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DOES A WHOLE BODY VIBRATION INTERVENTION HAVE ANY EFFECT ON ADIPOSITY IN ELDERLY PEOPLE?

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ABSTRACT

Introduction: The ageing process is accompanied by an increase in fat mass (FM) and a redistribution of the adipose tissue, which are associated with several pathologies. The aim of this study was to test if an 11-weeks whole body vibration (WBV) intervention has any effect on FM in older adults. Material and Methods: Forty-nine non-institutionalized seniors (20 men) participated in the study. Twenty-four participants (75.2±4.7 years) trained static squat-positioned on a WBV platform three times per week for eleven weeks. The remaining 25 (74.8±4.9 years) were allocated into the control group (CON). FM at the whole body, trunk, upper and lower limbs was assessed via DXA. Results: WBV and CON groups showed similar values for FM at every body region during pre- and post-testing. No significant within group variations were detected at total, trunk or arms FM; however, there was a significant decrease in legs FM in both groups ($p<0.05$). Discussion: From the obtained results, it can be concluded that an 11-weeks WBV therapy is not an effective method for reducing fat mass in older adults. Therefore, the use of the WBV devices available on the market, aiming weight loss or FM decreases should be avoided in this population.

Key Words: ageing, body composition, fat mass, obesity, exercise, training

¿TIENE EL ENTRENAMIENTO VIBRATORIO ALGÚN EFECTO SOBRE LA ADIPOSIDAD DE LAS PERSONAS MAYORES?

RESUMEN

Introducción: El proceso de envejecimiento se acompaña de un aumento de la masa grasa (MG) y una redistribución del tejido adiposo, lo que se asocia con un incremento de diversas patologías. El objetivo de este estudio fue el de evaluar si una intervención de entrenamiento sobre plataforma vibratoria de 11 semanas de duración tenía algún efecto sobre la masa grasa de las personas mayores. Material y métodos: Cuarenta y nueve personas mayores no institucionalizadas (20 hombres) participaron en el estudio. Veinticuatro (edad media de 75,2±4,7 años) realizaron un entrenamiento sobre plataforma vibratoria 3 veces a la semana durante 11 semanas (VIB). Los 25 restantes (edad media de 74,8±4,9 años) conformaron el grupo control (GC). Mediante DXA se midió la MG del cuerpo completo, tronco, extremidades superiores e inferiores tanto antes como después del programa de intervención. Resultados: Ambos grupos mostraron valores similares de MG en las dos evaluaciones. No se encontraron variaciones en la MG total, del tronco o brazos en ninguno de los grupos; sin embargo, se observó un descenso significativo de la MG en las piernas tanto en el grupo VIB como en el CG ($p<0,05$). Discusión: A partir de los resultados obtenidos se puede concluir que una intervención de 11 semanas sobre plataforma vibratoria no es un método eficaz para reducir la masa grasa en personas mayores. Por tanto, el uso de plataformas vibratorias como medida para la pérdida de peso o grasa en esta población debería tratar de evitarse.

Palabras clave: envejecimiento, composición corporal, masa grasa, obesidad, ejercicio, entrenamiento

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INTRODUCTION

Ageing is a process accompanied by variations in body composition, which include an increase in fat mass (FM) and a redistribution of the adipose tissue. These changes frequently lead to suffer body composition-related pathologies in this specific population, such as obesity, sarcopenia or sarcopenic obesity (Gomez-Cabello et al., 2012). In fact, the prevalence of overweight-obesity and central obesity in the Spanish non-institutionalized older adults rise up to 84% and 56%, respectively (Gomez-Cabello et al., 2011). Other countries, such as Greece showed similar patterns with 84% of the population aged 60 to 70 years being overweight (Koukoulis et al., 2010). Lower prevalences were found in France and Italy in studies carried out in 2006 and 2008 (Charles et al., 2008; Micciolo et al., 2010). In these studies, 68% and 51% of French men and women from 60 to 69 years of age were classified as overweight or obese (Charles et al., 2008), while in Italy this prevalence was 68% and 52% for men and women respectively (Micciolo et al., 2010). Higher prevalence than France and Italy was observed in England, where 75% of men and 67% of women were overweight (Hirani and Mindell, 2008).

Taking into account that an excess in FM is related with adverse health outcomes such as increased morbidity and higher risk of mortality (Donini et al., 2012), and keeping in mind the increased life expectancy in developed societies; these pathologies constitute a large and important problem which may imply concerns and costs for the health systems.

Traditionally, the efforts on managing body weight or reducing FM have focused on nutrition and physical activity interventions (Carson et al., 2014; Stehr and von Lengerke, 2012). In fact, it has been shown that a reduction of energy intake and/or an increase in physical activity leads to reductions in weight, total FM as well as a decrease in the visceral adipose tissue (Ross and Janssen, 2001). Moreover, in a recent systematic review aiming at examine the association between sedentary behavior and health outcomes in older people, a relationship between sedentary behavior, waist circumference and overweight/obesity was reported (de Rezende et al., 2014). On the other hand, specific training programs might help to reduce FM and lead to a favorable fat redistribution in elderly people. In fact, aerobic training without dietary modifications is effective in reducing total, intra-abdominal and subcutaneous abdominal FM (Friedenreich et al., 2011; Irwin et al., 2003). Also, there is some evidence that moderate- or high-intensity resistance exercises lead to decreases in total body FM (Campbell et al., 1994; Hunter et al., 2002).

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 type of devices have been advertised as effective for weight and FM losses and has been introduced in health and fitness centers as an alternative method for improving physical fitness and body composition; however, scientific data on its effectiveness is scarce. The rationale for using WBV to reduce body weight and/or FM lies in the fact that this intervention seems to increase the metabolic cost of exercise and therefore energy expenditure.

In this regards, Garatachea et al. (2007) found that VO_2 was higher when squatting on top of a WBV platform than doing the same on the floor. Recently Serravite et al. (2013) showed that WBV in conjunction with moderate external loading can increase oxygen consumption; however this effect was as effective as doubling the external load during squatting without WBV.

However, despite some efforts have been made in order to test this intervention in body-composition related variables, such as lean mass and mainly bone mass (Totosy de Zepetnek et al., 2009), evidence regarding the effect of WBV on FM is still scarce, especially in older adults.

METHOD

Experimental approach to the problem

This study tests whether an 11-weeks WBV intervention has any effect on total and regional FM in men and women over the age of 65. The knowledge provided in this study will allow knowing if these type of devices are a useful tool to reduce the adiposity in the elderly population.

Participants

A total of 49 non-institutionalized elderly (20 men) 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 characteristics have been described in detail elsewhere (Gomez-Cabello et al., 2011). Briefly, the EXERNET project was a cross-sectional study for the evaluation of body composition and physical fitness in a representative sample of the elderly people from Spain.

Baseline data were collected between January and February 2011. Written informed consent was obtained from all the included participants and subjects were informed of the benefits and risks of the investigation prior to signing. The study was performed according to the principles established with the Declaration of Helsinki and approved by the Clinical Research Ethics Committee of Aragón (18/2008).

The exclusion criteria for participation in this controlled trial were: 1) people under 65 years; 2) elderly who were living in nursing homes; 3) seniors who were not able to take care of themselves; 4) non-postmenopausal women: 5) those suffering from cancer and/ or dementia; 6) diabetes; 7) epilepsy; 8) stroke; 9) kidney stones; 10) gallstones; 11) neuromuscular or neurodegenerative diseases and 12) heart problems.

Those participants who met the inclusion criteria were randomly assigned to one of the groups (Figure 1). A total of 24 participants (10 men and 14 women, aged 75.2±4.7 years) composed the vibration group (WBV), and the remaining 25 (10 men and 15 women, aged 74.8±4.9 years) were allocated into the control group (CON) and did not participate in any training. Participants of both groups were asked not to change their lifestyle during the course of the project (ie. nutritional habits or physical activity).

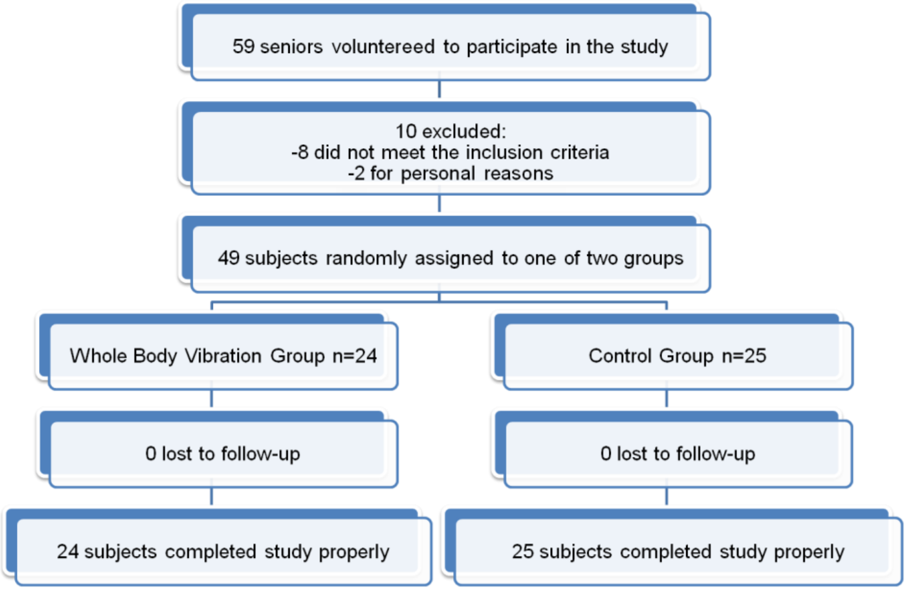

FIGURE 1: Flow diagram of participants.

Procedures

The WBV trainings were performed 3 times per week for 11 weeks. Each session was supervised by a PhD student in sport sciences and included 10 repetitions of 45 s with a rest period of 60 s between each repetition. During the training intervention, the participants were asked to stand (with shoes) in a wide static squat position (knee joint at 160º) on the WBV platform (Pro5 Power Plate, Power Plate International Ltd., Amsterdam, The Netherlands), lightly holding the handrails of the machine with both hands. The frequency of vibration was set at 40 Hz and the amplitude was 2 mm.

A dual-energy X-ray absorptiometry (DXA) scanner (QDR-Explorer, Hologic Corp., Software version 12.4, Waltham, MA, USA) was used to evaluate FM (in kg) at the whole body, trunk, upper and lower limbs. Additionally, lean mass

(LM, g), bone mineral content (g) and density (g/cm^2) were also analyzed (Gomez-Cabello et al., 2013a; Gomez-Cabello et al., 2013). 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 analysis of results, according to the manufacturer's guidelines. Quality assurance and spine phantom calibration procedures were performed daily prior to each scanning session. We have previously examined the test–retest (with repositioning) precision error for regional analysis of the complete body scan, using coefficients of variation (CV). The CV were: 2.3% for BMC, 1.3% for BMD, 2.6% for bone area and 1.9% for fat-free lean mass.

Statistical analyses

Mean and standard deviation (SD) are given as descriptive statistics. Kolmogorov-Smirnov tests showed normal distribution of the studied variables. Two-way repeated measures ANCOVA (group by time) tests, using height and age as covariates were used to determine the effects of WBV on each variable and the within group changes throughout the intervention period. As no sex by training interactions were found (data not shown) analyses were performed including women and men as a whole. ANCOVA analyses were also applied to test the differences between groups for total, regional FM and percentage of change, including height and age as covariates. Significance value was set at $p<0.05$. Analyses were performed using the Statistical Package for Social Sciences (v.15.0 for WINDOWS; SPSS Inc., Chicago, IL, USA).

RESULTS

Adherence to training averaged 90.2±10.7% with no withdrawals from any group and no adverse effects or health problems observed over the intervention period.

Table 1 shows descriptive data (mean ± SD) of the participants. No differences were found for age, height, body mass, body mass index (BMI), total lean mass, total FM and % FM between CON and WBV groups neither pre- nor post-training.

TABLE 1
Descriptive characteristics of the participants.

	CON (n=25)						WBV (n=24)					
	Pre-training			Post-training			Pre-training			Post-training		
	Mean	±	SD	Mean	±	SD	Mean	±	SD	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/m²)	27.71	±	3.86	27.68	±	3.84	26.61	±	3.24	26.54	±	3.28
Total lean mass (kg)	39.26	±	8.70	39.59	±	8.78	39.86	±	8.17	39.73	±	7.50
Total fat mass (kg)	23.68	±	5.49	23.33	±	5.33	22.50	±	6.40	22.33	±	6.25
% Fat mass	37.83	±	7.21	37.30	±	7.01	36.06	±	7.40	35.90	±	7.14

CON: control group; WBV: whole body vibration group; BMI: body mass index

Adjusted values for FM at pre- and post-training moments, as well as percentage of change and time by group interactions are reported in Table 2. WBV and CON groups showed no differences for total and regional FM in both evaluations (pre and post). No significant within group variations were detected at total, trunk or arms FM; however, there was a significant decrease in legs FM in both groups (2.4% and 3.0%, CON and WBV respectively; $p<0.05$). No significant differences in the percentage of change and no group by time interactions were found for any variable.

TABLE 2
Age- and height-adjusted values of fat mass in CON and WBV groups at pre- and post-training.

	CON							WBV							Group by time Interaction (P)
	Pre-training			Post-training				Pre-training			Post-training				
	Mean	±	SD	Mean	±	SD	% Change	Mean	±	SD	Mean	±	SD	% Change	
WB (kg)	23.68	±	5.55	23.33	±	5.38	-1.21	22.50	±	6.65	22.33	±	6.50	-0.57	0.638
Trunk (kg)	13.17	±	3.63	13.09	±	3.71	-0.52	12.07	±	3.84	12.18	±	3.71	1.16	0.464
Arms (kg)	1.53	±	0.39	1.51	±	0.41	-1.84	1.35	±	0.44	1.32	±	0.42	-1.80	0.858
Legs (kg)	3.74	±	0.93	3.64*	±	0.89	-2.43	3.87	±	1.41	3.76*	±	1.41	-2.97	0.814

CON: control group; WBV: whole body vibration group; WB: whole body.

**P<0.05 pre vs. post*

DISCUSSION

The main finding of the present study is that an 11-weeks WBV intervention is not enough to produce a significant reduction of total or regional FM in a group of non-institutionalized older adults. This study is the first randomized controlled trial testing the effects of a WBV intervention on

FM including non-institutionalized male and female older adults. While scientific evidence supports the use of WBV as an effective therapy by which bone mass and muscle strength (Totosy de Zepetnek et al., 2009) or physical fitness (Cristi et al., 2014; Gomez-Cabello et al., 2013b; Tsuji et al., 2014) can be improved, mainly in disabled populations (Gonzalez-Aguero et al., 2013; Matute-Llorente et al., 2014) there is a lack of data on the possible benefits of these interventions on adiposity and FM.

To the best of our knowledge, there are only a few studies that have previously evaluated this issue in the elderly (Fjeldstad et al., 2009; Verschueren et al., 2004; von Stengel et al., 2012). Moreover, only two of them tested the isolated impact of this intervention on FM (Verschueren et al., 2004). Verschueren et al. (2004) evaluated the effects of 24 weeks of WBV training in a group of postmenopausal women with an average age of 64 years. In this study, total FM decreased significantly during the intervention period, while no significant change in FM was observed in the control group. Tapp et al. (2014) evaluated the effectiveness of 8 weeks of WBV in body composition and muscular strength in sedentary postmenopausal women. WBV training was compared with aerobic and resistance training. The results indicated that performing WBV 3 times per week may not be an effective alternative to traditional training with regard to body composition or aerobic capacity, but could have a positive impact on lower body strength. Fjeldstad et al. (2009) and von Stengel et al. (2012) tested the effects of an 8-months and an 18-months WBV interventions on body composition in elderly women (aged ~63 and 68.5 years, respectively), combined with an additional exercise program. In both studies, the addition of WBV to high intensity resistance training did not result in greater improvements in total or regional FM compared to the exercise program alone. In our study, no significant changes at the whole body, trunk and upper limbs were found in the WBV or in the CON group. Unexpectedly, there was a decrease in lower limbs FM in both groups. However, this variation in FM did not differ between groups neither was explained by the intervention.

The efectiveness of WBV interventions, combined with diet or exercise programs, has also been tested in other type of populations, such as obese adults (Bellia et al., 2014; Milanese et al., 2013; Vissers et al., 2010; Wilms et al., 2012). Bellia et al. (2014) and Vissers et al. (2010) tested the effects of WBV plus diet in middle-aged obese people. Both studies showed higher reductions in FM when combining WBV and diet than when only dieting. Positive results were also found by Milanese et al. (2013) in a 10-week WBV training period in middle-aged obese women. They found that WBV training significantly reduced BMI, total FM, trunk fat, sum of skindfolds and body circumferences. On the contrary, Wilms et al. (2012) studied the effect of a 6-week endurance training program that was either combined or not with additional WBV. Waist circumference and FM percentage decreased to similar extent in both groups, showing no extra benefitial effect of WBV when added to endurance training in obese women.

According to the current literature, the impact of WBV interventions in adiposity remains still unclear and the different protocols used in the therapies might be hindering a better comparison between studies. Moreover, it seems that this type of intervention could impact differently in different population groups, being more effective in obese or disabled people.

Some limitations of this study deserve comment. Due to the relatively small number of participants assessed in the present study, a logical step for future research would be the inclusion of a bigger sample to test these results in larger cohorts. Another step to take into account in future research would be the evaluation of FM in a short- plus long-term WBV intervention, other training intensities and the inclusion of more training sessions per week. Finally, although participants were encourage not changing their nutritional and physical activity habits during the intervention period, we can not be sure that there were not changes in their lifestyle that could affect these results. Therefore, further studies evaluating diet and physical activity throughout the program are warranted.

CONCLUSIONS

From the obtained results, it can be concluded that an 11-weeks WBV intervention is not an effective method for reducing fat mass in non-obese older adults.

From a practical point of view, the current study provides useful information for personal trainers and proffesionals in the field of physical activity and health. Taking into account the non-conclusive and limited data in this field, the arguments for using WBV devices available on the market, which promote weight loss or FM decreases in short periods of time should be avoided, since these claims may produce misunderstandings and false expectations in the elderly population.

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