

# 6週全身垂直律動訓練動 對於老年人動脈硬化改善研究

▶▶▶ INFLUENCE OF SIX WEEKS WHOLE-BODY VIBRATION EXERCISE  
ON ARTERIAL STIFFNESS IN THE ELDERLY

## 發表自：

16th annual Congress of the EUROPEAN COLLEGE OF SPORT SCIENCE  
(ECSS), 2011

歐洲體育科學學院第16屆年會(ECSS)中的2011年7月9日

## 簡述內容：

動脈硬化的狀態是不正常的斑塊沉積在血管壁並造成動脈狹窄的疾病，就像是水管內若沉積污垢會造成水流速度變緩；而動脈硬化嚴重可能會併發冠心病、中風、器官功能衰竭等問題，相關的危險因子可能包括血中膽固醇異常、高血壓、糖尿病、吸菸、肥胖、動脈硬化家族史及不健康的飲食習慣。

運動能夠減少動脈硬化的情形發生，據醫學報導，運動促使動脈血流量提升，可以加速刺激血管內皮細胞組織活化，促進一氧化氮(NO)的分泌量，進而降低血管發炎，本研究證實經由六週全身垂直律動測試，能夠有效降低老年人的血壓，維持血管功能並增加氧氣輸送，改善動脈硬化狀況及高血壓的狀況，對於保護心血管方面有顯著之效益。

# INFLUENCE OF SIX WEEKS WHOLE-BODY VIBRATION EXERCISE ON ARTERIAL STIFFNESS IN THE ELDERLY

16th annual Congress of the EUROPEAN COLLEGE OF SPORT SCIENCE (ECSS)

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## Introduction

Whole body vibration (WBV) recent work has suggested that low amplitude, low frequency mechanical stimulation of the human body is a safe and effective way to exercise musculoskeletal structures and possibly beneficial to the cardiovascular system.

However, there is no study about WBV training on the elderly arterial function. So, the aim of this study was to analyze the influence of six weeks WBV training on arterial stiffness in the elderly. Methods To determine the six weeks WBV training effect on the elderly arterial stiffness which including three test : an arterial stiffness index (ASI) measurement (CardioVision MS-2000; USA) , six minutes walking and blood biomarker. 24 healthy elderly people were volunteered to participate in this study. Elderly people were performed in standing position on a BodyGreen whole vertical vibratory machine ( Taiwan ) for 3 times in a week. We analyze the data before 6 weeks WBV training and after the training for using Paired Samples T-test.

## Results

After 6 weeks WBV exercise program, the blood pressure ( systolic pressure:  $146.4 \pm 4.8$  mmHg  $\rightarrow$   $130.3 \pm 4.7$  mmHg , diastolic pressure:  $80.5 \pm 2.6$  mmHg  $\rightarrow$   $74.1 \pm 1.5$  mmHg and pulse pressure:  $73.8 \pm 3.4$  mmHg  $\rightarrow$   $61.6 \pm 3.2$  mmHg), biomarker NO concentration:  $11.4 \pm 1.6 \mu\text{M}$   $\rightarrow$   $16.5 \pm 2.3 \mu\text{M}$  , the 6 minutes walking distance (  $382.2 \pm 23.9$  meter  $\rightarrow$   $425 \pm 20.2$  meter) were significantly improved ( $p < .05$ ). And the inflammatory condition was no difference ( IL-6 and TNF- $\alpha$ ), even more the muscle was no damage (CK activity was no difference) before and after 6 weeks WBV training.

## Discussion

Exercise can attenuate large artery stiffness in elderly people (Otsuki et al.2007). In our study, we found that WBV can significantly lower ( $p < .05$ ) elderly blood pressure. Previous studies demonstrated that arterial remodeling in response to chronic changes in blood flow is endothelium- and NO-dependent (Rudic et al. 1998). Our WBV training increases the production of NO ( $p < .05$ ). NO is a potent endothelium-dependent vasodilator and reduces vasoconstrictor response to  $\alpha$ -adrenergic receptor stimulation. So, we think the blood pressure change was due to the increased NO concentration. According to our result, 6 weeks WBV training could be an effective strategy to combat arterial ageing.

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EUROPEAN COLLEGE OF SPORT SCIENCE

歐洲體育科學學院第16屆年會(ECSS)中的2011年7月9日，第638頁

## 簡述內容：

運動能夠減少動脈硬化的情形發生，據醫學報導，運動促使動脈血流量提升，可以加速刺激血管內皮細胞組織活化，促進一氧化氮(NO)的分泌量，進而降低血管發炎，由研究證實全身律動能夠有效降低老年人的血壓，維持血管功能並增加氧氣輸送，實驗證實六週的全身律動訓練能有效對抗動脈的老化及明顯改善高血壓的狀況，對於保護心血管有明確之效益，本篇為歐洲體育科學(ECSS)期刊的發表。



**16<sup>th</sup> Annual Congress of the ECSS**

**New horizons from  
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# Book of Abstracts



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# Welcome

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We are delighted, on behalf of the European College of Sport Science and the Research Institute of Sport and Exercise Sciences (RISES) at Liverpool John Moores University, to welcome you to Liverpool for the 16th Annual Congress of the ECSS.

The Congress theme of "New Horizons from a World Heritage City" provides a platform for our internationally renowned Plenary and Invited Speakers to stimulate and promote new research directions in our core Sport Science disciplines. These sessions will be supported, as ever, by the Young Investigator Awards of which we have the largest ever submission of 211 presenters. We are also particularly proud to have attracted 1756 abstracts, which will bring energy, academic rigour and debate to the 74 oral sessions and 120 poster sessions across the 4 days of the Congress. This volume of submitted work reflects the importance of our discipline to the societies in which we live and to the continued development of the College. A particular highlight of the Congress this year will be the presentation of the Tom Reilly Memorial Lecture, by Professor George Brooks, entitled "Three Decades of Research on Lactate Metabolism; A conversation with Tom Reilly". The programme has been designed to inspire debate and academic exchange and we trust that you will leave the Congress sufficiently challenged and energised to build new horizons for the future.

We are very excited to welcome you to our City of Liverpool, which is well known for its friendliness and fun. We trust that you will take time to network and socialise with friends and colleagues in the many restaurants and bars in the Albert Dock and City Centre that are all within walking distance of the Conference. In addition, we hope you will have time to explore the many cultural opportunities that range from world famous art galleries, to gothic architecture, to theatre, musical and sporting heritage.

On behalf of RISES and the ECSS we thank you for travelling to Liverpool and your continued commitment to ECSS. We trust that you will have a fruitful and pleasant visit to the North West of England.

Best wishes

Tim Cable

*Congress President*

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ergogenic effect of WBV, it does not seem appropriate to abandon the WBV-approach as a potential mean for performance enhancement. The apparent lack of effects may be due to the distinct features of the applied protocols. Accordingly, we aimed to investigate the effect of adding whole body vibration (WBV) to body-loaded half-squats, performed as preconditioning activity to 40 m sprint test. Nine male amateur soccer players performed one familiarization session and six separate test sessions. Each session included a standardized warm-up followed by one of the following preconditioning exercises; 30 s of half-squats with WBV at either 50 Hz or 30 Hz, or half-squats without WBV. The 40 m sprint was performed one minute after the preconditioning exercise. For each subject, each of the three protocols was repeated twice on separate days in a randomized order. Mean values were used in the statistical analysis. Performing the preconditioning exercise with WBV at a frequency of 50 Hz resulted in superior 40 m sprint performance compared to preconditioning exercise without WBV ( $5.48 \pm 0.19$  s vs.  $5.52 \pm 0.21$  s, respectively,  $p < 0.05$ ). There was no difference between preconditioning exercise with WBV at a frequency of 30 Hz and no WBV condition. In conclusion, preconditioning exercise performed with WBV at 50 Hz seems to enhance 40 m sprint performance in recreationally trained soccer players. The present findings suggest that coaches can incorporate such exercise into the warm-up to improve sprint performance or the quality of the sprint training. 1. J. D. Guggenheimer, D. C. Dickin, G. F. Reyes, D. G. Dolny, *Journal of Strength and Conditioning Research* 23, 1135. 2. N. Bullock et al., *Journal of Strength and Conditioning Research* 22, 1371.

### INFLUENCE OF SIX WEEKS WHOLE-BODY VIBRATION EXERCISE ON ARTERIAL STIFFNESS IN THE ELDERLY

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**Introduction** Whole body vibration (WBV) recent work has suggested that low amplitude, low frequency mechanical stimulation of the human body is a safe and effective way to exercise musculoskeletal structures and possible beneficial to the cardiovascular system. However, there is no study about WBV training on the elderly arterial function. So, the aim of this study was to analyse the influence of six weeks WBV training on arterial stiffness in the elderly. **Methods** To determine the six weeks WBV training effect on the elderly arterial stiffness which including three test : an arterial stiffness index (ASI) measurement (CardioVision MS-2000; USA) , six minutes walking and blood biomarker. 24 healthy elderly people were volunteered to participate in this study. Elderly people were performed in standing position on a BodyGreen whole vertical vibratory machine ( Taiwan ) for 3 times in a week. We analyze the data before 6 weeks WBV training and after the training for using Paired Samples T-test. **Results** After 6 weeks WBV exercise program, the blood pressure ( systolic pressure:  $146.4 \pm 4.8$  mmHg  $\rightarrow$   $130.3 \pm 4.7$  mmHg , diastolic pressure:  $80.5 \pm 2.6$  mmHg  $\rightarrow$   $74.1 \pm 1.5$  mmHg and pulse pressure:  $73.8 \pm 3.4$  mmHg  $\rightarrow$   $61.6 \pm 3.2$  mmHg), biomarker NO concentration:  $11.4 \pm 1.6 \mu\text{M}$   $\rightarrow$   $16.5 \pm 2.3 \mu\text{M}$  , the 6 minutes walking distance ( $382.2 \pm 23.9$  meter  $\rightarrow$   $425 \pm 20.2$  meter) were significantly improved ( $p < 0.05$ ). And the inflammatory condition was no difference ( IL-6 and TNF- $\alpha$ ), even more the muscle was no damage (CK activity was no difference) before and after 6 weeks WBV training. **Discussion** Exercise can attenuate large artery stiffness in elderly people (Otsuki et al.2007). In our study, we found that WBV can significant lower ( $p < 0.05$ ) elderly blood pressure. Previous studies demonstrated that arterial remodeling in response to chronic changes in blood flow is endothelium- and NO-dependent (Rudic et al. 1998). Our WBV training increases the production of NO ( $p < 0.05$ ). NO is a potent endothelium-dependent vasodilator and reduces vasoconstrictor response to  $\alpha$ -adrenergic receptor stimulation. So, we think the blood pressure change was due to the increased NO concentration. According to our result, 6 weeks WBV training could be an effective strategy to combat arterial ageing. **References** Otsuki, T., Maeda, S., Iemitsu, M., Saito, Y., Tanimura, Y., Ajsaka, R. & Miyachi, T. (2007). Vascular endothelium-derived factors and arterial stiffness in strength- and endurance- trained men. *Am J Physiol Heart Circ Physiol* 292, H786–H791. Otsuki, T., Takanami, Y., Aoi, W., Kawai, Y., Ichikawa, H. & Yoshikawa, T. (2008). Arterial stiffness acutely decreases after whole-body vibration in humans. *Acta Physiologica*, 1-6. Rudic, R., Shesley, E., Maeda, N., Smithies, O., Segal, S., Sessa, W. (1998). Direct evidence for the importance of endothelium-derived nitric oxide in vascular remodeling. *J Clin Invest* 101:731–736. Sugawara, J., Inoue, H., Hayashi, K., Yokoi, T., Kono, I. (2004) Effects of low-intensity aerobic exercise training on arterial compliance in postmenopausal women. *Hypertens Res* 27:897–901.

### EFFECTS OF BRIEF WHOLE-BODY VIBRATION ON BONE MINERAL DENSITY AND BONE TURNOVER MARKERS IN THE RAT

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**Introduction** Numerous studies have demonstrated the bone mass and strength benefits under the whole-body vibration programs based on high-frequency parameters. The goal of this study was to answer two questions: 1/ if the short-lasting vibration program is adequate for inducing bone tissue response and 2/ if the increased volume of a whole-body vibration modulates the metabolic processes of bone tissue. **Methods** Ten male Wistar rats, aged 6 months, were subjected to a regular 5-weeks whole-body vibration (WBV) program (5 days/week, frequency 50 Hz, amplitude of oscillations 2.5 mm). Results were compared to age-matched controls ( $n=5$ ). Five animals underwent a vibration training in one session lasting 30 s (group 1) and other five were subjected to four vibration sessions lasting 30 s, separated by 60 s rest intervals (group 2). Before and after the vibration program the total bone mineral density (BMD) was measured using a dual-energy X-ray absorptiometry. After completing the training, the blood was taken from all animals to analyze biochemical parameters: osteocalcin (OC), C-terminal telopeptide of type I collagen (CTX), osteoprotegerin (OPG), receptor activator of nuclear factor (NF)- $\kappa$ B ligand (RANKL). **Results** There were no significant differences with respect to the total BMD values between two terms of the study in both groups of WBV animals. There were no significant differences between both groups of trained animals and the control with respect to concentrations of bone turnover markers, but the tendencies to decreased OC (by 28%) and CTX concentrations (by 15%) were observed in animals from the group 2. The RANKL levels were higher in both WBV groups in comparison to control animals, however, the significant difference was revealed only for animals from the group 1 ( $p < 0.05$ ). **Discussion** The brief whole-body vibration did not influence the BMD values, however, the altered bone turnover was observed after the higher intensity of WBV (4 x 30s). High values of receptor activator of nuclear factor (NF)- $\kappa$ B ligand (RANKL) in WBV groups of animals changed the RANKL/OPG ratio, which is critical to determine bone metabolism. However, the contribution of other tissues in increased serum levels of RANKL could not be excluded.