Jiménez, M.C.; Párraga, J.A. y Lozano, E. (2013) Incidencia de un programa de actividad física sobre las capacidades físicas de mujeres más de 60 años / Impact of a training program in women 60 years-old and older. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. 13 (50) pp. 217-233. Http://cdeporte.rediris.es/revista/revista50/artincidencia352e.pdf

ORIGINAL

IMPACT OF A TRAINING PROGRAM IN WOMEN 60 YEARS-OLD AND OLDER

INCIDENCIA DE UN PROGRAMA DE ENTRENAMIENTO EN MUJERES MAYORES DE 60 AÑOS

Jiménez, MC[1]., Párraga, J.A[2]. y Lozano, E.[3]

1. Departamento de Ciencias de la Salud. Universidad de Jaén. España cjimenez@ujaen.es
2. Departamento de Didáctica de la Expresión Musical, Plástica y Corporal. Universidad de Jaén. España. jparraga@ujaen.es
3. Departamento de Estadística e Investigación Operativa. Universidad de Jaén. España. elonzano@ujaen.es.

Spanish-English translator: Erika María Casillas erika221@aol.com

Códigos UNESCO / UNESCO Code:

2411.06 Fisiología del Ejercicio / Exercise Physiology

3201.07 Geriatría / Geriatrics

Clasificación del Consejo de Europa / Council of Europe classification:

6. Fisiología del ejercicio / Exercise Physiology

11. Medicina del deporte / Sport medicine

Recibido 2 de marzo de 2011 **Received** March 2, 2011

Aceptado 26 de junio de 2011 **Accepted** June 26, 2011

ABSTRACT

In order to test the effects of an in group comprehensive exercise program, which exercises all the general physical abilities, a before and after comparison study was done with a group of 37 women (n=37) varying from 60-80 years old, with a median age of 66 all from Jaén. 58 sessions were administered bi-weekly (60 minute sessions). Significant differences between the initial and final measurements were found, $p \leq 0.05$, for variables weight (-1.28 kg), body mass index (- 0.9 kg/m2, -2,92%), fat mass (-1.78 kg, -3,63%), balance (+80%), walking test (-2 minutes) and VO_2max, obtained by means of the walking test (+6 ml of O_2/kg/minute). Changes in lean body mass and heart rate were not significantly different as measured before and after the Walking test. Conclusion: a comprehensive training program affects positively the physical abilities of women 60 years old and older.

KEY WORDS: Physical activity training program, physical abilities, women 60 years old and older.

RESUMEN

Para comprobar los efectos de un programa integral de actividad física en grupo, estimulando todas las capacidades de manera general, se realizó un trabajo, diseño pre-tratamiento-post, con un grupo de 37 mujeres (n=37), media= 66 años (60 y 80 años), de Jaén. Se aplicaron 58 sesiones, 2 semanales (60 minutos sesión). Se encontraron diferencias significativas entre la medición inicial y final, $p \leq 0,05$, para las variables Peso (-1,28 kg), Índice de masa corporal (-0,9 kg/m2, -2,92%), Masa grasa (-1,78 kg, -3,63%), Equilibrio (+80%), Walking-test (-2 minutos) y VO_2máx, obtenido mediante la prueba de Walking test (+6 ml de O2/kg/minuto). No se apreciaron diferencias en la masa magra y en la frecuencia cardíaca obtenida al finalizar la prueba de Walking test. Conclusión: un programa de entrenamiento integral incide positivamente sobre las capacidades físicas de las mujeres mayores de 60 años.

PALABRAS CLAVE: programa entrenamiento, capacidades físicas, mujeres mayores.

1. INTRODUCTION

Evidences confirm that an optimal level of physical capabilities of a person contributes significantly to the improvement and/or maintenance of health in any age group (OMS, 2010). This aspect becomes more important when we talk about older people, since the aging process impacts the body more quickly and strongly. Impacting the stimuli that are applied to the body differently as they occur in other ages.

It is a fact that exercise is a preventive and therapeutic strategy against aging (Marques et al., 2011). More and more seniors are finding that exercising is an optimal stimulus and it is connected with their happiness and personal satisfaction. The impact of exercise should not be simply focused on physical and/or cognitive factors, since emotional factors related to emotional and social aspects seem to have an important contribution to health (Justine and Hamid, 2010).

Undoubtedly, the increase or adequate maintenance of capacities in relation to age of the person suggests along with other habits and lifestyles, are one of the fundamental pillars on which their lifestyle should be based along with intervention we did with them. Not only does is it intended to increase the quality of life for the person and/or the potential for longevity (Balboa-Castillo et al., 2011), but rather, be conscious of the factors that enable us to bring awareness to these two aspects and how to intervene to ensure a greater and better efficiency in the intervention.

It has been shown sufficiently that as a consequence of aging, changes are produced in the structure and function of the body. They result from the combination of singular processes and the interaction between genetic and environmental factors, along with the appearance of certain diseases and the devastating effects of a sedentary lifestyle (Geithner and McKenney, 2010). All of which accelerates the development of diseases and weakening the physical capabilities.

A sedentary lifestyle, obesity, and the combination of both, are significant risks regarding important parameters that determine the health of people. These issues tend to be associated with impaired mobility, loss of strength, appearance of fatigue and a significant deficit in the balance and body stability. This, combined with the effects of aging, significantly increases the risk of disease, significant losses to the health or hastens death. Along this line is the work of Paffenbarger (1986) who found a significant association between increased energy expenditure and increased longevity of people, which was enhanced when shared with other habits. Aside from genetic factors, we have the ability to intervene on the other habits and decisively reversing the consequences.

Therefore, one of the most effective strategies for aging and increasing life expectancy and quality of life, is to conduct and maintain an adequate regular exercise program that comprehensively affects the body. It is not about specific stimuli, but enhancing the concept of overall functioning of the body and interaction that occur between stimuli that affect different organ systems. It is clear that the movement regardless of the activity, type of training, frequency, etc.., has comprehensive benefits on different and ample factors (obesity, cardiovascular disease, diabetes, metabolic syndrome, cancer, etc.) (Ryan, 2010).

The movement is vital for anyone, such as food and rest, but not all movement is healthy and not all stimuli are optimal or affect equally in the same or different people. Hence the need to identify what type of movement is the best in each situation and how to develop to affect the body as we want. Each person has the capabilities, needs, interests and possibilities in relation to their participation in activities that will guarantee the movement they need. So we must not fall into the trap of generalizing the practice, unless of course we understand it only as a statement of the general guidelines to follow. Being a reference the basis of sports training adapted to the elderly population from the health paradigm where it is broadly defined to encourage skills (OMS, 2010).

It is clear that any form of physical activity, with minimal levels of intensity and frequency in its exposure, is an optimal stimulus on the capabilities of the elderly. In numerous studies, Puggard (1999), Pescatello et al. (2000), Brochu et al. (2000), Hurley and Roth (2000), Left-Porrera et al. (2000), Hernandez (2001), Clearlock and Nuzzo, (2001), Fahlman et al. (2002), Verissimo et al. (2002), Restrepo et al. (2003), Izquierdo et al. (2003), Ballard et al. (2004), Grant et al. (2004), Bersot and Santos (2005), DiBrezzo et al. (2005), Evans et al. (2005), Stewart et al. (2005), Orr et al. (2006), Alexander Kolbe et al. (2006), Simons and Andel (2006), Morrison et al, (2010), Marques et al. (2011), among others, who analyzed training programs and their impact on the physical abilities in the elderly all obtained significant improvements. Adopting development strategies of individual and group, with a preventive orientation of rehabilitative, maintenance and/or recreational. All of have experimented in programs with different variables in terms of duration, intensity, tasks, organization, etc. and have shown improvements related to essential health.

The evidences lead us to state that having an energy expenditure is a key reference in the development of programs, such as the stimulation of different capacities, conditional and coordinated, because their interaction depends on the adaptive response of the body.

We think that when promoting physical activity in healthy populations, a good strategy is the development of activities that stimulate the body in a holistic manner, trying a sufficient level of empathy of the participants with the program and benefiting from the contributions of the activities in group.

The aim of our intervention was to test the effects of a comprehensive program, in-group, on their physical activity. The intervention was realized during 2 weekly meetings, each session lasting 60 minutes, and with intensities between 60-65 % of reservation. Testing also the effects the program had on great impact capacities for the health in healthy women 60 years old or older.

2. METHOD

In order to verify the effects of a physical activity program, a study was realized with a group of 37 women (n=37), with a mean age of 66 (60-80 years), and who all were from Jaén (table 1). At least 50 % were aged between 63 and 68 years, as the percentiles 25 and 75 reflect. The program was characterized by the integration of contents that stimulated the conditional capacities and the coordinative capabilities from an integral perspective. Communication and expression was important in order to stimulate the emotional component.

Table 1- Age of Subjects

Descriptive statistics		Age
N		37
Mean		66
Median		65
Std. Deviation		5
Minimum		60
Maximum		80
Percentile	25	63
	50	65
	75	68
Confidence Interval for the mean 95%	Lower limit	65
	Upper limit	68

This was a within-subjects experimental study, with a pretest and posttest design. The training program consisted of various stimuli such as: endurance, strength, coordination and balance, and range of motion. Focusing on aspects of control and body awareness. They were all characterized by group dynamics based on continuous interaction among participants, so that the emotional participation in the same was satisfactory. The sessions were systematized in a way to ensure a greater control of variables.

Before the experimental treatment, all subjects underwent a medical examination. This proved that the subjects didn't have any physical impediments in performing the physical exercises and that they were eligible to participate in the study. All subjects participated voluntarily by signing a consent form. It was found that no one had any previous experience in physical activity programs. It was deemed necessary they be submitted to an 8-week process of adaptation training. This phase consisted in similar activities to that of those that they would develop in the primary intervention, with the objective of blocking the effects of adaptation and or learning. The program was interrupted for four months in between the adaptation and experimental phase. This guaranteed enough time for the subjects to lose the improving effects acquired during the adaptation phase and have it not interfere with the study's results.

The treatment consisted of two weekly sessions, each lasting 60 minutes, and a total of 58 sessions (29 weeks). The comprehensive program included physical activities, which were executed in groups with general stimuli of the different physical capabilities. Focusing on the subjects moving with established levels of intensity. These conditions were maintained during the entire treatment.

The effects of the program to which the subjects were subjected to were tested in different physical capabilities such as: body composition (BC), static balance (SB) and a walking-test (WT) with a heart rate and VO_2max analysis at the end of the walking-test. Two measurements were taken before and after the treatment. Leaving 78 hours in between the last session and the final data collection.

The sessions were divided into three activity blocks:

a. Block I: A 10 min warm up; Focusing on general body movements and moving around. The tasks were organized in a way to encourage and create a positive attitude towards the session.

b. Block II: This primary blocks duration lasted 35 minutes and the working contents were: Endurance (60-65% intensity), strength (to improve muscle tone, working the body in different postural and spatial situations, and also using the resistance of fellow participants and small weights) range of motion (using joint mobility tasks), coordination, and balance. The objective was to stress and integrate different capabilities through games and adapted tasks. The shared tasks were to be alternated among the individuals. A simple organized structure was used with the objective of minimizing the organization time, which was all done in a group structure with a circular arrangement, all while having a large individual work sharing space.

c. Block III: A 15 minute cool down, similar to the warm up. Subjects do displacement movements, with a focus on mobility. Encouragement and group dynamics in relation with general mobility was emphasized. In this block, seven minutes was dedicated to stretching the principal big muscle groups and then a small game was played for final relaxation.

In order to ensure the control of intensity of the practice, two randomly selected subjects wore pulsometers, verifying that the data was within the established limits. In addition, the perceived exertion scale by Borg (1982) was used on 10 subjects at three different times (minute 15, 30, and 45 of the session). They also wore pedometers to prove the total distance they had traveled.

To calculate the body composition of the subjects a bioelectrical impedance analysis was carried out (TANITA® model TBF-30-MA). For testing balance, subjects had to balance on one foot for 60 seconds (best score out of two attempts was used). Notes were taken on the type of contact the subject made with the floor or wall with any part of their body during the test. Subjects for the walking test had to walk 2km at their maximum speed and at the end of the test, their total time of completion and heart rate were taken.

3. RESULTS

A descriptive analysis was done of the variables, complemented by the statistical hypothesis testing using Anova for one factor and t for Student for related measures. For the descriptive analysis of data, an analysis of the frequency in variables was completed, calculating the basic statistical parameters: valid cases, mean, median, standard deviation, minimum, maximum, and percentiles, and lastly a 95 % confidence interval. The statistical hypothesis testing proved the existence of differences between the values of: anthropometric measurements, body mass (BMI, fat mass and lean mass), static balance, walking test, heart rate and VO_2max. These values were obtained after applying a comprehensive exercise program.

This study was based on two hypothesis that were attempted to be proved, the significance level was set at α=0,05.

- **H_0** = Comprehensive exercise with intensity levels between 60-65% of the VO_2max has no effect on the variables tested.
- **H_1** = Exercise with intensity levels between 60-65% of the VO_2max, does effect the variables tested.

Table 2 shows the effects that the exercise program had over subject's weight. The subjects averaged a weight loss of 1.51 kg, this can be considered positive. Table 3, shows that there was a decrease in body mass (BMI), (31.10 before and 30.19 after), confirming the positive effects that the exercise had on these variables. It is relevant to note that the body composition (BC) and fat mass (FM) lowered (29.92 kg before and 28.14 kg after), meanwhile the lean mass (LBM) slightly increased (43.06 kg before and 43.36 kg after), as shown in table 4 and 5.

Table 2.- Height (cm) and Weight (kg) pretest and posttest

		HEIGHT	WEIGHT Pretest	WEIGHT Posttest
N	Valid	37	37	37
Mean		153	73.01	71.50
Std. Deviation		6.82	8.75	8.89
Minimum		136	55.90	53
Maximum		170	95.70	94.10
Percentile	25	149	67.50	65.50
	75	157	767.35	74.95
95% Confidence interval	Lower limit		70.10	68.50
	Upper limit		75.87	74.50

Table 3.- BMI results.

		BMI Pretest	BMI Posttest
N	Valid	37	37
Mean		31.10	30.19
Std. Deviation		2.89	3
Minimum		24.50	23.20
Maximum		38.40	38.30
Percentile	25	29.70	28.80
	75	32.70	31.73
95% Confidence interval	Lower limi	30.07	29.21
	Upper limi	31.97	31.18

Table 4.- Fat mass values obtained before and after intervention

		FM Pretest	FM Posttest

N	Valid	37	37
Mean		29.92	28.14
Std. Deviation		4.78	4.87
Minimum		17.90	15.90
Maximum		42	41.50
Percentile	25	27.15	24.55
	75	32.23	30.70
95% Confidence interval	Lower limit	28.34	26.54
	Upper limit	31.49	29.74

Table 5.- Lean mass (kg) obtained before and after treatment

		LBM Pretest	LBM Posttest
N	Valid	37	37
Mean		43.06	43.36
Std. Deviation		5.31	5.58
Minimum		37.70	37.10
Maximum		60	61.80
Percentile	25	39.83	40.28
	75	43.80	44.05
95% Confidence interval	Lower limit	41.32	41.53
	Upper limit	44.81	45.19

The Student t- distribution of body measurement variables show significant differences in the averages obtained in the first and second measurement, after seven months of exercise, with a p-value less than 0.05 for the variables: Weight, body mass and fat mass. In all cases a decrease in measurements were produced with time. On the contrary, there is no evidence that shows that the exercise modified the LBM variable (table 6 and 7).

Table 6.- Correlation samples of the body composition variables

		N	Correlation	Sig.
Pair 1	P pretest–P posttest	37	.987	.000
Pair 2	BMI pretest–BMI posttest	37	.950	.000
Pair 3	FM pretest–FM posttest	37	.957	.000
Pair 4	LBM pretest–LBM posttest	37	.979	.000

Table 7. - Sample test of body composition variables

		Related differences					t	gl	Sig. (bilateral)
		Mean	Standard deviation	Std. error	95% confidence interval for the difference				
					Inferior	Superior			
Pair 1	P pretest–P posttest	1.505	1.427	.234	1.029	1.981	6.414	36	.000
Pair 2	BMI pretest-BMI posttest	.835	.945	.155	.519	1.150	5.371	36	.000
Pair 3	FM pretest–FM posttest	1.748	1.428	.234	1.272	2.224	7.449	36	.000
Pair 4	LBMpretest–LBM posttest	-.302	1.163	.191	-.690	.085	-1.582	36	.122

The balance test variable results are shown below in Table 8. Improvement was indeed made by the end of the treatment, with an average of 15 touches before treatment and only 5 touches after. The 2km walking test (WT) results are shown in Table 9. Results show that a decrease in the average time of completion was made (18 minutes before and 16 minutes after). Table 10 shows the subjects average heart rate, which was taken at end of the walking test (WTHR), with an average of 111 bpm before and 112 bpm after. Table 11 shows the average amount of VO_2max ($WTVO_2max$) consumed (30ml of O_2/kg/min before and 36ml of O_2/kg/min after).

Table 8.- Balance before and after intervention (number of contact)

		SB Pretest	SB Posttest
N	Valid	33	33
Mean		15	5
Std. Deviation		11	5
Minimum		0	0
Maximum		40	17
Percentile	25	5	0
	75	24	8
95% Confidence interval	Lower limit	11	3
	Upper limit	18	7

Table 9.- Completion time (minutes) for walking test before and after intervention

		WTT' Pretest	WTT' Posttest
N	Valid	20	20
Mean		18	16
Std. Deviation		2	2
Minimum		15	13
Maximum		22	20
Percentile	25	16	14
	75	20	17
95% Confidence interval	Lower limit	17	15
	Upper limit	19	17

Table 10.- Heart rate (beats per min) obtained at the end of walking test before and after intervention

		WTHR pretest	WTHR posttest
N	Valid	20	20
Mean		111	112
Std. Deviation		20	24
Minimum		76	64
Maximum		140	168
Percentile	25	97	100
	75	127	123
95% Confidence interval	Lower limit	102	101
	Upper limit	120	123

Table 11.- VO_2max (ml) obtained at end of walking test before and after intervention

		$WTVO_2max$ Pretest	**$WTVO_2max$** Posttest
N	Valid	20	20
Mean		30	36
Std. Deviation		7	7
Minimum		15	22
Maximum		40	52
Percentile	25	26	32
	75	36	42
95% Confidence interval	Lower limit	27	33
	Upper limit	33	40

In tables 12,13,14 and 15, with the exception of the heart rate variable, there were significant differences in the average measurements obtained initially, in respect to at the end. The balance, walking and VO_2max walking tests all had a p-value less than 0.05. In both cases an improvement was made over time.

Table 12.- Sample correlations in variables: balance, walking test and heart rate

		N	Correlation	Sig.
Pair 1	SB pretest- SBposttest	33	.692	.000
Pair 2	WTT´pretest– WTT´posttest	20	.641	.002
Pair 3	WTHR pretest-WTHR posttest	20	.446	.049

Table 13.- Sample test in variables: balance, walking test and heart rate

		Related differences					t	gl	Sig. (bilateral)
		Mean	Std. Deviation	Std. error	95% Confidence interval for the difference				
					Inferior	Superior			
Pair 1	SB pretest- SB posttest	9.697	8.229	1.432	6.779	12.615	6.769	32	.000
Pair 2	WTT´ pretest– WTT´ posttest	1.821	1.907	.416	.953	2.690	4.377	19	.000
Pair 3	WTHR pretest- WTHR posttest	-1.000	23.102	5.166	-11.812	9.812	-.194	19	.849

Table 14.- Sample Correlation of the Maximal Oxygen Consumption (VO_2max)

		N	Correlation	Sig.
Pair 1	VO_2max_Pretest and VO_2max Posttest	20	.668	.001

Table 15.- Sample test of the Maximal Oxygen Consumption (VO_2max)

		Related differences					t	gl	Sig. (bilateral)
		Mean	Std. Deviation	Std. error	95% Confidence interval for the difference				
					Inferior	Superior			
Pair 1	VO_2max_Pretest and VO_2max Posttest	-6.550	7.287	1.629	-9.960	-3.140	-4.020	19	.000

4. DISSCUSION

Although no amount of physical activity can stop the biological aging process, there is evidence that regular exercise can minimize the physiological effects of an otherwise sedentary lifestyle and increase active life expectancy by limiting the development and progression of chronic disease and disabling conditions (Chodzko-Zajko, 2009). It has been proved that there is a strong correlation between physical inactivity and an increase in morbidity and mortality (Woolcott and cols, 2010).

Optimal values in the body composition of elderly people are reliable indicators of their health. A sedentary lifestyle and diet are two factors that play a decisive role on people's health and are factors that we have the ability to alter. Adequate body composition largely depends on maintaining a balanced combination of these two factors. Age as a chronological parameter affects body composition and if not intervened by stimulating a caloric expenditure through exercise, or having an adequate diet by adjusting calorie intake, the results may contribute to the appearance or accelerate existing processes. In the last few years, there has been a worrying and significant increase in obesity, a supposed 35.5%, among adult women in the United States (2007-2008) (Flegal and cols. 2010).

The results obtained in this study were significantly significant in the following variables: weight (-1.28 kg), fat mass (-1.78 kg, -3.63%) and BMI (-0.9 kg/m^2, -2.92%). There was no significant change in the lean mass variable. Similar results were obtained showing a decrease in fat mass, with a decrease in the waist in Marques y cols. (2011). Their study intervention was an 8-month program, done two times a week. In Evans and cols, (2005) and Giannopoulo and cols. (2005) similar results were obtained, although with only a 14 week intervention a 6% reduction in fat mass was achieved. Although, it should be noted that in these two studies the body mass index results were not provided. It was observed in Restrepo and cols. (2003) that premenopausal women who participated in a four month exercise program, managed to achieve a decrease in weight and body fat mass on average between 1,2 kg and 2 kg respectively. At the same time, the women gained 1 kg of lean mass. In Stewart and cols. (2005) men and women participated in physical activity for six months, three hours a week. The results obtained showed a significant decrease in the subject's body mass index. The results were similar to what was shown in our study, and overall were better than the data obtained by Restrepo and cols. (2003). The causes could be due to the correlation between the longer treatment time and the higher rate of improvement.

On the contrary, the study by Grant and cols. (2004) only showed significant improvements in the body mass index variable, with a decrease of 0.59% in women who participated in a 12 week intervention program. Brochu y cols. (2000) in three months achieved a significant decrease in fat mass of men and women. This was not achieved in the other body composition parameters, although the men did achieve a significant increase in lean mass compared to the women that didn't.

In the work of Hernández (2001) senior citizens living in a nursing home in Jaén underwent a 15-week intervention, with sessions three times a week each lasting 60 minutes. The results obtained showed no statistically significant improvements in adiposity. The results obtained by Kolbe and cols. (2006) were similar to this study when referring to the body composition variable.

The differences found in the studies analyzed could be due to the different methodological approaches used. It is reasonable to assume that for the effects of a program to have a significant impact on the different capabilities, a specific time frame of intervention must be established, along with the adequate frequency and intensity in the interventions. In fact, there are numerous studies that conclude in line with that higher intensity levels have a greater impact on the body.

Based on these findings, physical activity is a great alternative to improve the body composition in elderly people, whether they are overweight or not. However, even though there has been a slight increase, the failure to obtain significant results regarding increases in lean mass could become a concern. According to the World Health Organization, lean mass is the best predictor of survival in cases such as chronic diseases, malignant tumors and acute and serious illness. Weight loss and thinness causes a decrease in the lean mass among the elderly, which can become a greater health problem than being overweight (OMS, 1995).

The evidence suggests that the decrease in fat mass and increase in lean mass, due to muscle growth, has a significant impact on the different functional capacity factors that affect autonomy and longevity (Marques and cols. 2011). It is possible that the intensity level proposed in this study didn't produce the necessary stimulation needed to increase the lean mass values.

The ability to balance, among others, is the basis of a healthy and active lifestyle, due to the close connection between mobility, balance or stability and falls. Maintaining a high level of balance and range of motion or mobility is essential in order to maintain a good level of fitness in the aging process, despite all the malfunctions the body possesses over the years (Debra, 2005). Elderly women, due to their characteristics are more susceptible to falls (Barbosa, Arakaki and Silva, 2001 and Hu, 1994). Therefore, a key goal of prevention is establishing comprehensive programs in order to help improve balance, given the high risk that is posed to elderly falls.

Our study shows that elderly women, who participated in a comprehensive exercise program, had improved significantly in balance with an 80% improvement (p=<0.05). These results show a decrease in the likelihood of suffering a fall and also increasing their ability to move around. It is significant to note that these improvements are due to their increase of lean mass.

Coinciding with Bersot and Pereira (2005) who concluded in their study that women had improved significantly (p<0.05), considering the study population, with a 30.4% reduction in the probability of falling. The better results obtained in our study could be attributed to the intervention time, which is an important element to have in mind. The balancing process included involving and using different systems of the entire body. For this reason a comprehensive exercise program seems more adequate for the conditioning of the entire body, instead of having programs that just focus on just one of the systems, as was the case of these researchers. Balancing has a significant effect on strength and coordination capabilities (Marques y cols, 2011). It must be noticed that the measuring instruments used in the studies were different, which could affect the results obtained.

In groups of elderly people with Diabetes type II it was found that there was a higher prevalence in risk of falls. After undergoing a 6-week training program they showed significant improvement in balance and decreased the risk of falls (Morrison y cols, 2010).

These differences were attributable to the measurement instruments that can be seen in the works of Bersot and Pereira (2005) and Orr and Cols. (2006), in which results improved up to 10.8%. This data is not comparable in percentile terms, but showed a significant improvement in the ability to balance after being subjected to an exercise program.

In other studies like Robitaille and cols. (2005), a percentage improvement in balance was not shown, but significant improvements were shown in the participants compared to the control group. The same occurs in Kolbe and cols. (2006) where there was a 26% (p=0.001) improvement in 20 weeks of exercise. Like in the previous cases, there were differences in the percentages of improvement, as stated before this could be due to the different measuring instruments used.

The Kaneda and cols (2008) study shows an improved balance in women 61 years of age. They used an aquatic method where training consisted in walking in deeper waters and with increased levels of resistance for 12 weeks, two times a week.

All of the studies, including this one, showed a significant improvement in the ability to balance, independently speaking of the time of training, age and sex of participants. This study showed that a comprehensive exercise program that integrated different activities such as endurance, strength, mobility, coordination and balance obtained better results than those that currently exist in specialized literature using similar methodologies to the one used in this study.

The VO_2max can be modified to a certain extent through training. It is estimated that 90% of its variability is indicated genetically (Ribeiro, 1995). It has been shown that the ability to walk fast is an important indicator of fitness that can be used for prediction of independence of older women (Tainaka and cols. 2009).

The results analyzed showed a statistical significance in the walking test and VO_2max. It was observed that once the intervention started, there were differences in the cardiorespiratory fitness evaluated at the beginning and end of intervention. This indicates that the intervention program had a significant effect on the increase of the VO_2max levels (20%). These results are similar to those of Mohanca and cols. (2006), in obese postmenopausal women who did aerobic exercise at a moderate intensity for a total of one year. Results showed that their VO_2max had increased by 11%. Also in Evans and cols. (2005) participants in their 80's managed to have a 15% increase in their VO_2max after having undergone 108 exercise sessions. Izquierdo Porrera and cols. (2000) obtained a 7% VO_2max increase in men diagnosed with intermittent claudication, who underwent 6 months of exercise. Similar results were obtained by Brochu and cols. (2000), Stewart and cols. (2005), Giannopoulou and cols. (2005) and Puggard (1999). However, Hernández (2001) with 15 weeks of aerobic exercise managed to obtain greater effects (46.5%) compared to other studies, including this one.

On the contrary, Kolbe and cols. (2006) and Hurley and cols. (2000), executed the exercise programs using different intensities, first with a low intensity and the second using strength training. Results failed to show significant improvements in the VO_2max of the elderly participants under investigation.

Based on these findings, we can conclude that exercising is the best alternative to improve the VO_2max in men and women regardless of the duration and number of sessions.

5. CONCLUSIONS

The data confirms that an comprehensive exercise program done in group, two days a week with each session lasting 60 minutes, is an effective stimulus for losing weight, improving body composition, increasing the ability to balance and the walking speed of healthy women 60 years old or older. This is an effective strategy, which improves the physical capabilities of the participants and if done regularly improving their health and quality of life.

6. REFERENCES

Balboa-Castillo T, Guallar-Castillón P, León-Muñoz LM, Graciani A, López-García E, Rodríguez-Artalejo F (2011). Physical activity and mortality related to obesity and functional status in older adults in Spain. *Am J Prev Med*. Jan;40(1):39-46.

Ballard, J. E., McFarland, C., Wallace, L. S., Holiday, D. B. y Roberson, G. (2004). The Effect of 15 Weeks of Exercise on Balance, Leg Strength, and Reduction in Falls in 40 Women Aged 65 to 89 Years. *Journal of the american medical women's association*, *59* (4), 255-261.

Barbosa SM, Arakaki J, da Silva MF. (2001). Estudo do equilíbrio em idosos através da fotogrametria computadorizada. *Fisioterapia Brasil*; 2(3): 189-96.

Bersot, A. S. y Santos, J. (2005). Balance improvement and reduction of likelihood of falls in older women after Cawthorne and Cooksey exercises. *Rev Bras Otorrinolaringol. 71* (1), 38-46

Borg, G.A.V. (1982). Psychophysical bases of perceived exertion. *Med Sci Sports Exerc, 14,* 377-381.

Brochu, M., Poehlman, E. T., Savage, P., Fragnoli-Munn, K., Ross, S. & Ades, P. A. (2000). Modest effects of exercise training alone on coronary risk factors and body composition in coronary patients. *Journal of cardiac rehabilitation, 20* (3), 180-188.

Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, Minson CT, Nigg CR, Salem GJ, Skinner JS (2009). American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Med Sci Sports Exerc.* Jul;41(7):1510-30.

Ciolac,E.G., Brech G.C., and Greve J.M.D. Age Does Not Affect Exercise Intensity Progression Among Women, J Strength Cond Res 24 (10), 3023-3031.

Clearlock, D. M. y Nuzzo, N. A. (2001). Effects of sustained moderate exercise on cholesterol, growth hormone and cortisol blood levels in three age groups women. *Clinical Laboratory Science,* 14, (2), 108-111.

Debra, J. R. (2005). *Equilibrio y movilidad con personas mayores*. Barcelona: Paidotribo.

DiBrezzo, R., Shadden B. B., Raybon, B. H. y Powers, M. (2005). Exercise intervention designed to improve strength and dynamic balance among community-dwelling older adults. *Journal of Againg and Physical Activity, 13*, 198-209.

Evans, E. M., Racette, S. B., Peterson, L. R., Villareal, D. T., Greiwe, J. S. & Holloszy, J. O. (2005). Aerobic power and insulin action improve in response to endurance exercise training in healthy 77–87 yr olds. *J Appl Physiol, 98*, 40-45.

Fahlman, M. M., Boardley, D., Lambert, C. P. y Flynn, M. G. (2002). Effects of Endurance Training and Resistance Training on Plasma Lipoprotein Profiles in Elderly Women. *The Journals of Gerontology: BIOLOGICAL SCIENCES*, *57 A* (2), B54-60.

Flegal KM, Carroll MD, Ogden CL y Curtin LR. (2010). Prevalence and trends in obesity among US adults, 1999-2008. *JAMA*. Jan 20;303(3):235-41.

Geithner, C. y McKenney, D. (2010). Strategies for Aging Well. Strength and Conditioning Journal. 32, 5, p 36-52.

Giannopoulou, I., Ploutz-Snyder, L. L., Carhart, R., Weinstock, R. S., Fernhall, B., Goulopoulou, S. & Kanaley, J. A. (2005). Exercise Is required for visceral fat loss in postmenopausal women with type 2 diabetes. *The Journal of Clinical Endocrinology & Metabolism, 90* (3), 1511-1518.

Grant, S., Todd, K., Aitchison, T. C., Kelly, P. & Stoddart, D. (2004). The effects of a 12-week group exercise programme on physiological and psychological variables and function in overweight women. *Public Health, 118*, 31-42.

Hernández, J. (2001). Efectos de un programa de 15 semanas de ejercicio físico aeróbico sobre la salud física de personas mayores medido mediante la determinación de la resistencia cardiorrespiratoria, la adiposidad y la fuerza muscular. *Lecturas de Educación física y deportes*. *Revista digital*, *7,* 41.

Hu MH; Woollacott MH. (1994). Multisensory training of standing balance in older adults: I. Postural Stability and One-Leg Stance Balance. *J Gerontol;* 49(2): M52-M61.

Hurley, B. F. & Roth, S. M. (2000). Strength training in the elderly effects on risk factors for age-related diseases. *Sports Med, 30* (4), 249-268.

Izquierdo, M., Ibáñez, J., Carrión, J. L. y Gorostiaga, E. M. (2003). Efectos de un programa de entrenamiento combinado de fuerza y resistencia aeróbica sobre el sistema neuromuscular, la capacidad cardiovascular y el perfil lipídico en personas mayores. *Anales Sis San Navarra*, *26* (2). Pamplona.

Izquierdo-Porrera, A. M., Gardner, A. W., Powell, C. C. & Katzel, L. I. (2000). Effects of exercise rehabilitation on cardiovascular risk factors in older patients with peripheral arterial occlusive disease. *Journal of Vascular Surgery, 31*, (4), 670-677.

Justine, M., y Hamid, T.A. (2010). A multicomponent exercise program for institucionaliced older adults *Journal of Gerontolo ical ursine*. Vol. 36, o. 10,

Kaneda K, Sato D, Wakabayashi H, Hanai A, Nomura T (2008). A comparison of the effects of different water exercise programs on balance ability in elderly people. *J Aging Phys Act.* 16(4):381-92.

Koji Tainaka, Tsuyoshi Takizawa, Shizuo Katamoto, Junichiro Aoki (2009). Six-year prospective study of physical fitness and incidence of disability among community-dwelling Japanese elderly women. *Geriatrics & Gerontology International*. Volume 9, Issue 1, pages 21–28.

Kolbe-Alexander, T. L., Lambert, E. V. & Charlton, K. E. (2006). Effectiveness of a community basedlow intensity exercise program for older adults. *The Journal of nutrition, health & aging,* 10(1),21-29.

Marques, E. A., Mota J, Machado, L., Margarida Coelho, F., Moreira, P. y Carvalho, J. (2011). Multicomponent Training Program with Weight-Bearing Exercises Elicits Favorable Bone Density, Muscle Strength, and Balance Adaptations in Older Women. *Calcif Tissue Int*. 88:117–129

Mohanka, M., Irwin, M., Heckbert, S. R., Yasui, Y., Sorensen, B., Chubak, J., Tworoger, S. S., Ulrich, C. M. & McTiernan, A. (2006). Serum lipoproteins in overweight/obese postmenopausal women: A one-year exercise trial. *Official Journal of the American College of Sports Medicine,* 231-239.

Morrison, S., Colberg, S., Mariano, M., Parson, H. y Vinik, A. (2010). Balance Training Reduces Falls Risk in Older Individuals With Type 2 Diabetes. *Diabetes Care*. Tomo 33, Nº 4; pg. 748, 3 pgs

OMS (2010). *Recomendaciones mundiales sobre actividad física para la salud*. Organización Mundial de la Salud. Suiza.

Orr, R., de Vos, N. J., Singh, N. A., Ross, D. A., Stavrinos, T. M. & Fiatarone-Singh, M. A. (2006). Power training improves balance in healthy olders adults. *The Journals of Gerontology: Medical Sciences, 61* (1), 78-85**.**

Paffenbarger RS, Hyde, RT, Wing Al, and Hsieh,C-c. (1986). Physical Activity, All-Cause Mortality, and Longevity of College Alumni. *N Engl J Med*; 314:605-613.

Pescatello, L., Murphy, D. y Costanzo, D. (2000). Low-intensity physical activity benefits blood lipids and lipoproteins in older adults living at home. *AGe and Ageing*, *29*, 433-439.

Puggard, L. (1999). *Physical reactivation of the very old by exercise: Impact on body composition, physical performance and functional abilities*. Tesis Institute of Sports Science and Clinical Biomechanics. Odense University, Denmark.

Restrepo, M. T., Monroy, A., Pérez, J. y Velásquez, M. C. (2003). Efecto de la actividad física controlada sobre la composición corporal de mujeres sedentarias posmenopáusicas. *Revista Panamericana de Salud Públi, 14* (4), 229-234.

Robitaille, Y., Laforest, S., Fournier, M., Gauvin, L., Parisien, M., Corriveau, H., Trickey, F. & Damestoy, N. (2005). Moving forward in fall prevention: An intervention to improve balance among older adults in Real-World settings. *American Journal of Public Health Novembe*r, *95* (11), 2049-2056.

Ryan, A. (2010). Exercise in aging: its important role in mortality, obesity and insulin resistance. *Aging Health.* 6(5), 551–563

Simons, R. y Andel, R. (2006). The Effects of Resistance Training and Walking on Functional Fitness in Advanced Old Age. *Journal of aging and health*, Vol. 18 No. 1, 91-105.

Stewart, K. J., Bacher, A. C., Turner, K., Lim J. G., Hees P. S., Shapiro, E. P., Tayback, M. & Ouyang, P. (2005). Exercise and risk factors associated with metabolic syndrome in older adults, *American Journal of Preventive Medicine, 28* (1), 9-18.

Tainaka, K. Takizawa, T., Katamoto y Aoki (2009). Six-year prospective study of physical fitness and incidence of disability among community-dwelling Japanese elderly women. *Geriatr Gerontol Int*. **9**(1):21-28.

Verissimo, M. T., Aragao, A., Sousa, A., Barbosa, B., Ribeiro, H., Costa, D. y Saldanha, M. H. (2002). Effect of physical exercise on lipid metabolism in the elderly. *Rev-Port-Cardio, 21* (10), 1099-1112.

Woolcott, J.C; Ashe, MC; Miller, WC. Shi, P. y Marra, CA. (2010). Does physical activity reduce seniors' need for healthcare?: a study of 24 281 *Canadians British Journal of Sports Medicine*. Tomo 44, Nº 12; pg. 902.

Número de citas totales / Total references: 42 (100%)
Número de citas propias de la revista / Journal's own references: 0