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Effects of a short-term whole body vibration intervention on lean mass in elderly people

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Abstract

Objective: To clarify whether a short-term whole body vibration (WBV) training has an effect on lean mass (LM) in the elderly.

Method: 49 non-institutionalized elderly (20 men) participated in the study. Participants who met the inclusion criteria were randomly assigned to the WBV or control group. A total of 24 elderly trained squat positioned on a vibration platform 3 times per week for 11 weeks. LM at the whole body, upper and lower limbs was assessed by dual-energy X-ray absorptiometry. Two-way repeated measures ANOVA was used to determine the effects of the intervention on the studied variables and also to determinate the changes within group throughout the intervention period including age and height as covariates.

Results: 11 weeks of WBV training led to no changes in none of the LM parameters.

Conclusion: A short-term WBV therapy is not enough to cause significant changes on LM in non-institutionalized seniors.

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Key words: Ageing. Body composition. Muscle mass. Exercise. Training.

EFFECTOS DE UNA INTERVENCIÓN DE VIBRACIÓN CORPORAL TOTAL SOBRE LA MASA MAGRA EN PERSONAS ANCIANAS

Resumen

Objetivo: Comprobar si un programa de entrenamiento vibratorio de corta duración tiene algún efecto sobre la masa magra (MM) en personas mayores.

Método: 49 personas mayores no institucionalizadas (20 hombres) participaron en el estudio. Los participantes que reunieron los criterios de inclusión fueron distribuidos al azar en el grupo de entrenamiento o el grupo control. Un total de 24 personas entrenaron sobre una plataforma vibratoria 3 veces por semana durante 11 semanas. Mediante absorciometría fotónica dual de rayos X se evaluó la MM del cuerpo completo, brazos y piernas. Se utilizó ANOVA de medidas repetidas para determinar los efectos de la intervención sobre las variables estudiadas y también para determinar los cambios intra-grupo a lo largo del periodo de intervención, incluyendo la edad y altura como variables de confusión.

Resultados: 11 semanas de entrenamiento vibratorio no produjeron ningún cambio sobre la MM en ninguna de las regiones.

Conclusión: Un programa de entrenamiento vibratorio de corta duración no es suficiente para producir cambios significativos en la masa magra en personas mayores no institucionalizadas.

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Palabras clave: Envejecimiento. Composición corporal. Masa muscular. Ejercicio. Entrenamiento.

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Introduction

Ageing is accompanied by changes in body composition, which include a decrease in muscle mass in both men and women, especially after the age of 60.¹ This characteristic change that occurs in elderly people may lead to suffer sarcopenia later in life. Although no consensus diagnosis has been reached, sarcopenia is increasingly defined by the loss of muscle mass and the loss of muscle function or strength.² This pathology is a critical age-related disorder within the older population and constitutes a large and important problem worldwide due to the degradation of muscle mass. In addition, the loss of strength causes functional decline and loss of independence in older adults, diminishes the functional status, produces impaired mobility, lead to a higher risk of falls, and eventually produces an increased risk of mortality.³

Although pharmaceutical agents targeting multiple biological pathways are being developed, adequate nutrition and exercise remain the “gold standard” for therapy.² In fact, both physical activities and exercise have been shown to decrease the risk of sarcopenia and onset of functional limitations in older persons. Moreover, the guidelines state that physical inactivity or a decreased physical activity level is a part of the underlying mechanisms of sarcopenia and it has been shown that prolonged inactivity due to illness or hospitalization results in accelerated loss of skeletal muscle, strength and functional capacity.⁴ Therefore, physical activity can be seen as an important factor to preserve or modify the development of this pathology.³

Although the participation in regular physical activity throughout lifetime has been proved to be beneficial for the muscle mass in older adults and elderly people, it has been suggested that the best non-pharmacological way to improve lean mass (LM) includes specific exercise training programmes. In fact, it has been previously reviewed that resistance exercise training is effective for eliciting gains in LM among ageing adults, with or without nutritional supplementation, particularly with high volume (sets per session) programs.^{5,6}

Whole body vibration (WBV) is a type of exercise that uses high-frequency mechanical stimuli, which are generated by a vibrating platform and transmitted through the body. This technology may be attractive especially for subjects otherwise unable or unwilling to exercise conventionally and will be therefore a promising option to increase subjects' physical activity.⁷ Even the effects of this type of intervention have already been tested with tomography in community-dwelling seniors, to our knowledge the impact of a short-term intervention on LM in non-institutionalized elderly men and women has not been tested yet with dual-energy X-ray absorptiometry (DXA). Positive results of this intervention may provide an easy tool for fast improvements in muscle strength and functionality.

Therefore, the aim of this research was to clarify whether a short-term WBV training has an effect on LM in elderly men and women.

Methods

A total of 49 non-institutionalized elderly (20 men and 29 women) from the city of Zaragoza (Spain) volunteered to participate in the study. The recruitment was carried out through the elderly EXERNET multi-centre study, whose participants were informed the details of the study including purposes and procedures to use. Briefly, the elderly EXERNET multi-centre study was a cross-sectional study for the evaluation of physical fitness and body composition in elderly people that was carried out in 6 different regions from Spain. The general characteristics of this project have been described in detail elsewhere.^{8,9}

Written informed consent was obtained from all the participants included. The study was performed according to the principles established with the Declaration of Helsinki (1964) as revised in 2000 in Edinburgh, and approved by the Clinical Research Ethics Committee of Aragón (18/2008).

The exclusion criteria were: (1) people under 65 years; (2) those suffering from cancer; (3) elderly who were living in nursing homes or were not able to take care of themselves; (4) non-postmenopausal women; (5) any persons with neuromuscular or neurodegenerative diseases or physical disabilities, including orthopedic or arthritic problems; (6) those with serious heart problems as heart failure and arrhythmias; (7) diabetes; (8) epilepsy; (9) gallstones; (10) kidney stones and (11) stroke.

Those who met the inclusion criteria were randomly assigned to one of the study groups. A total of 24 elderly trained on a vibration platform (WBV group). A group of 25 age-matched elderly served as a control group (CON group) and did not participate in any training. Participants of both groups were asked not to change their lifestyle during the course of the project. The baseline characteristics of both groups are shown in table I.

The trainings were performed 3 times per week for 11 weeks. Each session was supervised and included 10 repetitions of 45 seconds with a rest period of 60 seconds between each repetition. During the training intervention, the participants were asked to stand in a wide squat position (160°) on the vibration platform, lightly holding the handrails of the machine (Pro5 Power Plate, Power Plate International Ltd., London, UK) with both hands. The frequency of vibration was 40 Hz and the amplitude was 2 mm (low).

A DXA scanner (QDR-Explorer, Hologic Corp., Software version 12.4, Waltham, MA, USA) was used to evaluate LM (g) at the whole body, upper and lower limbs. All DXA scans, which were completed with the same device and software, were performed by the same technician who had been fully trained in the operation of the scanner, the positioning of participants, and the

Table I
Descriptive characteristics of the participants

	CON (n = 25)		WBV (n = 24)	
	Pre-training Mean ± SD	Post-training Mean ± SD	Pre-training Mean ± SD	Post-training Mean ± SD
Age (y)	74.84 ± 4.85	75.16 ± 4.88	75.17 ± 4.70	75.54 ± 4.76
Body mass (kg)	68.42 ± 11.31	68.45 ± 11.44	67.92 ± 11.27	67.63 ± 10.71
Height (cm)	157.09 ± 9.57	157.20 ± 9.73	159.54 ± 9.42	159.49 ± 9.17
BMI (kg/m ²)	27.71 ± 3.86	27.68 ± 3.84	26.61 ± 3.24	26.54 ± 3.28

CON: Control group; WBV: Whole body vibration group; BMI: Body mass index.

analysis of results, according to the manufacturer's guidelines. Quality assurance and spine phantom calibration procedures were performed daily prior to each scanning session to ensure no machine drift occurred during the intervention period.

Mean and standard deviation (SD) are given as descriptive statistics. Kolmogorov-Smirnov tests showed normal distribution of the studied variables. Group differences of descriptive data were assessed by one-way analysis of variance (ANOVA).

Analysis of covariance (ANCOVA) was used to test the differences between groups for all variables in pre- and post-training assessments, including age and height as covariates. The same analysis was carried out to test the differences in the percentage of change between groups.

Two-way repeated measures ANOVA (group by time) was used to determine the effects of the intervention on the variables and also to determinate the within group changes throughout the intervention period, controlling for age and height as possible confounders. The same statistical procedure was used to test whether there was a sex by training interaction.

All the analyses were performed using the Statistical Package for Social Sciences software (SPSS, v. 15.0 for WINDOWS; SPSS Inc., Chicago, IL, USA), and values of $P < 0.05$ were considered statistically significant.

Results

Adherence to training averaged $90.15 \pm 10.73\%$, ranged from 61 to 100 per cent. No withdrawals from

the CON or WBV groups occurred. There were no adverse effects and no health problems in the participants of both groups over the intervention.

Table I shows descriptive characteristics (mean ± SD) of the study sample. No differences were found in age, height, body mass and body mass index between CON and WBV groups in pre- and post-training moments.

As no sex by training interactions were found (data not shown) analyses were performed including men and women as a whole.

Adjusted values of LM at pre- and post-training moments, as well as percentage of change and time by group interactions are reported in table II. CON and WBV groups showed similar values of LM at every site. No significant within group variations were detected at total, arms or legs LM. Moreover, no significant differences in the percentage of change of both groups and no group by time interaction were found in none of the variables.

Discussion

To our knowledge, this study is the first randomized controlled trial testing the effects of a short-term WBV training program on LM which includes non-institutionalized elderly men and women in the study sample. The results of the present study show that an 11-week intervention program based on WBV is not enough to cause any significant changes on LM in the whole body, upper body or lower body extremities measured by DXA.

Although the effects of long- and short-term WBV interventions in other health issues such as bone mass

Table II
Adjusted values of lean mass in CON and WBV groups at baseline and follow-up

	CON (n = 25)			WBV (n = 24)			Group by time interaction (p)
	Pre-training Mean ± SD	Post-training Mean ± SD	% Change	Pre-training Mean ± SD	Post-training Mean ± SD	% Change	
Whole body (kg)	39.26 ± 5.19	39.59 ± 5.25	0.8	39.86 ± 4.35	39.73 ± 4.09	0.1	0.212
Arms (kg)	2.07 ± 0.41	2.09 ± 0.39	0.8	2.06 ± 0.32	2.09 ± 0.33	1.9	0.728
Legs (kg)	6.43 ± 0.79	6.45 ± 0.81	0.3	6.67 ± 0.73	6.68 ± 0.68	0.6	0.971

CON: Control group; WBV: Whole body vibration group.

or physical fitness are well reported in this specific population,^{10,11} less is known about the impact of this specific intervention on LM. In fact, to our knowledge there are only two studies which tested the impact of WBV training alone (not in combination with other types of exercise)^{12,13} on muscle mass measured by computed tomography. The first one showed a significant muscle hypertrophy after 10 weeks of WBV training in community-dwelling postmenopausal women and the latter showed similar increments in muscle mass in community-dwelling older men after 1-year of WBV. One of the possible explanations for the differences found between the studies mentioned above and those found in our study could be the baseline characteristics of the participants. It is widely known that low levels of muscle mass are associated with lower functional capacity, autonomy and higher dependence. Therefore, due to community-dwelling seniors use to have lower values of LM, they may achieve improvements more quickly. Other possible explanations could be the different devices used to assess LM between our study (DXA) and the research developed by Machado et al.¹² and Bogaerts et al.¹³ (tomography) and also the characteristics of the intervention, such as the differences in the intensity and the exercises performed during the vibration.

Taking into account the results found in this study, an 11-weeks WBV intervention does not lead to improvements in the LM of non-institutionalized elderly men and women. However, it seems to be useful to improve upper- and lower- strength¹⁴ and therefore, this type of exercise could be effective for the treatment and prevention of sarcopenia in the elderly.

Some limitations of this study deserve comment. Although we controlled for several potential confounders as age and height, we cannot be certain that other unmeasured confounders such as other physical activity participation, medication or genetic variation, have influenced our observations.

Due to the relative small size of population assed in this study, a logical step for future research would thus be the inclusion of more participants to test these results in larger cohorts. Another step to take into account in future research would be the evaluation of LM in a short- plus long-term WBV intervention, other training intensities and the inclusion of more training sessions per week.

Conclusion

A short-term low intensity WBV intervention is not enough to cause any changes on LM measured with DXA in non-institutionalized elderly men and women; however, despite of the absence of hypertrophic effects on muscle mass, it may be a good non-pharmacological therapy for sarcopenia due to it causes improvements on muscle strength in this specific population.

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References

1. Gomez-Cabello A, Vicente Rodriguez G, Vila-Maldonado S, Casajus JA, Ara I. Aging and body composition: the sarcopenic obesity in Spain. *Nutr Hosp* 2012; 27: 22-30.
2. Walston JD. Sarcopenia in older adults. *Curr Opin Rheumatol* 2012; 24: 623-7.
3. Freiburger E, Sieber C, Pfeifer K. Physical activity, exercise, and sarcopenia - future challenges. *Wien Med Wochenschr* 2011; 161: 416-25.
4. Evans WJ. Skeletal muscle loss: cachexia, sarcopenia, and inactivity. *Am J Clin Nutr* 2010; 91: 1123S-1127S.
5. Burgos Pelaez R. Global therapeutic approach to sarcopenia. *Nutr Hosp* 2006; 21 (Suppl. 3): 51-60.
6. Peterson MD, Sen A, Gordon PM. Influence of resistance exercise on lean body mass in aging adults: a meta-analysis. *Med Sci Sports Exerc* 2011; 43: 249-58.
7. Kemmler W, von Stengel S. Alternative Exercise Technologies to Fight against Sarcopenia at Old Age: A Series of Studies and Review. *J Aging Res* 2012; 2012: 109013.
8. Gómez-Cabello A, Pedrero-Chamizo R, Olivares PR, Luzardo L, Juez-Bengochea A, Mata E et al. Prevalence of overweight and obesity in non-institutionalized people aged 65 or over from Spain: the elderly EXERNET multi-centre study. *Obes Rev* 2011; 42: 301-25.
9. Pedrero-Chamizo R, Gomez-Cabello A, Delgado S, Rodriguez-Llarena S, Rodriguez-Marroyo JA, Cabanillas E et al. Physical fitness levels among independent non-institutionalized Spanish elderly: The elderly EXERNET multi-center study. *Arch Gerontol Geriatr* 2012; 55: 406-16.
10. Gómez-Cabello A, Ara I, González-Aguero A, Casajús JA, Vicente-Rodríguez G. Effects of training on bone mass in older adults: a systematic review. *Sports Med* 2012; 42: 301-25.
11. Sitja-Rabert M, Rigau D, Fort Vanmeerghaeghe A, Romero-Rodríguez D, Bonastre Subirana M, Bonfill X. Efficacy of whole body vibration exercise in older people: a systematic review. *Disabil Rehabil* 2012; 34: 883-93.
12. Machado A, García-López D, González-Gallego J, Garatachea N. Whole-body vibration training increases muscle strength and mass in older women: a randomized-controlled trial. *Scand J Med Sci Sports* 2010; 20: 200-7.
13. Bogaerts A, Delecluse C, Claessens AL, Coudyzer W, Boonen S, Verschueren SM. Impact of whole-body vibration training versus fitness training on muscle strength and muscle mass in older men: a 1-year randomized controlled trial. *J Gerontol A Biol Sci Med Sci* 2007; 62: 630-5.
14. Gómez-Cabello A, González-Aguero A, Ara I, Casajus JA, Vicente-Rodríguez G. Effects of a short-term whole body vibration intervention on physical fitness in elderly people. *Maturitas* 2013; (in press). doi:pii: S0378-5122(12)00408-2. 10.1016/j.maturitas.2012.12.008.