platform showed significant improvements. The acute effects of a short period of whole-body vibration were increased movement velocity (+6.5%), greater muscle strength (+6.5%), and greater force during leg-press exercises with external weight.

6. Perceived effort during isotonic training and isotonic training combined with vibrations

Effort perception during conventional isotonic training and isotonic training combined with superimposed vibratory stimulation

Authors	D. G. Liebermann, V. Issurin, and others
Location	Ribstein Center for Research and Sports Medicine Science, Wingate Institute, Israel, 1993
Duration	Single session

Study: 41 athletes of different performance levels used the Borg scale to assess their individual perceived effort when lifting a weight (60, 70, 90, and 100% of capacity) under conventional isotonic conditions and during isotonic tension supported by vibration.

Result: The results showed a linear increase in perceived effort as weight increased during conventional isotonic weight lifting. With amplified vibrations, perceived effort was significantly reduced. The subjects were able to bring their muscle activity to a higher level, which resulted in increased performance in isotonic contractions performed in combination with vibrations. Strength capacity increased within the same training session.

7. Effects of vibration training on maximum strength and flexibility

Effect of vibratory stimulation training on maximal force and flexibility

Authors	V. B. Issurin, D. G. Liebermann, and G. Tenenbaum
Location	Ribstein, Centre for Research and Sport Medicine Sciences, Wingate Institute, Israel, 1994
Duration	3 weeks

Study: 28 male athletes were divided into three groups: Group A - arm strength training with vibration and conventional stretching of the legs; Group B - conventional arm strength training and leg stretching with vibration; Group C - control group. The groups trained 3 times per week, with a volume of approximately 55 minutes.

Result: Maximum strength: Group A = 49.8% (with vibrations); Group B = 16.1% (without vibrations). Flexibility: Group B = 8.7% (with vibrations); Group A = 2.4% (without vibrations).

- Maximum strength: Group A = 49.8% (with vibrations)
- Maximum strength: Group B = 16.1% (without vibrations)
- Flexibility: Group B = 8.7% (with vibrations)
- Flexibility: Group A = 2.4% (without vibrations)

8. Comparison: effects of Power-Plate vibration strength training and conventional strength training on standard strength machines

Author	Institute of Sports Science
Location	University of Bayreuth, 2001-2002
Duration	9 weeks

Study: The study was conducted with three experimental groups: a training group that trained exclusively with the Power-Plate; a training group that performed only conventional strength training; and a control group that performed no strength training at all. Both training groups trained over a period of seven weeks, twice per week (initial and final testing took place one week before and one week after, respectively). One group (KK) trained conventionally according to the common hypertrophy method - repeated strength efforts until muscle fatigue with increasing weights. The second training group worked exclusively with the Power-Plate, with intensity controlled by gradually increasing the vibration amplitude of the Power-Plate (2-4 mm) and the frequency in hertz (40 Hz low - 50 Hz high). The control group (KO) performed no strength training during the study period.

Result: In both training groups, subjects were able to increase their maximum strength performance with high statistical significance. In the test exercises - leg press, lat pull-down, and bench press - the increases in maximum-strength development in both groups were relatively similar, with slight advantages for the Power-Plate group. As with maximum-strength development, there was no significant difference between the Power-Plate group and the conventional-strength-training group. Thus, vibration training can be regarded as equivalent to conventional strength training within the parameters used in this study.

9. Influence of whole-body vibration training on the mechanical behaviour of skeletal muscle

The influence of whole body vibration on the mechanical behaviour of skeletal muscle

Author	C. Bosco
Location	University of Rome, Italy
Duration	10 days

Study: 14 subjects were divided into two groups: the experimental group (EG) and the control group (CG). Subjects in both groups performed drop jumps and continuous jumping for 5 seconds. The flight time and contact time of each jump were recorded. From contact and flight time, average mechanical power (AP) and the average increase of the centre of gravity (AH) were calculated. The best jump performance, maximum mechanical power (PBJ), and the greatest increase in the body centre of gravity (HBJ) were also measured. Subjects in the experimental group trained 5 times for 90 seconds with whole-body vibration, with a 40-second pause between each set. In different standing positions, 5 seconds of training time were added each day. The investigation was conducted over 10 days until the training time reached 2 minutes per set. The control group continued its usual activities.

Result: The control group showed no changes. Significant improvements were observed in the experimental group for HBJ, PBJ, and average jump height during continuous jumping.

10. Hormonal adaptations after whole-body vibration training in men

Hormonal responses to whole-body vibration in men

Author	C. Bosco
Location	University of Rome, Italy, 1999
Design	Blood hormone concentration and neuromuscular performance after whole-body vibration training
Duration	Single 10-minute session

Study: 14 male subjects (25 +/- 4.6 years) were exposed to whole-body vibration training 10 times for 60 seconds, with a 60-second pause between vibration-training sets. Drop jumps and dynamic leg-press exercises with an additional load of 160% of body weight were measured before and immediately after whole-body vibration training. Average velocity, acceleration, average force, and power were measured using EMG. Blood samples were also taken, and plasma concentrations of testosterone (T), growth hormone (GH), and cortisol (C) were measured.

Result: The results showed a significant increase in plasma concentrations of testosterone and growth hormone, while cortisol decreased. An increase in mechanical force was recorded, while muscle activity in the EMG decreased. An improvement in drop jumps was also observed. This means that whole-body vibration training leads to acute adaptation of the hormonal profile and neuromuscular performance.

11. Muscle stimulation through vibration

Author	Reinhard Weber
Location	Research Institute for Physical Culture and Sport, Leipzig, 1997
Design	Initial experience with vibrations and verification of known values from Nazarov studies
Duration	29 weeks

Study: An individual experiment with middle-aged recreational gymnasts on a rowing-pull apparatus with applied vibration. Load indicator: 10 times in succession every second day, 6 series at 80% of 1 RM until fatigue.

Result: Clear increase in maximum strength by 24%.

12. Vibration training relieves urinary incontinence

Author	Dr. Volker Viereck
Location	Department of Gynecology and Obstetrics, University of Göttingen, 2003
Duration	12 weeks

Study: The method was tested in 90 women with stress urinary incontinence. In a multicentre study, one third of the women first participated in conventional pelvic-floor training and then in vibration training. Another third did the reverse. The remaining women combined both methods. Training took place twice per week. Vibration training lasted 8 minutes per session, while conventional pelvic-floor training lasted about 30 minutes.

Result: Viereck stated: "Women who received the combination therapy achieved the best results. 80% became continent again. With conventional pelvic-floor training, this is achieved in only 30% to 40% of cases."

13. Vibratory stimulation exercise: a new approach to strength training for performance swimmers

Author	Prof. Vladimir B. Issurin, PhD
Location	Elite Sport Department of Israel, Wingate Institute, Netanya, Israel
Duration	20 days

Study: 9 male junior swimmers formed the control group for comparison with the Barcelona Olympic champion in the 100 m breaststroke, Helena Rudkovskaya. She trained 3 times per week on a pulling machine, performing arm and leg strokes with applied vibration. The training included maximum-strength training, speed-strength training, and strength-endurance training. The control group completed normal strength and swimming training.

Result: Helena Rudkovskaya increased her maximum strength by 25.7%. In the control group, maximum strength did not increase. Helena Rudkovskaya increased her speed strength by 18.5%, while it did not change in the control group.