Benefits of physical activity on elderly

Beneficios de la Actividad Física en adultos mayores

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Abstract: Introduction: The increase of the Elderly population as the main characteristic of the demographic transition brings with it multiple challenges for public health. As part of the public politics of the World Health Organization (WHO) on healthy aging, Physical Activity (PA) is relevant, being the subject of multiple studies about its benefits on the quality of life of older people. Method: This article is a systematic review of the PubMed, Google Scholar, Elsevier, Scielo and Redalyc index. Using the keywords "physical activity", "exercise", "elderly" and "quality of life", 138 related articles were found, however, according to the inclusion and exclusion criteria, 120 articles were discarded, leaving 18 studies for review. Results: 72% of the studies showed benefits at a physical level: PA in old age improves strength, balance, flexibility and muscle tone. It is also related to a significant reduction in arterial stiffness. 11% of the investigations refer to improvements in the psychoemotional sphere: PA generates positive feelings such as happiness or good self-perception. And 17% of the articles focused on quality of life: PA favours the perception of better quality of life. Conclusion: Physical activity improves health in the physical, mental and social spheres of older adults, improving their quality of life and promoting healthy aging.

Keywords: Physical activity, exercise, elderly, quality of life.

Resumen: Introducción: El incremento de la población Adulta Mayor como principal característica de la transición demográfica, trae consigo múltiples retos para la salud pública. Como parte de la política pública de la Organización Mundial de la Salud (OMS) sobre envejecimeinto saludable, la Actividad Física (AF) toma relevancia, siendo objeto de mútiples estudios acerca de sus beneficios en la calidad de vida de las personas mayores. Método: El presente artículo es una revisión sistemática en los índices PubMed, Google Schoolar, Elsevier, Scielo y Redalyc. Utilizando las palabras clave "actividad física", "ejercicio", "adulto mayor" y "calidad de vida", se encontraron 138 artículos relacionados, sin embargo, de acuerdo con los criterios de inclusión y exclusión, se descartaron 120 artículos, quedando para su revision 18 estudios. Resultados: El 72% de los estudios mostraron beneficios a nivel físico: La AF en la vejez mejora la fuerza, equilibrio, flexibilidad y tono muscular. También está relacionada con una importante reducción en la rigidez arterial. El 11% de las investigaciones refieren mejorías en la esfera psicoemocional: La AF genera sentimientos positivos como felicidad o buena autopersepción. Y el 17% de los artículos se centraron en la calidad de vida: La AF favorece la percepción de mayor calidad de vida. Conclusión: La actividad física mejora la salud en las esferas física, mental y social de los adultos mayores, mejorando su calidad de vida y favoreciendo el envejecimiento saludable.

Palabras clave: Actividad física, ejercicio, adulto mayor, calidad de vida.

INTRODUCTION

Globally, population dynamics is essentially centred on a phenomenon: population aging, for which the two most important variables are low fertility rate and increased life expectancy; where the aging population increases to the detriment of the other age groups.[1,2] By 2019, one in 11 people in the world (9%) were older adults, and projections indicate that by 2050, one in six people in the world will be older (16%).[3] These demographic changes also bring their own problems, which have been addressed since 1982, when the first world assembly on aging was held, where The Vienna International Action Plan of Action on Aging. In said assembly, member countries suggested carrying out specific actions on topics such as health, nutrition, housing and the environment, family, social welfare, income and employment security, education, and the compilation and analysis of research data.[4]

In accordance with the Sustainable Development Goals (SDG), the 2020-2030 decade is established as the decade of healthy aging. Healthy aging "is the process of development and maintenance of functional capacity that allows well-being in old age." [5] The World Health Organization (WHO) argues that current demographic changes must be considered and older adults should be given the importance they have in the development of populations, in order to achieve equitable, passive and safe communities.[6]

However, achieving healthy aging is not easy, since in the normal aging process, morphological and functional changes become imminent, often decreasing the ability to function.[7] One of the most notable and important changes with the physical activity carried out by the elderly is the loss of muscle mass.[8,9] Functional performance is having the physiological capacity to carry out normal daily activities safely and independently without excessive fatigue.[10] But it does not only refer to the capacities characteristic of the person (intrinsic capacity), but also of the environment in which it develops (extrinsic capacity).[11]

According to the WHO, physical activity in old age consists of recreational activities, displacements, occupational activities, domestic tasks, sports or programmed exercises in order to improve cardiorespiratory functions, functionality and reduce the risk of NCDs, depression, risk cognitive and falls.[10]

The promotion of Physical Activity (PA) is a key element to achieve healthier old people. Various studies have been conducted with the aim of recognizing the benefits of PA in older adults. This review aims to update the information that is available.

MATERIAL AND METHODS

A systematic review was performed on the PubMed, Google Scholar, Elsevier, Scielo and Redalyc indexes; about the benefits of physical activity observed in older adults, using as keywords “physical activity”, “exercise”, “older adults” and “quality of life”. As selection criteria, original articles published in English or Spanish, of applied research with older adults (60+ year), regardless of sex and unlimited publication dates. And as exclusion criteria, those investigations applied to children, young people, young adults (<60), review articles, descriptive studies, or don´t provide significant information about the theme of study.

Once the articles were selected, they were classified into three groups according to the area of health in which the benefits of PA were evaluated in: physical / physiological effects, psycho-emotional effects and effects on quality of life.

RESULTS

According to the search criteria, 138 related articles were identified, however, following the criteria determined at the beginning of this review, 120 manuscripts were discarded for not meeting the selection criteria or being within the exclusion criteria. The remaining 18 articles were considered for review and were grouped according to the main variable evaluated. To analyse the results of the studies and compare them, two tables were made. Table 1 includes reference, design, sample, method and instruments (including the time during which the training program or exercise was applied) and main findings. Table 2 describes only 12 of the 18 studies since they are the ones that specifically applied training or exercise programs in older adults and measured their effects at the physical / physiological level. Through this table it is possible to compare the results and identify the types of training that obtained the best results. Table 2 includes reference, method and instruments, results of pre and post evaluations and the value of P. 11% of the investigations report improvements in the psycho-emotional sphere: PA generates positive feelings such as happiness or good self-perception.[12,13] 72% of studies showed benefits on a physical level: PA in old age improves strength, balance, flexibility and muscle tone.[14-26] It is also related to a significant reduction in arterial stiffness. And 17% of the articles focused on quality of life: PA favours the perception of a higher quality of life.[27-29] Finally, 66.7% of the studies were carried out applying an exercise or training program, which show important differences in their design and results. Varying in the application time from four weeks to 48 weeks. As shown in Table 2, which describes the results of pre and post evaluations.

DISCUSSION

Aging is very often related to a decline in different human functions, such as cognitive state, strength, balance, the musculoskeletal and cardiovascular systems, among others.[30] This deterioration is closely linked to the decrease in PA.[31] However, according to different investigations, it has been identified that the AF contributes significantly to the health of the elderly, since it promotes strength, flexibility, agility, speed and endurance on a physical level. As Miller KL et al. In a quasi-experimental study of an exercise program with a duration of four weeks applied in older adults, where it was shown that through this type of PA, there are significant improvements in balance confidence, balance performance and walking in weakened .[19] It is important to highlight that not all forms of PA have the same functions or reach the expected results, such is the case of research applied by Wolf SL et al., in which after 48 weeks of Tai Chi training, there was no evidence of statistically significant reduction in the risk of falls in the elderly.[21]

The investigations made by Jorgensen MG et al. and Pluchino A. et al is interesting and innovative, who applied PA programs for older adults using the Nintendo Wii. Both programs were effective as there were substantial improvements in muscle function, muscle performance, and functional performance. [22,23] Video games can be a new window of opportunity to improve the physical condition of the elderly, as it can be applied at home, providing economic savings, time, transfers and risks.

On an emotional level, PA generates a feeling of happiness, a positive effect on mood and on different mental illnesses such as depression. As evidenced by Bohórquez MR et al. with a descriptive study applied to 104 elderly adults where PA is related to happiness. The results show that the practice of PA in the past, in the present or throughout life, influences in a significant way the mood and feeling of happiness of the elderly.[13] If we consider that depression as well as the feelings of sadness are very frequent in older adults, PA turns out to be an economic tool and significant tool in mental health care in old age.[32,33]

Finally, it is useful to rescue that PA has been studied in its impact on the quality of life of the elderly, as demonstrated by Guallar-Castillón P et al. in a cross-sectional research carried out with 3066 older adults, where it concludes that the higher the PA practiced during free time, the higher the Health-Related Quality of Life (HRQL) reported by the elderly.[27]

Although strategies aimed at promoting a healthy lifestyle have been created worldwide and policies have been implemented, these have not been sufficient, since although they are aimed at preventing chronic non-communicable diseases (NCDs), this has not been achieved. NCDs lead the prevalence of diseases and are also the main causes of death in the world. The worst thing is that they are diseases that are mostly preventable with the adoption of good lifestyles, such as a healthy and balanced diet and PA. As a result, we have a young and adult population with sufficient risk factors to reach an old age with multiple diseases or premature death, and for those who are already old, it means functional deterioration, disability and premature death.

CONCLUSIONS

According to the revised references, PA improves health in the physical, mental and social spheres of older adults, improving their quality of life and promoting healthy aging. Including PA as part of the activities of daily life of the elderly promotes balance, prevents falls, improves physical strength and flexibility. In addition, it improves the cognitive condition, favours positive attitudes and encourages a feeling of happiness. PA has positive consequences at the vascular level, decreasing arterial stiffness. It also favours social relationships necessary for the well-being of the elderly.

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Appendix

TABLE 1
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Table 1. Classification and description of analysed studies.

Assessment area	Reference	Design	Sample	Method and instruments	Main findings
Psycho-emotional effects	Medina Briones MR et al. 2009.12	Qualitative	15 older adults	Semi-structured questionnaire.	Physical Activity (AF) improves physical and emotional health and increases interpersonal relationships.
	Bohórquez MR et al. 2013.13	Descriptive	104 older adults.	General Physical Activity Questionnaire in Spanish version and the Happiness Scale.	1 Those who do FA today are happier than those who have done it only in the past, never or always. 2 Those who have always done FA or those who have started doing it from the age of 65 are happier than those who abandoned it in old age. 3 Never having done AF is related to lower levels of current happiness than having done it at some point in life or maintaining it.
Physical/ Physiological effects	Liu IT et al. 2020.14	Randomized controlled trial	61 older adults	4 weeks of training. Barthel index, MMSE, MOCA and GDS. BDNF serum, MCP-1 plasma, and IGF-1 plasma.	Those who received strength training had improvements in the Barthel index, MMSE, MoCA, and plasma MCP-1; while those who received the aerobic exercise program obtained improvements in the same indicators and in the BDNF serum test.
	Orr R et al. 2006.15	Randomized controlled trial	112 older adults	10-week exercise program. Chattecx Dynamic Balance System, digital Keizer pneumatic resistance machines fitted with A400 electronics, Physical Activity Scale for the Elderly (PASE), Mini-Mental State Examination (MMSE).	Low-load power training improves balance, in turn improving subjects quality of life (QOL) and promoting active aging and preventing falls.
	Kobayashi R et al. 2020.16	Quasi-experimental study.	41 older adults	Plan for 8 weeks of exercise. Pulse Wave Velocity (VOP), Cardio-Ankle Vascular Index (CAVI), Arterial Pulse Wave Index (AVI) as an index of systemic arterial stiffness and the Index of Blood Pressure Volume (API) as an index of peripheral arterial stiffness.	Regardless of intensity or duration, regular aerobic exercise can be important in reducing arterial stiffness.
	Campbell AJ et al. 1997.17	Randomized control trial.	233 older adults	6-month exercise program. A functional reach test, Standing with feet side by side, standing with one foot next to and halfway in front of the other, standing with one foot directly behind the other, and standing on one foot with the other raised for up to 10 seconds, scored as the 4test balance scale, electronic dynamometer, "Chair stand" test, Time taken to walk eight feet and 20 meters, Time taken to climb up and down a set of four steps in the assessment room and Distance walked in six minutes using the walking aid normally used outside the home.	The percentage of falls of subjects who carry out a training program and those who do not show significant differences.
	Castillo de Lima V et al. 2020.18	Quasi-experimental study.	16 older adults	14-week agility ladder exercise program. Functional tests Illinois agility, five times sit-tostand, timed up-and-go, walking usual speed, and one-leg stand.	Agility ladder training programs are practical and improve the performance of physical function in older adults.
	Miller KL et al. 2010.19	Quasi-experimental pilot study.	14 older adults	4 week training program. Falls Efficacy Scale (FES), Performance Oriented Mobility Assessment (POMA), and the One-Leg Stance Test (OLST) administered prior to and following 4 weeks of exercise and balance training.	Significant improvement in balance confidence, balance performance, and gait in weakened, outpatient community-dwelling older adults after participation in a home balance and training program.

own source

Assessment area	Reference	Design	Sample	Method and instruments	Main findings
Physical / Physiological effects	Faber MJ et al. 2006.20	Multicenter Randomized Controlled Trial	150 older adults	Functional walking program (FW) and Balance program (IB) for 20 weeks. Performance Oriented Mobility Assessment (POMA), physical performance score, and the Groningen Activity Restriction Scale (GARS) (measuring self-reported disability).	Moderate intensity exercise programs increase the risk of falls in frail elderly people, so it is only suggested in pre-frail and non-frail elderly.
	Wolf SL et al. 2003.21	Randomized, randomized controlled study	291 institutionalized older women and 20 older men.	Two weekly sessions for 48 weeks. Falls Efficacy Scale and the Activities-specific Balance Confidence Scale. Sickness Impact Profile (SIP). The Depression Scale. Minimental Scale Examination MMSE.	The 48-week Tai Chi intervention did not show a statistically significant reduction in the risk of falls.
	Jorgensen MG. Et al. 2013.22	Randomized controlled trial	57 older adults	10 weeks of training with Nintendo Wii. Static adjustable leg press apparatus, Fourth-order Butterworth filter, force plate, Good balance,	Older adults who took the 10 weeks of training with the Nintendo Wii had a significant improvement in mechanical muscle function, where there was an increase of approximately 20% not only in maximum muscle strength (MVC), but also in the rapid force generation capacity (RFD). In addition to substantial improvements in functional performance. Static postural balance (CoP-VM) was not affected after Wii training.
	Pluchino A et al. 2012. 23	Randomized controlled trial	40 older adults.	8 weeks of training. Timed Up & Go, One-Leg Stance, functional reach, Tinetti Performance Oriented Mobility Assessment, force plate center of pressure (COP) and time to boundary, dynamic posturography (DP), Falls Risk for Older People - Community Setting, and Falls Efficacy Scale.	The Wii balance program and formalized training programs are equally effective. But the Wii program reduces costs, transfers and time, since it can be done at home.
	Chimbo-Yunga JM et al. 2017.24	Transversal study	387 older adults	National Cholesterol Education Program and the Adult Treatment Panel III. Short version of the International Physical Activity Questionnaire.	The prevalence of metabolic syndrome was high (59.9%), as well as the high level of physical activity (45%), however, there was no significant association between metabolic syndrome and level of physical activity.
	Gómez-Cabello A et al. 2018.25	Transversal study	3104 older adults	Assessment of physical condition through 8 tests; 6 of them from the "Senior Fitness Test" battery. Balance test and a gait speed test.	1 Greater strength, flexibility, agility, speed and endurance. 2 The activities carried out in organized PA classes (mainly maintenance gymnastics) are useful to improve the physical condition of older people and reduce the risk of having too low levels of it.
	Chalapud-Narváez LM et al. 2017.26	Quasi-experimental study	57 older adults	1) Functional extension or functional scope. 2) Tandem Test 3) Unipodal or monopodal test. 4) Sit-up or Sit-up test	Positive changes in balance and muscle strength of the lower limbs after applying the physical activity program.
Effects on quality of life	Guallar-Castillón P et al. 2004.27	Transversal study	3066 older adults	Structured interview and SF-36 health questionnaire.	The higher the intensity of AF during free time, the better CV related to health.
	Herrera Mor EM. 2015.28	Quasi-experimental study	26 older adults	Two days a week for 8 months. SF12-v2 questionnaire, SFT, MEC, Rosenberg's self-esteem test and the question of Fun with Sports Practice?	The higher volume of AF is positively related to mental health in older adults and due to the positive effect of exercise on mood and on different mental illnesses such as depression. Significant increase in leg and arm strength and flexibility, agility and aerobic endurance.
	Gallegos-Carrillo K et al. 2019.29	Transversal study	1085 older adults	Short-Form Health Survey evaluated the HRQoL	Participants who were physically active and used PHS reported better perceived HRQoL scores.

Source: Own elaboration.

Own elaboration

TABLE 2
Description of results

Table 2. Description of results

Reference	Method and instruments	Pre-Post variables											P value
		Evaluation	Pre					Post					
Liu IT et al. 2020.14	4 weeks of training. Barthel index, MMSE, MoCA and GDS. BDNF serum, MCP-1 plasma, and IGF-1 plasma.	Barthel index	89.33 ± 10.65					94.5 ± 7.92					<0. 001
		MMSE	22.7 ± 4.28					24.2 ± 4.87					0.014
		GDS	0.4 ± 0.68					0.63 ± 0.77					0.166
		Mocha	19.12 ± 3.79					20.76 ± 5.39					0.026
		BDNF (pg / ml)	23458.35 ± 5418.26					25413.81 ± 7504.38					0.243
		IGF-1 (ng / ml)	48.02 ± 17.13					48.79 ± 17.25					0.717
		MCP-1 (pg / ml)	291.12 ± 42.07					262.54 ± 95.57					0.044
Orr R et al. 2006.15	10-week exercise program. Chattecx Dynamic Balance System, digital Keizer pneumatic resistance machines fitted with A400 electronics.		HIGH	MED	LOW WITH	WITH		HIGH	MED	LOW	WITH		
		BI	93.6 ± 18.3	84.9 ± 13.7	90.4 ± 6.6	88.7 ± 9.9		92.6 ± 15.7	82.9 ± 14.3	79.6 ± 12.6	84.5 ± 13.9		.0001
		Loss of balance score	4.3 ± 1.8	3.6 ± 1.3	4.3 ± 1.8	4.0 ± 1.2		4.2 ± 2.1	3.5 ± 1.3	3.5 ± 1.5	3.6 ± 1.2		.003
		Peak power						14 ± 8	15 ± 9	14 ± 7	3 ± 6		<. 0001
		Strength						20 ± 7	16 ± 7	13 ± 7	4 ± 4		<. 0001
		Endurance						185 ± 126	103 ± 75	82 ± 57	26 ± 29		<. 0001
Kobayashi R. et al. 2020.16	Plan for 8 weeks of exercise. CAVI, AVI, API and PWV		LOW-15	LOW-30	MED-15	MED-30	WITH	LOW-15	LOW-30	MED-15	MED-30	WITH	
		CAVI (unit)	8.3 ± 1.0	8.6 ± 0.9	8.6 ± 1.1	8.2 ± 1.4	8.2 ± 1.5	7.5 ± 0.8	7.6 ± 0.6	7.7 ± 1.1	7.3 ± 1.0	8.2 ± 1.5	0.0001
		AVI (unit)	27.4 ± 3.3	28.4 ± 1.6	27.4 ± 3.4	25.1 ± 4.3	25.1 ± 4.3	19.2 ± 2.5	20.4 ± 1.4	18.5 ± 1.9	21.7 ± 3.6	25.0 ± 3.6	0.0001
		API (unit)	31.9 ± 2.8	34.0 ± 4.8	31.7 ± 2.5	31.9 ± 4.0	32.1 ± 2.6	25.0 ± 1.4	26.7 ± 3.1	26.1 ± 1.6	24.1 ± 1.9	31.6 ± 1.6	0.0001
		baPWV (cm / sec)	1,565.3 ± 111.1	1,533.7 ± 102.2	1,548.0 ± 98.5	1,513.4 ± 175.0	1,511.4 ± 150.1	1,349.3 ± 91.6	1,329.0 ± 82.3	1,367.3 ± 78.5	1,275.0 ± 85.6	1,530.6 ± 181.8	0.0001
		hbPWV (cm / sec)	588.1 ± 26.1	582.1 ± 35.6	623.9 ± 16.4	551.5 ± 18.4	581.3 ± 44.7	514.2 ± 15.7	498.7 ± 43.9	543.8 ± 31.2	470.0 ± 15.4	582.1 ± 53.0	0.0001
Campbell AJ et al. 1997.17	6-month exercise program. Test balance scale Chair stand test.		Exercise Group		Control Group			Exercise Group			Control Group		
		Test balance score	0.42 (0.86)		−0.01 (0.80)								
		hair stand test	1.07		1.87								
		Falls						88			152		
Castillo de Lima V et al. 2020.18	14-week agility ladder exercise program. FTSS, TUG, WS, OLS R, OLS S.	Illinois (s)	35.9 ± 5.4					31.5 ± 4.5					0.02
		FTSS (s)	10.7 ± 2.0					7.7 ± 1.1					<0.01
		TUG (s)	7.7 ± 1.2					5.8 ± 0.7					<0. 01
		WS (m / s)	1.3 ± 0.1					1.5 ± 0.1					<0. 01
		OLS R (s)	16.4 ± 10.4					23.7 ± 9.0					0.03
		OLS L (s)	15.7 ± 8.5					24.6 ± 8.1					0.01

Own source

Reference	Method instruments	Pre-Post variables									P value
		Evaluation	Pre				Post				
Miller KL et al. 2010.19	4 week training program. FES, POMA, OLST.	Fes	38.9 (17.5)				16.5 (6.9)				0.00
		POMA	16.2 (2.3)				23.2 (2.6)				0.00
		POMA Balance Sub-Section	9.6 (1.3)				13.6 (1.6)				0.00
		POMA Gait Sub-Section	6.5 (1.7)				9.6 (1.3)				0.00
		OLST (time / sec)	2.9 (2.2)				5.1 (4.9)				0.02
Faber MJ et al. 2006.20	Functional walking program (FW) and Balance program (IB) for 20 weeks.		FW	IB	FORMER	CONTROL	FW	IB	FORMER	CONTROL	
		POMA	20.2 ± 4.5	19.2 ± 4.9	19.7 ± 4.7	19.8 ± 5.6	22.1±4.9	21.2 ± 5.0	21.6 ± 4.9	20.3 ± 5.8	> 0.5
		PPS	9.4 ± 4.2	8.2 ± 3.8	8.7 ± 4.0	8.7 ± 4.6	9.8±4.5	8.3 ± 4.1	9.0 ± 4.3	8.7 ± 4.7	> 0.5
		GARS	40.6 ± 13.4	44.3 ± 12.0	42.7 ± 12.7	40.3 ± 13.7	40.0±12.9	44.1 ± 12.2	42.3 ± 12.6	41.4 ± 14.8	> 0.5
Wolf S. et al. 2003.21	Two weekly sessions for 48 weeks. Falls Efficacy Scale.	Intervention	0	1	two	3	4	5	6	7	
		Tai Chi	76m (52.4) *	36 (24.8) *	20 (13.8) *	7 (4.8) *	3 (2.1) *	1 (0.7) *	1 (0.7) *	1 (0.7) *	
		Wellness	56 (39.7) *	43 (30.5) *	20 (14.2) *	10 (7.1) *	5 (3.5) *	5 (3.5) *	2 (1.4) *	0 (0.0) *	
Jorgensen MG et al. 2013.22	10 weeks of training with Nintendo Wii. RFD, TUG test, FES-1, Chair Stand test.		Wii		Control		Wii		Control		
		RFD (N / s)	3266 ± 2271		4143 ± 2831		3704 ± 2627		3622 ± 2423		.03
		TUG test (s)	10.3 ± 3.8		9.0 ± 3.2		11.0 ± 5.0		10.9 ± 5.1		.01
		FES-I (short) -score	11.3 ± 3.5		10.5 ± 3.0		11.3 ± 4.3		11.6 ± 3.8		.03
		30-s Chair Stand test (n)	11.5 ± 3.8		13.3 ± 3.2		11.2 ± 3.0		12.1 ± 3.0		.01
Pluchino A et al. 2012.23	8 weeks of training. TUG, OLS, FR, POMA.		SBEP	Tai Chi	Wii Fit		SBEP	Tai Chi	Wii Fit		
		TUG (s)	9,381.86	8,251.8	7,712.34		9,441.49	8,861.76	8,182.44		.044
		OLS (s)	7,619.67	28.2219.1	31.1827.94		16.1118.83	31.8523.24	28.7626.41		.084
		FR (cm)	36,178.08	40,397.00	35,188.64		38,417.26	40,799.45	39.7115.80		.060
		POMAbal	15.001.60	15,900.30	15,131.46		15,630.74	16,000.00	15.132.10		.027
		POMAgait	11,380.92	12,000.00	11,751.16		12,000.00	12,000.00	11,950.35		.093
Chalapud-Narváez LM et al. 2017.26	1) Functional extension or functional scope. 2) Tandem Test 3) Unipodal or monopodal test. 4) Sit-up or Sit-up test	Functional Extension	Higher risk of falling	47.4%			28.1%				0.000
			Lower risk of falling	29.8%			33.3%				
			Normal risk of falling	22.8%			38.6%				
		Tandem eyes open	Higher risk of falling	3.5%			7%				0.020
			Lower risk of falling	12.3%			21.1%				
			Normal risk of falling	84.2%			71.9%				
		Tandem eyes closed	Higher risk of falling	73.7%			52.6%				0.002
			Lower risk of falling	15.8%			29.8%				
			Normal risk of falling	10.5%			17.5%				
		Unipodal eyes open	increased risk of falling	98.2%			94.7%				0.102
			Lower risk of falling	1.8%			1.8%				
			normal fall risk	0%			3.5%				
		Unipodal eyes closed	Higher risk of falling	82.5%			66.7%				0.012
			Lower risk of falling	12.3%			19.3%				
			Normal risk of falling	5.3%			14%				
		Sitting / standing	Lower muscle strength	82.5%			31.6%				0.000
			Increased muscle strength	5.3%			52.6%				
			Normal muscle strength	12.3%			15.8%				

Own source

Reference	Method and instruments	Pre-Post variables					P value
		Evaluation	Pre		Post		
Herrera Mor EM. 2015.28	Two days a week for 8 months. SF12-v2 questionnaire,SFT, MEC, Rosenberg's self-esteem test and questionnaire on Fun with Sports Practice?		Experimental Group	Control group	Experimental Group	Control group	
		Physical function	84.6 (26.5)	68.75 (34.3)	86.5 (23.7)	62.5 (28.7)	
		Physical role	77.4 (26.5)	76.2 (33.0)	86 (23.2)	70 (33.0)	
		Body ache	77.9 (32.7)	72.5 (31.3)	85.6 (28.4)	63.7 (27.5)	
		General health	50.2 (17.8)	49.8 (24.14)	53.5 (17.7)	48.7 (27.5)	
		Vitality	64.4 (33.3)	67.5 (36.4)	58.7 (43.0)	43.7 (41.3)	
		Social function	88.5 (23.7)	90 (27.4)	94.2 (17.7)	78.7 (31.7)	
		Emotional role	78.8 (34.4)	76.9 (34.2)	82.7 (26.0)	73.1 (35.4)	
		Leg strength	14.1 (5.2)	11.6 (4.0)	18.4 (4.7)	11.7 (2.8)	
		Strength arms	11.0 (4.1)	9.4 (3.2)	15.4 (3.0)	8.5 (3.1)	
		Leg flexibility	-6.4 (13.2)	-9.7 (11.9)	0.8 (12.2)	-7.9 (12.4)	
		Arms flexibility	-12.2 (13.7)	-14.8 (11.3)	-10.3 (11.6)	-18.7 (10.1)	
		Agility	6.3 (1.5)	7.1 (2.3)	4.8 (.8)	7.3 (3.0)	
		Aerobic resistance	496.4 (110.1)	441.3 (81.6)	511.6 (76.6)	409.7 (73.1)	
		Cognitive state	26.65 (2.9)	25.25 (3.4)	27.12 (2.3)	26.00 (4.2)	
		Self esteem	30.0 (3.1)	30.7 (3.8)	34 (3.5)	34.8 (2.7)	
		Fat mass (kg)	28.0 (7.1)	29.8 (8.4)	27.9 (8.1)	29.4 (8.7)	
		Lean mass (kg)	41.3 (5.3)	43.3 (7.3)	40.5 (5.5)	42.6 (7.1)	
		BMI	30 (3.7)	31.5 (4.8)	29.3 (3.7)	30.5 (5.3)	

Abbreviations: CAVI: Cardio-ankle Vascular Index, AVI: Blood Pulse Wave Index, API: Blood Pressure Volume Index, FES: Falls Efficacy Scale, POMA: Performance Oriented Mobility Assessment, OLST: One-Leg Stance Test , GARS: Groningen Activity Restriction Scale, POMAbal: balance portion of the Tinetti Performance Oriented Mobility Assessment; POMAgait: mobility portion of the Tinetti, Performance Oriented Mobility Assessment, SBEP: standard balance exercise program. *Percentage
Source: Own elaboration.

Own elaboration