

Title

Effect of vibration training on muscle strength, muscle performance and velocity-related mechanical muscle characteristics

Andere titel

Effect van vibratie training op spierkracht, prestatie en snelheidsgerelateerde mechanische spierkarakteristieken

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Summary

Based on the results of the studies presented in this thesis it is clear that the vibration stimulus during WBV training has clearly a surplus value upon the unloaded exercises performed on the platform for improving muscle strength (no placebo effect). Coaches and physiotherapists should know that long term WBV training is an efficient exercise intervention for increasing knee-extensor strength and jump performance in certain subject groups. Especially subjects with low initial muscle strength levels due to disuse or due to the aging process will benefit of following a WBV training program. The low training load during WBV training and the non-complicated technique to master can be of particular benefit to weak subjects (e.g. untrained and elderly populations) not attracted to conventional training methods. In this respect WBV training can lower the threshold to start an exercise program. It is also important to mention that an optimal volume and intensity of the WBV training program, especially a sufficient total duration of the vibration exposure in one session, are essential to create a sufficient overload necessary for inducing neuromuscular adaptations. While no reductions in body weight, percentage body fat or subcutaneous fat have been found, total body fat free mass increases in untrained subjects following WBV training by means of this specific protocol. Moreover, strength gain following WBV training is comparable with the strength increases after an equal number of resistance training sessions at moderate intensity. However, professionals involved in the health, fitness and therapeutic sector should know that until now no surplus value of WBV training upon conventional fitness training has been found. WBV training is not more efficient to improve explosive strength compared to resistance training. Also the effects of WBV training on other muscle groups (e.g. arm muscles) and cardiovascular fitness have not been investigated yet. Consequently, WBV training can not be seen as a replacement of conventional fitness training consisting of resistance training and endurance training but rather as an additional training method that can be integrated in the conventional training program. However, it should be taken into account that all subjects of previous WBV studies, independent of their initial muscle strength and body weight, performed exercises without external loads on the WBV platform. In contrast, the relative training load used in resistance training programs is individually tuned using the concept of repetition maximum (RM). An individualized training load in WBV training might optimize the effects on strength.

In trained athletes a short intervention period of WBV training by means of this specific protocol has no surplus value upon the conventional training program to induce specific adaptations improving speed-strength performance. It is reasonable that in these highly trained athletes WBV in general have no effects. However, it is also possible that the intensity and volume of the specific WBV protocol was not high enough to induce positive effects. The effects of WBV training combined with external weights in trained subjects are not clear yet.

WBV significantly increases the EMG rms of the leg muscles during different squat exercises compared to the non-vibration control condition. The increase in muscle activity due to vibration was significantly higher in one-legged squat compared to high squat and low squat. Leg muscle closer to the vibration platform show a higher vibration effect (gastrocnemius versus quadriceps muscle). During WBV activation of the different leg muscle varies between 12.6% and 82.4% of values recorded during an isolated maximal voluntary contraction of that muscle.

Although strength increases following WBV training are clearly not attributable to the exercises performed on the vibration platform but are associated with the vibration stimulus, the well-standardized segmental vibration training study found that the increase in EMG rms due to vibration does not induce specific adaptations in torque-velocity relationship and contraction time compared to a control group without vibration induced increase in EMG rms. Although other researchers linked the vibration induced increase in EMG rms to the tonic vibration reflex (TVR) and specific muscle adaptations, one should be careful when interpreting the EMG signal during vibration. A possible electromechanical (an artefact), rather than a neurophysiological origin (TVR) of the vibration induced increase in EMG rms should be considered. Although segmental vibration is without doubt a good standardized setting to investigate more fundamental research questions about vibration training, no definite answer can be given whether WBV and segmental vibration are exactly the same and therefore whether findings of segmental vibration training can be applied to WBV training. Independent of the potential underlying mechanisms by which muscles respond to vibration positive effects of WBV training on muscle strength in certain subject groups can be not denied. Consequently the increase in EMG rms during WBV should represent not only an artefact but also 'real' muscle activity. No vibration related side-effects or adverse reactions were reported or observed in all studies.

Samenvatting

De resultaten van de studies van dit doctoraatsproject tonen aan dat de vibratiestimulus tijdens 'whole body vibration' (WBV) een duidelijke meerwaarde heeft bovenop de oefeningen uitgevoerd op het WBV platform om spierkracht te verbeteren (geen placebo effect). WBV training is een efficiënte trainingsmethode om de kracht van de knie-extensoren en de sprongkracht te verbeteren in specifieke groepen **more/meer ...**

Vibratietraining: worden we er werkelijk sterker en sneller van?

De voorbije jaren rijzen vibratietraining toestellen als paddestoelen uit de grond in de gezondheids- en fitnesscentra. Bij trilplaat training, ook wel 'whole body vibration' training genoemd, voert men oefeningen uit op een vibrerend platform dat mechanische trillingen genereert aan een frequentie tussen 25 en **more/meer ...**

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Doctoral thesis

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