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PHYSICAL ACTIVITY AND DIFFERENCES OF FUNCTIONAL FITNESS AND QUALITY OF LIFE IN OLDER MALES

ACTIVIDAD FÍSICA Y DIFERENCIAS DE FITNESS FUNCIONAL Y CALIDAD DE VIDA EN HOMBRES ADULTOS MAYORES

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ABSTRACT

The aim of this study was to examine the associations between amount and type of physical activity (PA) with functional fitness, quality of life, and mood states in 246 noninstitutionalized male older adults (≥65 years old). The participants were interviewed using a standardized PA questionnaire, quality of life (EuroQOL-5D) scale, and depression scale (CES-D10). Functional fitness (Senior Fitness Test), anthropometric data, and blood pressure were measured. The data were analyzed with ANOVA using two criteria: tertiles of PA (hours/week) and participation in organized PA. The results showed that most components of fitness were correlated to total PA performed, but the associations did not appear to be lineal. Although a trend to dose-response was observed in fitness, the differences were significant only when compared with

extreme PA tertiles. Organized PA was associated with a better fitness, perceived health, and depression scale than unorganized PA.

KEY WORDS: Physical activity, functional fitness, mood state, older adult, quality of life.

RESUMEN

El objetivo fue examinar las relaciones de la cantidad y tipo de actividad física (AF) con el fitness, calidad de vida y estados de ánimo en 246 hombres mayores (≥65 años) no institucionalizados. Los participantes cumplimentaron un cuestionario estandarizado de AF (RAPA), calidad de vida percibida (EuroQOL-5D) y estados de ánimo (CES-D10). Se evaluó el fitness funcional y se tomaron medidas antropométricas, presión arterial y frecuencia cardiaca en reposo. Los datos se analizaron con ANOVA usando dos criterios: tertiles de AF (horas/semana) y participación en AFs organizadas. Los resultados sugieren que la mayor parte de los componentes del fitness funcional son sensibles a la cantidad de AF que se hace, pero las relaciones no son lineales. Las diferencias de fitness solo se observaron entre los tertiles extremos de AF. La participación en AF organizadas se asoció a una mejora del fitness, salud percibida y estados de ánimo en comparación a las AF no organizadas.

PALABRAS CLAVE: Actividad Física, condición física funcional, adultos mayores, estados de ánimo, calidad de vida.

INTRODUCTION

Elderly people older than 65 years represent a faster growing social group in developed countries. In Spain, the collective percentage of elderly people increases annually by 2.5% (vs. 0.84% for the rest), and it has been estimated that they will represent about 33% of the entire population in 2050 (vs. 16.7% in 2007) (Instituto de Mayores y Servicios Sociales, 2009). In 1998, the collective older adults took over 48.5% of the pharmaceutical expenses and 44% of the total health services expenses (Vaqué-Rafart and San José-Laporte, 2002), similar to that observed in the UK (40%) (Taylor et al., 2004). Given the pace of growth of older people, the financial consequences in the future could be enormous, suggesting greater attention to preventive health policies.

Physical activity (PA) is a major strategy for public health among older adults. Prospective studies (6 years) with older adults demonstrated that an increase in 1 standard deviation in the energy expenditure in occupational PA (measured with double-labeled water) was independently associated with a reduction of about 32% in mortality risk (Manini et al., 2006). In longitudinal studies (3.5 years) with adults older than 40 years and with at least two risk factors of chronic disease, it was found that those with less than 30 minutes per day (min/d) of PA (assessed by questionnaire) had a 2.8-fold greater mortality risk than those with more than 30 min/d of PA (Martinson et al., 2001). In a short term, the increase of PA from 0–1 day per week (d/wk) to 3 d/wk was observed to be associated with a reduction in medical budget of about $2,202 per year,

when compared with inactive older adults (Martinson et al., 2003). In Canada, it has been estimated that inactive older adults who walk 20 minutes daily would have 2% reduction in the number of days of hospitalization per year (Sari, 2010).

A review of intervention studies with exercise, mostly walking, reported an increase in aerobic capacity and muscular strength in older adults (Keysor, 2003). Also, a longer duration in light-intensity PA (assessed by accelerometers) was found to decrease arterial stiffness in older adults, particularly among those less active (Gando et al., 2010). Thus, PA has been considered as a key element for primary prevention as well as improvement of several chronic and cardiovascular diseases and locomotor system in older adults (Ben-Sira and Oliveira, 2007; World Health Organization, 2011). However, some discrepancies still remained about the efficacy of PA in the reduction of functional disability (Keysor, 2003; Keysor and Brembs, 2010; Keysor and Jette, 2001). Owing to the specificity of the response to exercise, major international agencies have recommended specific sessions for muscular strength, balance, and flexibility (Chodzko-Zajko et al., 2009; Nelson et al., 2007b; World Health Organization, 2011). Muscular strength has been observed to be the best measure to account for muscular changes linked to aging, as well as for functional disability in older adults (Hairi et al., 2010).

Besides PA (defined as caloric expenditure), there are many evidences that fitness (defined as capability for PA) is a strong health marker in older adults. In transversal studies, a higher level of aerobic fitness was found to be associated with a reduction in insulin resistance (HOMA-IR), triglycerides, total cholesterol, and low-density lipoproteins (Chen et al., 2008; Dvorak et al., 2000). In long-term longitudinal studies (>12 years), the lowest quintiles of aerobic fitness were noted to be independently associated with an increase in the mortality risk for all causes, which was almost twice when compared with the highest fitness quintiles (Sui et al., 2007a; Sui et al., 2007b). Intervention studies for 16 weeks, with 3 days/week of moderate intensity PA, exhibited significant improvements in metabolic profile and diastolic blood pressure (Martins et al, 2010).

The relative importance of PA vs. fitness to achieve health benefits has not been totally clarified. Recommendations for older adults may be centered on the increase in daily energetic expenditure or fitness improvement. The question about which of these two, PA and fitness, need more emphasis remains unclear. In 2001, Blair et al. (2001) posited that it was not possible to conclude whether PA was more important than fitness to obtain health benefits. In contrast, Dvorak et al. (2000) reported that older adults with higher aerobic fitness and lower PA (measured with double-labeled water) had a better cardiovascular risk profile than the inverse case (lower aerobic fitness and higher PA level), concluding that higher fitness levels had better cardioprotective effects in older adults than higher levels of daily PA. However, age could play a differential role in the relative importance of PA and fitness. A 13-year longitudinal study involving middle-age and older adults (Talbot et al., 2002) demonstrated that fitness, but not PA, predicted coronary risk in adults younger than 65 years, whereas in adults older than 65 years, vigorous energy expenditure and aerobic fitness were found to be equally important in explaining

coronary risk. In both the groups, the total energy expenditure (including light PA) was not associated with coronary risk. Later revisions in older adults (Dionne et al., 2003) suggested that fitness is a more consistent predictor than lifestyle PA, which is the sum of daily energy expenditure and not exercise alone.

The relative importance of fitness vs. PA to prevent functional limitations in older adults does not seem to consider one of both (Huang et al., 1998). The primary recommendation for older adults is to preserve functional capacity and independence, and the secondary objectives are focused on reducing chronic disease risk, decreasing the time of disability, and extending the life (Paterson et al., 2007). The prevention of functional limitations is important because it usually begins the cycle that drives to inactivity.

The question of whether PA induces fitness improvements in older adults is relevant to establish advice, guidelines, and programs in the elderly population. Fitness has been recognized as a powerful marker of health and could present a differential sensitivity to the amount of PA performed (e.g., hours/week) or type of PA (e.g., organized participation). Previous research suggests that energy expenditure and fitness level may be independent in the elderly (Blair et al., 2001; Myers et al., 2004). This may happen if the PA increase occurs predominantly in low-intensity activities (e.g., <3 METs). A study in older adults analyzing the contribution of daily PA in aerobic fitness reported that PA explained only 5% of the variance of V_{O2max} (Tager et al., 1998). If the increase in PA occurs in daily and occupational activities, then this type of PA may not be associated with an improvement in all the aspects of fitness and quality of life. Fitness and quality of life improvements in older adults could also be linked to the context of PA, and in our study, we focused on organized and unorganized context.

The aim of this study was to explore the relationships between the functional fitness (aerobic, strength, balance, gait, agility, body mass index [BMI], blood pressure, and heart rate), quality of life, and mood states, and the amount and type of daily PA in noninstitutionalized men older than 65 years. In line with the research, we posit two hypotheses: 1) The amount of PA performed by older adults expressed in tertiles will tend to be associated with a higher level of functional fitness, quality of life, and mood state, and 2) participation in organized PA programs will tend to be associated with an improvement in fitness, quality of life, and mood, when compared with unorganized PA.

PARTICIPANTS AND METHODS

SAMPLE

The participants were 246 noninstitutionalized men, aged 65 years or older, recruited from Mayores, Salud y Actividad Física de Gran Canaria Study (MASAF study), which used a stratified and random sample of the population of Gran Canaria (*n* = 2945). The exclusion criteria applied were the following: elders whose doctor had advised against exercise; those who had suffered a recent heart attack, chest pain, or concomitant dizziness; those whose blood

pressure is over 160/100; and those who have uncontrolled metabolic disease and musculoskeletal disorders that exacerbates with PA. The study was carried out according to the Helsinki Declaration of 1975, updated in 2000, regarding the conduct of clinical research. The study was approved by the University of Las Palmas Bioethical Committee. The participants were informed about the objectives and procedures of the study and had signed their consent.

MEASURES

The participants completed a battery of physical tests from Senior Fitness Test (SFT) and two additional tests of static balance and running speed in a track of 10 meters. The SFT had been previously tested in their validity and reliability (Rikli & Jones, 1999, 2001) and consists of eight different tests, of which, five were used in this study: (1) upper-body strength (number of arm-curl cycles, left and right separately, with 5 pounds for women and 8 pounds for men, for 30 seconds), (2) leg strength (number of sit-ups from a chair for 30 seconds), (3) aerobic endurance (distance walked in 6 minutes, measured in meters), (4) agility and dynamic balance (time to stand up from a chair, walk 2.5 meters to a cone, walk around it, and return to the chair), and (5) BMI, obtained by measuring the weight and height of the participants.

As BMI may be affected by the decreased height of older adults (Houston et al., 2009), in this study, we used the waist-to-height ratio as an alternative, which has shown better sensitivity and specificity than other anthropometric measures, including BMI, in relation to type 2 diabetes mellitus (DM2) and cardiovascular risk in adult population of Canarias (Rodríguez Pérez et al., 2009). The optimal cutoff was determined by the ROC curves at 0.55 for adults, which indicates that the estimated health risk for DM2 increases when the waist circumference exceeds half of the measure of height. Additionally, we used the walking speed test in a track of 10 meters, which had also been previously tested for validity and reliability (VanSwearingen and Brach, 2001). The study also included measurement of blood pressure and heart rate following standardized protocols. A total of 12 tests were performed by each participant.

To assess PA, the participants were asked about their participation in organized and unorganized PA separately (OPA questionnaire) and their weekly frequency and duration per day in the dominions of recreational PA (e.g., walking, petanque, bowling, and exercise) and occupational PA (e.g., gardening, shopping, and active transport). Intramural domestic PA was excluded. Organized PA was defined as participation in supervised or directed PA, usually in a group setting, as well as the affiliation to a club or gym service where the PA was performed. The survey also included items from the Rapid Physical Activity (RAPA) questionnaire (Topolski et al., 2006) to evaluate the consistency of the OPA questionnaire. To assess the agreement between both the questionnaires, the participants were classified into three groups of RAPA and OPA (sedentary, insufficiently active, and sufficiently active) using the recommendations for older PA as cutoff (Nelson et al., 2007a). The Spearman correlation between the three groups of RAPA and OPA was 0.83 ($p < 0.05$).

The participants also completed a questionnaire on perceived quality of life (Euroqol-5D) and mood states in the last week (Center for Epidemiological Studies Depression Scale: CES-D10). Both Euroqol-5D (Brooks et al., 2003, de Vries et al., 2005, Marra et al., 2005) and CES-D10 (Prieto et al., 2003; Radloff, 1977, Soler et al., 1997) have sufficient evidence of its psychometric properties in older adults with different pathologies.

DATA ANALYSIS

The normal distribution of data for all variables was previously tested with the Kolmogorov-Smirnov test. Descriptive statistics are given as means (M) and standard deviations (SD). To analyze the associations between the amount of PA (hours per week) and functional fitness, Euroqol-5D and CES-D10 ANOVAs were used with the Bonferroni post hoc test. The equality of variances between tertiles of PA was tested using Levene's test. When it was not possible to assume equal variances, Tamhane post hoc *t*-test was used. Statistical significance was assumed when $p < 0.05$. The same analysis was used to analyze the relationship between the type of PA and the above-defined outcome variables (fitness, Euroqol-5D, and CES-D10), except that instead of PA tertiles, we used three groups: sedentary, unorganized PA, and organized PA. The data were analyzed using SPSS (v.18).

RESULTS

SAMPLE

Table 1 shows the characteristics of the study's participants. The number of participants in the age groups ranged between 36 for the oldest group and 88 for the youngest group (65–69 years). The most prevalent educational profile was primary education or lesser, which was observed in more than two-thirds of the participants. It should be noted that this cohort was born between 1925 and 1946. More than 80% were married or lived with a partner, and more than 10% were widow or lived alone (12%). Furthermore, 8% were current smokers, although 63% were ex-smokers. Type II overweight (27.5–29.9 kg/m^2) or obesity (≥ 30 kg/m^2) affected 59% of the participants.

The most prevalent type of PA was not organized, with 72% of elders adhering to this modality. Elders who did some kind of organized PA (14%) slightly exceeded the sedentary group (13% without PA in a usual week).

Table 1. Characteristics of the participants

	n	%
Age		
65-69 years	88	35,8
70-74 years	64	26,0
75-79 years	58	23,6
≥ 80 years	36	14,6
Education		
Primary or lesser	165	67,1
Secondary	39	15,9
University	42	17,1
Marital status		
Unmarried	5	2,0
Married, partner	200	81,3
Divorced, separated	13	5,3
Widow	28	11,4
Laboral history		
Outdoor work	245	99,6
Not outdoor work	1	0,4
Cohabitation		
Live alone	31	12,6
Live acocompained	215	87,4
Smoking		
Smoker	20	8,1
Non smoker	71	28,9
Ex-smoker	155	63,0
BMI		
Normal	33	13,4
Overwight I	66	26,8
Overwight II	79	32,1
Obese	68	27,6
PA type		
Sedentary	33	13,4
Unorganized	177	72,0
Organized	36	14,6

FUNCTIONAL FITNESS AND PHYSICAL ACTIVITY

Table 2 reports the means and standard deviations of the three PA tertiles (hours/week) for the 12 measures of fitness included in the study. Significant differences were observed between those with less PA (first tertile), when compared with those with more PA (upper tertile) in three dimensions of fitness: balance, walking speed, and endurance. There were no significant differences in fitness between the middle and upper tertiles, although there was a linear trend in the walking speed and endurance (upper tertile ran 21 meters more than the middle tertile in 6 minutes), upper-body strength, and diastolic blood pressure.

Table 2. Differences in functional fitness in regard to amount and type of PA in older adults. MASAF study, Gran Canaria, 2010

	PA amount			PA type		
	1º tertil	2º tertil	3º tertil	Sedentary	Unorganized	Organized
	M ± SD	M ± SD	M ± SD	M ± SD	M ± SD	M ± SD
Physical activity (hours/week)	1,6 ± 1,5	6,2 ± 1,0	12,6 ± 8,1	0 ± 0,0	7,1 ± 6,4 [a]	8,7 ± 2,8
Fitness						
Static balance (sec.)	20 ± 19,9 [a,b]	28 ± 22	28 ± 22	21 ± 22 [a]	25 ± 22 [a]	29 ± 22
Upper body strength (repet.)	16 ± 5	17 ± 5	18 ± 5	17 ± 4	16 ± 5 [a]	18 ± 6
Leg strength (repet.)	15 ± 4	15 ± 5	15 ± 5	15 ± 3	15 ± 5	16 ± 5
Agility, dinamic balance (sec.)	6,4 ± 3,0	5,6 ± 1,3	6,0 ± 3,7	6,1 ± 1,6 [a]	6,2 ± 3,1 [a]	5,3 ± 1,4
Walking speed (mt/segs.)	1,71 ± 0,39 [a]	1,83 ± 0,34	1,87 ± 0,43	1,7 ± 0,3 [a]	1,8 ± 0,4 [a]	2,0 ± 0,4
Cardiorespiratory fitness (meters)	487 ± 97 [a]	508 ± 84	529 ± 121	490 ± 96 [a]	502 ± 101 [a]	542 ± 96
BMI (Kg/m2)	28,7 ± 4,2	28,5 ± 3,4	28,6 ± 3,8	28,5 ± 4,1	28,6 ± 3,6	28,4 ± 4,3
Wais-to-hip ratio	0,99 ± 0,07	1,00 ± 0,09	0,99 ± 0,07	1,00 ± 0,08	0,99 ± 0,08	0,98 ± 0,07
Waist-to-height ratio	0,61 ± 0,06	0,60 ± 0,06	0,60 ± 0,06	0,62 ± 0,07	0,61 ± 0,06	0,59 ± 0,07
Sistolic pressure (mmHg)	144 ± 21	144 ± 19,8	142 ± 20	145 ± 23	144 ± 20	140 ± 18
Diastolic pressure (mmHg)	75 ± 10	74 ± 11,3	73 ± 11	74 ± 11	75 ± 11	73 ± 11
Heart rate (beats/min.)	72 ± 11	70 ± 11,3	70 ± 13	74 ± 12	70 ± 12	69 ± 12

a = p< 0.05 in comparison to 3º tertil b = p< 0.05 in comparison to 2º tertil

Table 3. Number of significant dimensions of functional fitness, quality of life and mood states in regard to amount and type of physical activity in older adults

	Funtcional fitness	Quality of life (EuroQOL)	Mood states (CES)
PA amount			
1º vs. 2º tertil	1	3	0
1º vs 3º tertil	3	1	1
2º vs 3º tertil	0	0	0
Total pairs	3	4	1
Total dimensions	3	3	1
PA type			
Sedentary vs. unorganized	0	0	0
Sedentary vs. organized	4	1	4
Organized vs. unorganized	4	1	5
Total pairs	9	2	9
Total dimensions	5	1	5

Analysis based on the type of PA (Table 2) showed significant differences when comparing older adults participating in organized PA with the other two groups (sedentary and unorganized PA) in five dimensions of fitness: balance, upper-body strength, agility, speed, and endurance. No significant differences were observed between sedentary and unorganized PA. However, there was a linear trend in balance, walking speed, endurance, waist-to-height ratio, systolic blood pressure, and heart rate.

Table 3 shows the analysis based on the number of significant differences in functional fitness with regard to the amount (tertiles) and type of PA (sedentary, unorganized, and organized). Comparisons between PA tertiles showed four pairs of significant differences in three dimensions of fitness. In contrast, when analyzing the organizational level of PA, we observed nine pairs of significant differences in five dimensions of fitness.

HEALTH-RELATED QUALITY OF LIFE AND PHYSICAL ACTIVITY

Table 4 shows the results for the eight dimensions of quality of life with respect to the amount and type of PA. Older men showed significant differences in three dimensions of quality of life: anxiety-depression, index of quality of life, and perceived health. These differences were mainly observed between the lower tertile and middle tertile.

Table 4. Differences in health-related quality of life and mood states in regard to amount and type of PA in older adults. MASAF study, Gran Canaria, 2010

	PA amount			PA type		
	1º tertil	2º tertil	3º tertil	Sedentary	Unorganized	Organized
	M ± SD	M ± SD	M ± SD	M ± SD	M ± SD	M ± SD
Quality of Live (EURO-QOL_5D)						
Mobility	1,9 ± 0,3	2,0 ± 0,2	1,9 ± 0,2	2 ± 0,3	1,9 ± 0,3	2,0 ± 0,2
Self-care	2,0 ± 0,2	2,0 ± 0,0	2,0 ± 0,2	2,0 ± 0,0	2,0 ± 0,1	2,0 ± 0,0
Usual activities	1,9 ± 0,2	2,0 ± 0,1	2,0 ± 0,2	2,0 ± 0,2	2,0 ± 0,2	2,0 ± 0,0
Paint-discomfort	1,7 ± 0,5	1,8 ± 0,4	1,7 ± 0,4	1,7 ± 0,5	1,7 ± 0,5	1,7 ± 0,5
Anxiety-depression	1,8 ± 0,5 [b]	1,9 ± 0,3	1,9 ± 0,3	1,8 ± 0,5	1,9 ± 0,4	1,9 ± 0,3
Index EURO-QOL-D5	9,2 ± 1,1 [b]	9,7 ± 0,7	9,5 ± 0,8	9,3 ± 0,9	9,5 ± 0,9	9,6 ± 0,7
Perceived health (0-10)	7,1 ± 2,0 [a,b]	7,8 ± 1,5	8,1 ± 1,5	7,0 ± 2,0 [a]	7,7 ± 1,7	8,1 ± 1,5
Perceived health change	1,0 ± 0,6	1,1 ± 0,5	1,1 ± 0,6	1,1 ± 0,6	1,0 ± 0,5	1,1 ± 0,6
Mood State/Depression (CES-D10)						
I was bothered by usual things	0,3 ± 0,6	0,2 ± 0,5	0,2 ± 0,5	0,3 ± 0,6	0,3 ± 0,6	0,2 ± 0,4
I had trouble keeping my mind	0,4 ± 0,7	0,3 ± 0,6	0,4 ± 0,7	0,5 ± 0,8	0,4 ± 0,7	0,2 ± 0,5
I felt depressed	0,4 ± 0,6 [a]	0,3 ± 0,7	0,2 ± 0,4	0,4 ± 0,7 [a]	0,3 ± 0,6 [a]	0,1 ± 0,3
I felt that everything I did was an effort	0,4 ± 0,7	0,3 ± 0,6	0,3 ± 0,6	0,4 ± 0,7	0,3 ± 0,7	0,3 ± 0,6
I felt hopeful about the future	1,8 ± 1,1	1,9 ± 1,0	1,9 ± 1,1	1,8 ± 1,0 [a]	1,8 ± 1,1 [a]	2,3 ± 1,0
I felt fearful	0,1 ± 0,4	0,2 ± 0,5	0,1 ± 0,4	0,1 ± 0,2	0,2 ± 0,5	0,0 ± 0,2
My sleep was restless	0,7 ± 0,9	0,5 ± 0,8	0,8 ± 1,1	0,4 ± 0,7	0,7 ± 1,0	0,6 ± 1,0
I was happy	2,0 ± 0,9	2,3 ± 0,8	2,2 ± 0,9	2,0 ± 0,9 [a]	2,1 ± 0,9 [a]	2,7 ± 0,6
I felt lonely	0,2 ± 0,5	0,2 ± 0,6	0,2 ± 0,5	0,3 ± 0,7	0,2 ± 0,5	0,2 ± 0,4
I enjoyed life	2,2 ± 0,9	2,4 ± 0,8	2,3 ± 0,9	2,3 ± 0,8	2,2 ± 0,9 [a]	2,6 ± 0,8
Indice de depresion (0-30)	5,5 ± 4,4	4,4 ± 4,3	4,8 ± 3,8	5,2 ± 4,3 [a]	5,2 ± 4,3 [a]	3,1 ± 3,4

EuroQol (0-2): 0= unable, 1= some problems, 2= no problems. **Index EURO-QOL (0-20):** 0= unable, 20= no problems.
CES-D10 (0-3): 0= rarely, 1= little, 2= moderate, 3= all the time. **Index CES-D10 (0-30)**: 0= rarely, 30= all the time
Perceived Health Change (0-2): 0 = worse; 1 = same; 2 = better; a = p< 0.05 compared with 3º tertil; b = p< 0.05 compared with 2º tertil;

Analysis based on the type of PA showed significant differences only between the two extreme tertiles in perceived health (Table 4). In other dimensions, such as the index of quality of life, the results showed a more favorable trend for organized PA, but the differences were not significant. In summary, the analysis of relationships between the quality of life and the amount of PA showed a total of four pairs of differences in three dimensions of quality of life and a couple of differences in the type of PA (Table 3).

MOOD STATES AND PHYSICAL ACTIVITY

The amount of PA only showed significant differences between the two extreme tertiles (lower vs. higher) for depression (Table 4). On the other hand, the analysis based on the type of PA showed differences in five dimensions of mood states (depression, optimism, happiness, enjoyment of life, and CES-D10 index). These differences were prevalent in organized vs. unorganized and sedentary group. In summary, the analysis based on the amount of PA showed a couple of differences in one dimension of mood states, whereas the analysis based on the type of PA showed significant differences in nine pairs and five dimensions of mood states.

DISCUSSION

The main finding of this study with older men is that the accumulation of PA expressed in tertiles was associated with an improvement of three major components of fitness: balance, walking speed, and endurance; however, this relationship was observed when comparing the upper tertile of PA (12 hours/week of total PA) vs. the lower tertile of PA (1.7 hours/week). This suggests that the relations between PA and fitness are not linear. It has been suggested that this relation is curvilinear with a threshold for health benefits, which is dependent on the initial level of fitness (Blair et al., 2001). If the fitness level is low, then the improvements are easier to achieve with less PA (Aoyagi and Shephard, 2010).

Additionally, in our study, the participation in organized PA increased (in number and magnitude) the fitness differences found when analyzing the amount of PA. Those elders who were active and unorganized expressed better fitness than sedentary ones, but the differences were not significant. However, sedentary and active-unorganized older people expressed significantly worse fitness, when compared with organized participants. Furthermore, similar relationship was found with respect to mood states, showing that the organized participants had better profiles in depression, optimism, happiness, enjoyment of life, and CES-D10 index, when compared with the active-unorganized and sedentary participants. Perceived health derived from the EURO-QOL was also higher among organized participants than the unorganized ones. These improvements observed in the organized participants may be explained by the influence of sociocognitive mediators of PA behavior, such as self-efficacy, social support, and modeling, which are more common in the context of group classes (Deforche and De Bourdeaudhuij, 2000). In addition, organized classes provide a more systematic and complete PA, which stimulate several components of fitness that are

important for health in older adults, explaining a possible mechanism through which the organized PA may be more effective than unorganized PA in improving functional fitness.

Our study suggests, first, that organized PA adds more quality to the daily PA performed, leading to better fitness, when compared with unorganized PA, although the amount of PA from organized group is even lower than the unorganized group. In fact, elders who carried out organized PA in our study achieved similar or better fitness results with PA less than the upper tertile of the amount of PA (8.7 vs. 12.6 hours/week, respectively). Second, our study suggests that unorganized PA performed outdoor requires a longer duration daily to induce improvements in cardiovascular and musculoskeletal fitness in the elderly. In our study, the group of elders performing unorganized PA reported an average of 7.1 hours/week, and no significant differences in fitness were found with respect to the sedentary group. This is because unorganized elders mostly spent their PA in occupational and recreational low-intensity activities.

Occupational PA of light intensity in older men may be ineffective in improving physical health if they do not meet a critical threshold of accumulation (in our study, 12 hours/week). The result is consistent with a longitudinal study (5 years) that examined the relationship of recreational as well as occupational PA and fitness with mortality from all causes (Myers et al., 2004). The authors found that the best predictor of mortality was the effort test performance and that the amount of occupational PA by itself or combined with recreational PA did not predict mortality. However, total PA in the recreational domain moderately predicted mortality (Myers et al., 2004). The questionable value of occupational PA and, in general, of those PA below 3 METs of intensity has been shown in the Nakajomi Study with adults older than 65 years using accelerometers that were ported 24 hours for 1 full year (Aoyagi and Shephard, 2010). The study showed that the optimum level of overall health benefit was achieved from a combination of walking for 20 minutes or more (above 3 METs [1.4 m/s or 5 km/hour]), plus 60 minutes of lighter PA per day. The inclusion of PA of moderate intensity or above has also been reported to improve lipid profile and insulin resistance (Gill, 2007; King, Haskell, Young, Oka, & Stefanick, 1995), which is of particular interest for older groups with metabolic disorders.

The advantage observed in our study for organized PA with respect to the fitness and mental states is consistent with that reported in the literature. An intervention study of 11 months compared two strategies: stimulation of lifestyle PA vs. systematic program of PA in a gym on health. The results showed an advantage of the organized program in improving cardiorespiratory fitness and strength, with moderate effects on cardiovascular risk (Van Roie et al., 2010).

The contribution of formal PA (organized) and informal PA (unorganized) in the total PA was analyzed in a study using pedometers and diaries to record PA data in older adults living independently. The authors concluded that participation in organized programs was a major contributor of total PA and was also the only source to stimulate strength and flexibility (Tudor-Locke et al., 2002). Strength is important for mobility and independence of older people, as demonstrated in a 2.5-

year longitudinal study, which defined the loss of mobility as having had two consecutive incidents or difficulties in walking ¼ mile or climbing 10 steps (Visser et al., 2005). The three best predictors of loss of mobility were all related to muscular fitness: a low cross-sectional area of the thigh, high muscle attenuation (infiltration of fat into muscle), and a low knee extension strength. It has been suggested that training programs in older adults should aim at maximizing muscle power because they are well tolerated and promote adaptive changes in neuromuscular variables that are highly correlated to the risk of falls and disability (Cayley, 2008, Hariri et al. 2010; Otaka, 2008). On the other hand, prevention of functional limitations is a public health priority in the elderly population, and understanding the factors that contribute to prevention is useful for the intervention. A factor analysis with a large number of measures of physical disability in older adults showed that 68% of the functional performance was explained by four factors: mobility/fall risk, coordination, fitness, and flexibility (Brach and VanSwearingen, 2002) .

Some studies have reported that supervised programs at home or integrated into the lifestyle may be more effective than organized ones in increasing the amount of PA in older adults. Supervision by telephone contact could be considered as a variant of organized programs with remote monitoring. Opdenacker et al (2008) tested an intervention study with three groups of participants: structured PA (3 days/week), individualized PA program supervised by phone to be integrated into the lifestyle, and control group. Measures were taken at the beginning (pretest), end (posttest, 11 months), and follow-up (23 months). In the posttest, the two PA groups had significantly increased their total PA, when compared with the control group. During the follow-up (23 months), the intervention group focused on lifestyle showed the largest increase in PA in transport and total steps walked, whereas the structured group and control did not differ significantly. However, the study did not measure fitness or other markers of health risk. It is possible that older adults, who adhere to organized programs, tend to reduce PA after the days with classes. Thus, interventions focused to integrate PA in lifestyle (unorganized) may be more effective in the long term, accumulating PA along the day and mostly benefiting sedentary adults.

In older men with chronic conditions (overweight, obesity, dyslipidemia, hypertension, and osteoarthritis), the effectiveness of participating in a program organized at a center vs. at home was compared (Reeder et al., 2008). The intervention study (3 months) found that the most effective program was the organized one with respect to functional fitness, total PA, and perceived quality of life (assessed with the SF-12). However, both the programs were of similar effectiveness in improving physical fitness. A review of the effectiveness of the interventions focused at home or at a center suggested that the efficacy may be different depending on the initial state. For elders with peripheral cardiovascular disease, organized programs in classes or schools have shown better results than those at home. For sedentary or inactive elders, home-based and lifestyle programs have shown more long-term efficacy in increasing PA and better adhesion. In the elderly with chronic obstructive pulmonary disease, both the types of programs have been found to be effective in the short term of 3 months (Ashworth et al., 2005).

In our study, the elders who participated in organized programs maintained a higher level of PA and better level of functional fitness. Moreover, in terms of mood states and perceived health, organized elders showed better results than the unorganized ones.

Nevertheless, our study has some limitations. The evaluation of PA was through questionnaires, which has less precision than other objective methods in assessing the amount of PA. However, an advantage of using the questionnaires is that it allowed us to separately estimate organized and unorganized PA. The stratification into tertiles minimized the possible variability of PA evaluation, and the absence of relationships among various components of the quality of life could be due to low sensitivity of the scale of EuroQol-5D (3 points) in older adults living independently.

CONCLUSIONS

This study found that most of the components of functional fitness in older adult men are sensitive to the amount of PA performed, particularly balance, walking speed, strength, and agility. The differences were observed when comparing the extreme groups of PA. Furthermore, participation in organized PA showed consistent differences in most of the components of fitness, when compared with unorganized PA, and mood states were more sensitive to the organizational level of PA than to the amount of PA.

REFERENCES

Aoyagi, Y., Park, H., Watanabe, E., Park, S., & Shephard, R. J. (2009). Habitual physical activity and physical fitness in older Japanese adults: the Nakanojo Study. *Gerontology*, 55 (5), 523-531.

Aoyagi, Y., & Shephard, R. J. (2010). Habitual physical activity and health in the elderly: the Nakanojo Study. *Geriatrics & Gerontology International*, 10 Suppl 1, S236-243.

Ashworth, N. L., Chad, K. E., Harrison, E. L., Reeder, B. A., & Marshall, S. C. (2005). Home versus center based physical activity programs in older adults. *Cochrane Database of Systematic Reviews* (1), CD004017.

Ben-Sira, D., & Oliveira, J. (2007). Hypertension in aging: physical activity as primary prevention. *European Review of Aging and Physical Activity*, 4 (2), 85-89.

Blair, S. N., Cheng, Y., & Holder, J. S. (2001). Is physical activity or physical fitness more important in defining health benefits? *Medicine and Science in Sports and Exercise*, 33 (6 Suppl), S379-399; discussion S419-320.

Brach, J. S., & VanSwearingen, J. M. (2002). Physical impairment and disability: relationship to performance of activities of daily living in community-dwelling older men. *Physical Theraphy*, 82 (8), 752-761.

Brooks, R., Rabin, R., & de Charro, F. (Eds.). (2003). *The Measurement and Valuation of Health Status Using EQ-5D*: *A European Perspective*. Norwell, MA: Kluwer Academic Publisher.

Cayley, P. (2008). Functional exercise for older adults. *Heart, Lung & Circulation*, 17 Suppl 4, S70-72.

Chen, C. N., Chuang, L. M., & Wu, Y. T. (2008). Clinical measures of physical fitness predict insulin resistance in people at risk for diabetes. *Physical Theraphy,* 88 (11), 1355-1364.

Chodzko-Zajko, W. J., Proctor, D. N., Fiatarone Singh, M. A., Minson, C. T., Nigg, C. R., Salem, G. J., et al. (2009). American College of Sports Medicine position stand. Exercise and physical activity for older adults. *Medicine and Science in Sports and Exercise*, 41 (7), 1510-1530.

de Vries, M., Ouwendijk, R., Kessels, A. G., de Haan, M. W., Flobbe, K., Hunink, M. G., et al. (2005). Comparison of generic and disease-specific questionnaires for the assessment of quality of life in patients with peripheral arterial disease. *Journal of Vascular Surgery*, 41 (2), 261-268.

Deforche, B., & De Bourdeaudhuij, I. (2000). Differences in psychosocial determinants of physical activity in older adults participating in organised versus non-organised activities. *Journal of Sports Medicine and Physical Fitness*, 40 (4), 362-372.

Dionne, I. J., Ades, P. A., & Poehlman, E. T. (2003). Impact of cardiovascular fitness and physical activity level on health outcomes in older persons. *Mechanisms of Ageing and Development*, 124 (3), 259-267.

Dvorak, R. V., Tchernof, A., Starling, R. D., Ades, P. A., DiPietro, L., & Poehlman, E. T. (2000). Respiratory fitness, free living physical activity, and cardiovascular disease risk in older individuals: a doubly labeled water study. *The Journal of Clinical Endocrinology and Metabolism*, 85 (3), 957-963.

Gando, Y., Yamamoto, K., Murakami, H., Ohmori, Y., Kawakami, R., Sanada, K., et al. (2010). Longer Time Spent in Light Physical Activity Is Associated With Reduced Arterial Stiffness in Older Adults. *Hypertension*, 56 (3), 540-546.

Gill, J. M. (2007). Physical activity, cardiorespiratory fitness and insulin resistance: a short update. *Current Opinion in Lipidology*, 18 (1), 47-52.

Hairi, N. N., Cumming, R. G., Naganathan, V., Handelsman, D. J., Le Couteur, D. G., Creasey, H., et al. (2010). Loss of muscle strength, mass (sarcopenia), and quality (specific force) and its relationship with functional limitation and physical disability: the Concord Health and Ageing in Men Project. *Journal of American Geriatrics Society*, 58 (11), 2055-2062.

Houston, D. K., Nicklas, B. J., & Zizza, C. A. (2009). Weighty concerns: the growing prevalence of obesity among older adults. *Journal of American Dietetic Association*, 109 (11), 1886-1895.

Huang, Y., Macera, C. A., Blair, S. N., Brill, P. A., Kohl, H. W., 3rd, & Kronenfeld, J. J. (1998). Physical fitness, physical activity, and functional limitation in adults aged 40 and older. *Medicine and Science in Sports and Exercise*, 30 (9), 1430-1435.

Instituto de Mayores y Servicios Sociales. (2009). *Las personas mayores en españa*. *Informe 2008* [Older persons in Spain. Report 2008]. Madrid: Ministerio de Sanidad y Política Social.

Keysor, J. J. (2003). Does late-life physical activity or exercise prevent or minimize disablement? A critical review of the scientific evidence. *American Journal of Preventive Medicine*, 25 (3 Suppl 2), 129-136.

Keysor, J. J., & Brembs, A. (2011). Exercise: necessary but not sufficient for improving function and preventing disability? *Current Opinion in Rheumatology,* 23 (2), 211-218

Keysor, J. J., & Jette, A. M. (2001). Have we oversold the benefit of late-life exercise? *Journal of Gerontology serie A: Biological and Medical Sciences*, 56 (7), M412-423.

King, A. C., Haskell, W. L., Young, D. R., Oka, R. K., & Stefanick, M. L. (1995). Long-term effects of varying intensities and formats of physical activity on participation rates, fitness, and lipoproteins in men and women aged 50 to 65 years. *Circulation,* 91 (10), 2596-2604.

Manini, T. M., Everhart, J. E., Patel, K. V., Schoeller, D. A., Colbert, L. H., Visser, M., et al. (2006). Daily activity energy expenditure and mortality among older adults. *Jama*, 296 (2), 171-179.

Marra, C. A., Woolcott, J. C., Kopec, J. A., Shojania, K., Offer, R., Brazier, J. E., et al. (2005). A comparison of generic, indirect utility measures (the HUI2, HUI3, SF-6D, and the EQ-5D) and disease-specific instruments (the RAQoL and the HAQ) in rheumatoid arthritis. *Social Science Medicine*, 60 (7), 1571-1582.

Martins, R. A., Verissimo, M. T., Coelho e Silva, M. J., Cumming, S. P., & Teixeira, A. M. (2010). Effects of aerobic and strength-based training on metabolic health indicators in older adults. *Lipids in Health and Disease*, 9, 76.

Martinson, B. C., Crain, A. L., Pronk, N. P., O'Connor, P. J., & Maciosek, M. V. (2003). Changes in physical activity and short-term changes in health care charges: a prospective cohort study of older adults. *Preventive Medicine*, 37 (4), 319-326.

Martinson, B. C., O'Connor, P. J., & Pronk, N. P. (2001). Physical inactivity and short-term all-cause mortality in adults with chronic disease. *Archives of Internal Medicine*, 161 (9), 1173-1180.

Myers, J., Kaykha, A., George, S., Abella, J., Zaheer, N., Lear, S., et al. (2004). Fitness versus physical activity patterns in predicting mortality in men. *The American Journal of Medicine*, 117 (12), 912-918.

Nelson, M. E., Rejeski, W. J., Blair, S. N., Duncan, P. W., Judge, J. O., King, A. C., et al. (2007a). Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. *Medicine and Science in Sports and Exercise*, 39 (8), 1435-1445.

Nelson, M. E., Rejeski, W. J., Blair, S. N., Duncan, P. W., Judge, J. O., King, A. C., et al. (2007b). Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the *American Heart Association. Circulation*, 116 (9), 1094-1105.

Opdenacker, J., Boen, F., Coorevits, N., & Delecluse, C. (2008). Effectiveness of a lifestyle intervention and a structured exercise intervention in older adults. *Preventive Medicine*, 46 (6), 518-524.

Otaka, Y. (2008). [Muscle and bone health as a risk factor of fall among the elderly. Sarcopenia and falls in older people]. *Clinical Calcium*, 18 (6), 761-766.

Paterson, D. H., Jones, G. R., & Rice, C. L. (2007). Ageing and physical activity: evidence to develop exercise recommendations for older adults. *Canadian Journal of Public Health*, 98 Suppl 2, S69-108.

Prieto, L., Novick, D., Sacristan, J. A., Edgell, E. T., & Alonso, J. (2003). A Rasch model analysis to test the cross-cultural validity of the EuroQoL-5D in the Schizophrenia Outpatient Health Outcomes Study. *Acta Psychiatrica Scandinavica,* Suppl (416), 24-29.

Radloff, L. (1977). CES-D scale: A self report depression scale for research in the general populations. *Applied Psychological Measurement*, 1, 385-401.

Reeder, B. A., Chad, K. E., Harrison, E. L., Ashworth, N. L., Sheppard, M. S., Fisher, K. L., et al. (2008). Saskatoon in motion: class- versus home-based exercise intervention for older adults with chronic health conditions. *Journal of Physical Activity and Health*, 5 (1), 74-87.

Rikli, R. E., & Jones, C. J. (1999). Development and Validation of a Functional Fitness Test for Community-Residing Older Adults. *Journal of Aging and Physical Activity*, 7 (2), 129-161.

Rikli, R. E., & Jones, C. J. (2001). *Senior fitness test manual*. Champaign, IL: Human Kinetics.

Rodríguez Pérez, M. C., Cabrera De León, A., Aguirre-Jaime, A., Domínguez Coello, S., Brito Díaz, B., Almeida González, D., et al. (2009). El cociente perímetro abdominal/estatura como índice antropométrico de riesgo cardiovascular y de diabetes. *Medicina Clínica*, 134 (9), 386-391.

Sari, N. (2010). A short walk a day shortens the hospital stay: physical activity and the demand for hospital services for older adults. *Canadian Journal of Public Health*, 101 (5), 385-389.

Shephard, R. J. (1993). Exercise and aging: extending independence in older adults. *Geriatrics*, 48 (5), 61-64.

Soler, J., Perez-Sola, V., Puigdemont, D., Perez-Blanco, J., Figueres, M., & Alvarez, E. (1997). [Validation study of the Center for Epidemiological Studies-Depression of a Spanish population of patients with affective disorders]. *Actas luso-espanolas de neurologia, psiquiatria y ciencias afines,* 25 (4), 243-249.

Sui, X., Laditka, J. N., Hardin, J. W., & Blair, S. N. (2007). Estimated functional capacity predicts mortality in older adults. *Journal of the American Geriatric Society*, 55 (12), 1940-1947.

Sui, X., LaMonte, M. J., Laditka, J. N., Hardin, J. W., Chase, N., Hooker, S. P., et al. (2007). Cardiorespiratory fitness and adiposity as mortality predictors in older adults. *Jama*, 298 (21), 2507-2516.

Tager, I. B., Hollenberg, M., & Satariano, W. A. (1998). Association between self-reported leisure-time physical activity and measures of cardiorespiratory fitness in an elderly population. *American Journal of Epidemiology*, 147 (10), 921-931.

Talbot, L. A., Morrell, C. H., Metter, E. J., & Fleg, J. L. (2002). Comparison of cardiorespiratory fitness versus leisure time physical activity as predictors of

coronary events in men aged < or = 65 years and > 65 years. *American Journal of Cardiology*, 89 (10), 1187-1192.

Taylor, A. H., Cable, N. T., Faulkner, G., Hillsdon, M., Narici, M., & Van Der Bij, A. K. (2004). Physical activity and older adults: a review of health benefits and the effectiveness of interventions. *Journal of Sports Science*, 22 (8), 703-725.

Topolski, T. D., LoGerfo, J., Patrick, D. L., Williams, B., Walwick, J., & Patrick, M. B. (2006). The Rapid Assessment of Physical Activity (RAPA) among older adults. *Preventing Chronic Disease*, 3 (4), A118.

Tudor-Locke, C., Jones, R., Myers, A. M., Paterson, D. H., & Ecclestone, N. A. (2002). Contribution of structured exercise class participation and informal walking for exercise to daily physical activity in community-dwelling older adults. *Research Quarterly of Exercise and Sport*, 73 (3), 350-356.

Van Heuvelen, M. J., Kempen, G. I., Ormel, J., & Rispens, P. (1998). Physical fitness related to age and physical activity in older persons. *Medicine and Science in Sports and Exercise*,, 30 (3), 434-441.

Van Roie, E., Delecluse, C., Opdenacker, J., De Bock, K., Kennis, E., & Boen, F. (2010). Effectiveness of a lifestyle physical activity versus a structured exercise intervention in older adults. Journal of Aging and Physical Activity, 18 (3), 335-352.

VanSwearingen, J. M., & Brach, J. S. (2001). Making geriatric assessment work: selecting useful measures. *Physical Therapy*, 81 (6), 1233-1252.

Vaqué-Rafart, J., & San José-Laporte, A. (2002). *Envejecimiento: problemas que plantea y soluciones adoptadas*. In G. Piédrola Gil (Ed.), Medicina Preventiva y salud pública (pp. 867-886). Barcelona: Masson.

Visser, M., Goodpaster, B. H., Kritchevsky, S. B., Newman, A. B., Nevitt, M., Rubin, S. M., et al. (2005). Muscle mass, muscle strength, and muscle fat infiltration as predictors of incident mobility limitations in well-functioning older persons. *Journal of Gerontology serie A: Biological and Medical Sciences*, 60 (3), 324-333.

World Health Organization. (2011). *Global Recommendations on Physical Activity for Health. 65 years and above*. Retrieved 12 may 2011 from http://www.who.int/dietphysicalactivity/pa/en/index.html

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