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A NOVEL FUNCTIONAL FITNESS SCORE AND ITS ASSOCIATION WITH OBESITY STATUS IN NON-INSTITUTIONALIZED MALES AND FEMALES AGED 65 OR OVER: THE EXERNET MULTICENTER STUDY

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ABSTRACT

Introduction: Performing activities of daily living independently and safely requires adequate levels of strength, endurance and agility. However, functional fitness (FF) components have been usually evaluated separately. We aimed to create a novel global FF score and to calculate its relationship with adiposity levels in the elderly. **Methods:** Muscle mass, body fat and waist circumference were obtained in 3,136 non-institutionalized Spanish elderly subjects. Physical performance was evaluated by the Senior Fitness Test battery (upper- and lower-body strength, agility and endurance). The participants were categorized as highly fit (HF; moderate-high functioning in all FF capacities), moderately fit (MF; low-functioning in 1-3 FF measures) and unfit (UF; low-functioning in all FF capacities) according to the FF score. Odds ratios for obesity, central obesity and sarcopenic obesity were calculated according to the FF score. **Results:** The percentage of UF older adults was 6.9%. Agility was the most impaired physical condition among all the participants. A lower FF score was significantly related with a higher prevalence of obesity, central obesity and sarcopenic obesity. **Conclusion:** A strong relationship between lower levels of FF and higher levels of adiposity was observed. In order to provide a greater independence in later life we should emphasize about the need for concerted efforts to prevent and treat the FF decline with aging.

Key words: aging, older people, elderly, sarcopenia, dynapenia, adiposity, body fat, testing

UNA NUEVA PUNTUACIÓN DE FITNESS FUNCIONAL Y SU ASOCIACIÓN CON EL NIVEL DE OBESIDAD EN PERSONAS MAYORES DE 65 AÑOS NO INSTITUCIONALIZADAS: ESTUDIO MULTICÉNTRICO EXERNET

Resumen

Introducción: Las personas mayores requieren de unos adecuados niveles de fuerza, resistencia y agilidad para llevar a cabo las actividades de la vida diaria de manera independiente y segura. Sin embargo, normalmente los componentes del fitness funcional (FF) han sido evaluados de manera individual. Nuestro objetivo fue crear una nueva puntuación global de FF y evaluar su relación con los niveles de adiposidad en las personas mayores. **Métodos:** Se obtuvieron medidas de masa muscular, grasa corporal y circunferencia de cintura en un total de 3,136 personas mayores no institucionalizadas en España. La función física se evaluó por medio de la batería *Senior Fitness Test* (fuerza de brazos y piernas, agilidad y resistencia). Los participantes fueron clasificados como nivel de fitness alto (FA; funcionalidad moderada-alta en todas las capacidades de FF), fitness moderado (FM; baja funcionalidad en 1-3 medidas de FF) y fitness bajo (FB; baja funcionalidad en todas las capacidades de FF) de acuerdo a la puntuación de FF. Se calcularon los o*dds ratios* para obesidad, obesidad central y obesidad sarcopénica en función de la puntuación de FF. **Resultados:** El porcentaje de personas mayores con FB fue del 6.9%. La agilidad fue la medida más deteriorada entre los participantes. Una menor puntuación de FF estuvo significativamente relacionada con una mayor prevalencia de obesidad, obesidad central y obesidad sarcopénica. **Conclusión:** Se observó una fuerte relación entre unos bajos niveles de FF y altos niveles de adiposidad. Para alcanzar un alto grado de independencia funcional en las personas mayores, es importante implementar medidas que consigan prevenir y tratar el deterioro del FF asociado al envejecimiento.

Palabras clave: envejecimiento, ancianos, sarcopenia, dinapenia, adiposidad, grasa corporal, evaluación

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INTRODUCTION

The increased number and proportion of older adults around the world (Lutz, Sanderson, & Scherbov, 2008) and the consequent change in the population pyramid is expected to lead to a series of challenges for economies and societies in relation to the provision of health and social cares (Harper, 2014). In this sense, promoting older people to remain healthy and independent for as long as possible seems critical to reduce the negative consequences for the future society. Physical independence has been defined as having the physical capacity required to perform common everyday activities on one´s own without additional assistance (Rikli & Jones, 2013). Functional fitness (FF) has been presented as a key factor in maintaining the optimal physical ability to perform normal every day activities independently and safely without undue fatigue (Rikli & Jones, 2001). A lower FF level has been strongly associated with the occurrence of disability requiring long-term care (Tainaka, Takizawa, Katamoto, & Aoki, 2009) and institutionalization (Król-Zielińska, Kusy, Zieliński, & Osiński, 2011).

In later years, several studies have analyzed FF from the elderly through the Senior Fitness Test (SFT) (Gouveia et al., 2013; Gusi et al., 2012; Konopack et al., 2008; Krause et al., 2009; Langhammer & Stanghelle, 2011; Pedrero-Chamizo et al., 2012; Rikli & Jones, 1999b; So et al., 2013), a valid and widely used field-based measurement tool for assessing fitness parameters in older people (Rikli & Jones, 1999a, 1999b, 2001). The findings from these studies have provided us with normative and descriptive data from older adults for each of the components of FF separately (flexibility, strength, agility/dynamic balance and endurance). Recently, the normative values of FF for the Spanish elderly have been published (Pedrero-Chamizo et al., 2012), which let us to compare older individuals to their counterparts, but do not establish what a good level of FF is. Concerning this, criterion-references standards have also been published providing information about the level of fitness needed by an older adult on each FF component to be moderate functioning (Rikli & Jones, 2013). Nevertheless, performing activities of daily living (ADLs) independently and safely might require different components of FF all together (Rikli & Jones, 1999a). For example, stair-climbing while carrying objects might require an adequate level of endurance, lower-body strength, upper-body strength and agility. Thus, a global FF score would be a more appropriate method to evaluate physical functioning in older adults.

Otherwise, an increase and redistribution of body fat has been observed with aging, leading to the growing prevalence of obesity reported among older adults (Gomez-Cabello et al., 2011), which has been related to a greater risk of functional limitations and disability (Coakley et al., 1998; Davison, Ford, Cogswell, & Dietz, 2002; Pedrero-Chamizo et al., 2015). In Spain, 67% of the older people are overweight and/or obese according to their body fat level, while it is increased to 84% when considering their BMI values (Gomez-Cabello et al., 2011). In any case, increased levels of both, body fat and BMI, have been reported to be strongly associated with a higher incidence of mobility limitations in the elderly (Coakley et al., 1998; Davison et al., 2002; Koster et al., 2008; Riebe et al., 2009; Woo, Leung, & Kwok, 2007).

Therefore, the goals of the present study were: 1) to create a novel global FF score based on the main components of FF in the elderly; 2) to find those population groups and FF qualities most affected by mobility problems; and 3) to know whether those older adults with a lower FF score show higher prevalences of obesity, central obesity and sarcopenic obesity compared to the moderate-high functioning older adults.

METHOD

Study Population

The study was carried out within the framework of the elderly EXERNET multi-center study. The full methodology of this study has been previously published (Gomez-Cabello et al., 2011). This study was performed on a representative sample of non-institutionalized Spanish seniors (3,136 subjects; 724 males and 2,412 females) aged from 65 to 92 years old (mean age = 72.4±5.4 years old), all of whom lived in Spain. The exclusion criteria were: people under 65 years old, those suffering from cancer and/or dementia, and those who were living in nursing homes and/or were not independent or able to take care of themselves. Fieldwork was conducted between June 2008 and November 2009. Written informed consent was obtained from all the subjects included. The protocol was approved by the Clinical Research Ethics Committee of Aragón (18/2008) and the ethical guidelines for human research studies as stated in the Helsinki Declaration were followed throughout the study.

Functional fitness assessment

The SFT battery (Rikli & Jones, 1999a) was used to assess the FF of the sample. This battery evaluates the key physiological parameters underlying the functional mobility in older people and consists of 6 tests assessing flexibility of the upper and lower extremities (chair sit and reach test and back scratch test, respectively), strength of the lower and upper limbs (30-sencond chair stand test and arm curl test, respectively), agility (8-foot up-and-go test) and endurance (6-minute walk test) (Rikli & Jones, 1999a). However, criterion-referenced standards for FF scores have been only reported for strength of the lower and upper extremities, agility and endurance (Rikli & Jones, 2013) due to there is insufficient evidence documenting the relationship between measures of flexibility and improved functional ability (Fiatarone Singh, 2002; Paterson, Jones, & Rice, 2007). Therefore, flexibility tests were not taken into account for the present work.

Functional fitness score

Cutoffs points for older people to determine the level of FF needed on a physical capacity to be moderate-high functioning have recently been published (Rikli & Jones, 2013). The authors reported mean FF values from the older adults classified as moderate functioning according to their scores in the Composite Physical Functional (CPF) scale, which assess physical function across a wide range of abilities (such as dressing oneself, housework or exercise activities) (Rikli & Jones, 1998, 2013). Thus, upper and lower extremities strength, agility and endurance scores from each subject were classified as moderate-high functioning or low-functioning according to the cutoffs points aforementioned. Finally, our novel global FF score classified the participants depending on the number of qualities categorized as low-functioning. Three groups were created: a highly fit (HF) group with individuals that were moderate-high functioning in all of the FF variables measured; a moderately fit (MF) group including those subjects who showed between one and three low-functioning FF measures; and an unfit (UF) group with the subjects who had all of the FF measures at a low-functioning level.

Anthropometric and body composition measurements

Height. A portable stadiometer (SECA 225, SECA, Hamburg, Germany) with a maximum capacity of 2.10 m and an error of ±0.001 m was used to record the height of the sample. The measure was taken with subjects standing, without shoes, with scapulas, thighs and heels against the wall and the head placed in the Frankfort plane (Sanchez-Garcia et al., 2007)

Body mass, body fat percentage, total muscle mass, relative muscle mass and body mass index. Body mass, body fat percentage (BF%) and total muscle mass (TMM) were measured by a portable bioelectrical impedance analyzer (Tanita BC-418 MA, Tanita Corp., Tokyo, Japan) with a maximum capacity of 200 kg and an error of ±0.1 kg. The measure was taken with subjects standing, without shoes or socks, and the heavier clothing and metal targets were removed (Gómez-Cabello et al., 2012). TMM was estimated with the equation published elsewhere (Janssen, Heymsfield, Baumgartner, & Ross, 2000). Relative muscle mass (RMM) (TMM/height^2) was calculated to consider height differences in TMM among subjects. Meanwhile, body mass index (BMI) was calculated from the ratio of body mass (in kg) and height squared (in meters).

Waist circumference. An inelastic tape measure with a maximum capacity of 2 m and an error of ±0.001 m (Rosscraft Innovation Inc., Vancouver, Canada) was used to measure waist circumference. Subjects were in a standing position with feet together and arms resting by their sides. The measurement was performed at the narrowest point between the lower border of the last rib and the iliac crest.

Body composition calculations

Prevalence of overweight and obesity by BMI. It was calculated according to the premises established by the World Health Organization considering thresholds for overweight and obesity as a BMI ≥25 kg/m^2 and ≥30 kg/m^2, respectively (WHO, 1995).

Prevalence of overweight and obesity by BF%. For males a BF% ≥25% and ≥31% were considered as overweight and obesity, respectively, and for females a BF% ≥38% and ≥43% were considered as overweight and obesity, respectively (Gallagher et al., 2000).

Prevalence of central obesity. Waist circumference was used to establish central obesity prevalence. Those records ≥102 cm for males and ≥88 cm for females were considered as central obesity (Lean, Han, & Morrison, 1995).

Prevalence of sarcopenic obesity. Sarcopenic obesity was defined as a condition in which older people suffer from a high level of fat mass and low muscle mass (Baumgartner, 2000). Fat mass quintiles from a representative sample from the Spanish elderly population (Gomez-Cabello et al., 2011) were used to detect those subjects with a high level of fat mass. Similarly, muscle mass quintiles from the same representative Spanish elderly sample were used to detect those subjects with low muscle mass. Finally, subjects at the 2 highest fat mass quintiles and 2 lowest muscle mass quintiles were categorized as sarcopenic obese.

Data Analysis

Descriptive statistics (mean and standard deviation for continuous variables) were used to report the general characteristics of the sample. Student's t-test for independent samples was used to analyze differences in anthropometrics and body composition between females and males. Moreover, frequencies and percentages for categorical variables were calculated using contingency tables to calculate the prevalences of the different FF levels (HF, MF and UF groups), prevalences of low-functioning and moderate-high functioning subjects in each FF capacity separately, and the prevalences of adiposity (obesity, central obesity and sarcopenic obesity) according to the FF score. To analyze associations of FF with other factors, dichotomous variables were created. For FF, subjects were divided in a moderate-highly fit (MHF) group (highly fit and moderately fit older people were matched) and an UF group. For age, a group of people older than 75 years and another group of people younger than 75 years were created. For obesity, an obesity group and a non-obesity group were created (normal-weight and overweight groups were matched). Finally, associations and odds ratios were calculated through the Cochran-Mantel-Haenszel test, where reference values were women for sex, ≥75 years for age, and HF subjects for FF. Data analysis was conducted using the statistical software program SPSS 20.0 for Windows (SPSS Inc., Chicago, Illinois), and statistical significance level was set at $p < 0.05$.

RESULTS

The main characteristics of the studied sample are presented in table 1. Height, weight, BMI, waist circumference, body fat percentage, TMM and RMM were significantly different in women compared to men, while no significant differences in age were observed between sexes. Within this representative sample of non-institutionalized Spanish elderly, a 6.9% of older adults were UF, a 53.6% were MF, and a 39.5% were HF (table 2). There were not significant associations between the FF score and the sex and/or age in the entire sample, and neither by sex and/or age subgroups.

TABLE 1
General characteristics of the sample and sex comparisons.

	Female		Male		Total	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)
Age, *years*	2,412	72.18 (5.29)	724	72.43 (5.45)	3,136	72.23 (5.33)
Height, *cm*	2,357	152.77 (5.90)*	710	165.36 (6.67)	3,067	155.68 (8.08)
Weight, *kg*	2,335	68.22 (10.61)*	702	76.96 (10.93)	3,037	70.24 (11.30)
BMI, *kg/m²*	2,335	29.25 (4.37)*	702	28.13 (3.47)	3,037	28.99 (4.20)
WC, *cm*	2,355	92.39 (12.35)*	712	98.67 (10.12)	3,067	93.85 (12.17)
BF, *%*	2,300	39.29 (5.44)*	691	28.99 (5.22)	2,991	36.87 (6.94)
TMM, *kg*	2,300	14.98 (2.09)*	691	24.16 (2,97)	2,991	17.10 (4.51)
RMM, *kg/m²*	2,300	6.41 (0.74)*	691	8.82 (0.85)	2,991	6.96 (1.27)

*Note. SD = standard deviation; BMI = body mass index; WC = waist circumference; BF = body fat; TMM = total muscle mass; RMM = relative muscle mass. *Significant differences between females and males by the student's t-test for independent samples for p < 0.001.*

TABLE 2
Functional fitness score according to sex and age of the participants.

	N	Highly fit, *%*	Moderately fit, *%*	Unfit, *%*
Gender				
Female	2.100	38.7	54.3	7.0
Male	626	42.2	51.3	6.5
Age				
65-75 years	1.879	39.3	54.4	6.3
≥75 years	847	39.9	51.9	8.1
Total	2.726	39.5	53.6	6.9

Percentages of older adults showing low functionality in each of the four capacities evaluated from the SFT are presented in Table 3. The higher prevalence of low functioning was observed for agility, followed by lower-body strength, endurance and upper-body strength for the entire sample and women. However, for men the upper-body strength was the most affected functional ability. Regarding sex, a higher prevalence of poor functionality in strength of the lower extremities, agility and endurance was reported in women compared to men; while there was a higher percentage of men than women with reduced functionality in strength of the upper extremities. There was no association between low functioning and age for the capacities tested, except for agility, in which the percentage of adults older than 75 years old presenting low functioning was significantly higher than in those younger than 75 years.

TABLE 3
Prevalence of low and moderate-high functioning in each measured functional fitness component by sex and age and odds ratios calculated through the Cochran-Mantel-Haenszel test.

	N	Low, %	Moderate to high, %	*p* value*	OR (95% CI)
Upper limbs strength					
Female	2.305	21.6	78.4	<0.001	0.39 (0.33-0.47)
Male	696	41.5	58.5		
≥75 years	954	27.1	72.9	0.48	1.07 (0.90-1.27)
65-75 years	2.047	25.8	74.2		
Total	3.001	26.3	73.7		
Lower limbs strength					
Female	2.299	33.7	66.3	<0.001	1.55 (1.28-1.88)
Male	693	24.7	75.3		
≥75 years	946	33.3	66.7	0.18	1.12 (0.95-1.32)
65-75 years	2.046	30.8	69.2		
Total	2.992	31.6	68.4		
Agility					
Female	2.314	40.8	59.2	<0.001	2.17 (1.79-2.63)
Male	697	24.1	75.9		
≥75 years	956	40.6	59.4	<0.01	1.26 (1.08-1.47)
65-75 years	2.055	35.2	65.8		
Total	3.011	36.9	63.1		
Endurance					
Female	2.137	31.3	68.7	<0.001	1.51 (1.23-1.86)
Male	630	23.2	76.8		
≥75 years	865	31.7	68.3	0.09	1.17 (0.98-1.39)
65-75 years	1.902	28.4	71.6		
Total	2.767	29.5	70.5		

*Note. OR = Odds ratio; CI = Confidence interval. *Extracted from the Cochran-Mantel-Haenszel test.*

Finally, the prevalence of obesity (by BMI and by BF%), central obesity and sarcopenic obesity according to the FF score are presented in figure 1. The UF and MF subjects showed a significantly higher prevalence of obesity (by BMI and by BF%), and central obesity than the HF group. Regarding the prevalence of sarcopenic obesity, only those UF older participants showed an increased risk of sarcopenic obesity over that observed in the HF older group. These associations remained significant when the prevalence of adiposity for each level of FF was calculated considering the sex and age of the participants.

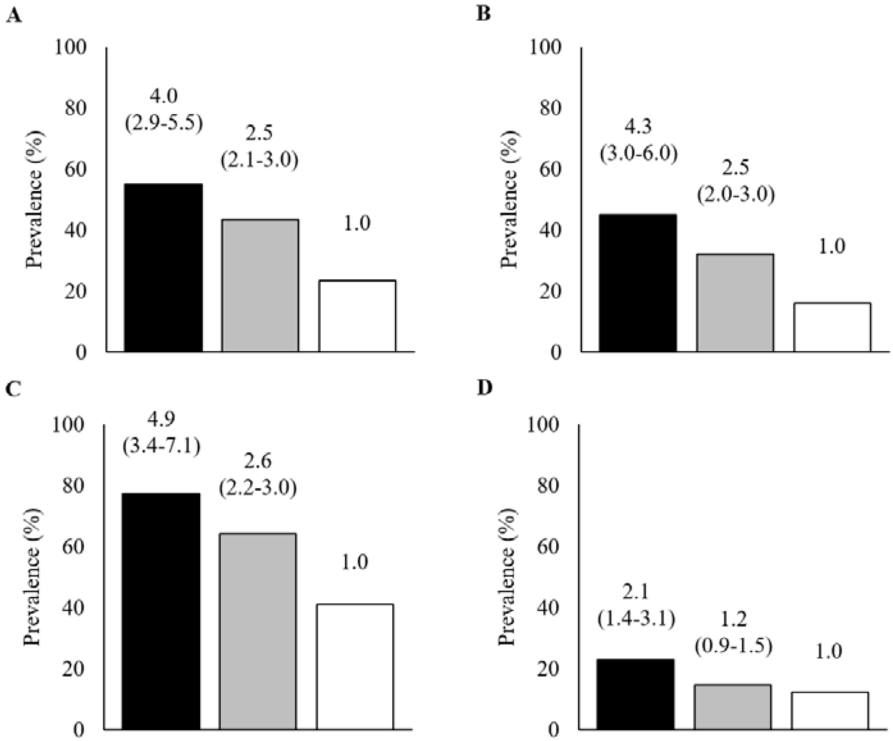

FIGURE 1: Prevalences of obesity (A, body mass index; and B, body fat percentage), central obesity (C), and sarcopenic obesity (D) according to the functional fitness score (unfit older adults represented in black bars; moderately fit older adults in grey bars; and highly fit older adults in white bars). *Note: odds ratios (95% confidence intervals) are presented for each prevalence of adiposity over the bars.*.

DISCUSSION

The main findings of the present study were: (1) the prevalence of UF people in this representative sample of non-institutionalized Spanish older adults was 6.9%; (2) agility was the most affected FF capacity with a 36.9% of older adults showing a low-functioning level, and its prevalence increased with age; and (3) the prevalences of obesity, central obesity and sarcopenic obesity were higher in those UF subjects compared to the HF individuals, even after the age and sex were considered.

Overall, this is the first time that a nationwide prevalence of non-institutionalized older people presenting problems of physical functioning based on four objective FF tests has been reported, rising up to 6.9%. In contrast, other studies have only used a single measure of physical function. Lobo reported a 4.8% of older adults at risk of falling after measuring by the Functional Reach Test, which is a single measure of functional balance (Lobo, 2012). The Short Physical Performance Battery (SPPB) is also a widely used battery composed of three tests assessing balance, walking speed and chair-to-stand speed in older adults (Guralnik, Ferrucci, Simonsick, Salive, & Wallace, 1995). However, due to its low physical demand, the application of this battery could be a more appropriate alternative for those most mobility-limited individuals (e.g. institutionalized subjects) compared with non-institutionalized older people (Guralnik et al., 1995). In other cases, the frailty assessment is used as a screening tool to detect older people with an increased situation of vulnerability to negative clinical outcomes (Fried et al., 2001). A frailty prevalence of 17% has been reported in a European sample of older people from 10 countries (Santos-Eggimann, Cuénoud, Spagnoli, & Junod, 2009), while the frailty prevalence in a Spanish elderly cohort was 8% (Garcia-Garcia et al., 2011). Frailty is usually identified in those subjects reporting at least three of the following conditions: exhaustion, shrinking, weakness, slowness and low physical activity (Fried et al., 2001). Two out of 5 frailty criteria are assessed by objective tests (handgrip strength for weakness and walking speed for slowness), while the other conditions are measured through personal interviews, which has been proven as a valid and time-efficient strategy in the clinical setting. However, the use of the SFT battery is probably a more adequate instrument for measuring physical condition in non-institutionalized older people. In addition, we have provided a novel global FF score to detect the percentage of older people in a specific population presenting low levels of FF based on criterion-references standards.

The level of FF was not significantly different by sex or age, although in the literature there is a clear evidence reporting that men and younger individuals generally score better than women and older individuals, respectively, in FF tests and questionnaires (Gouveia et al., 2013; Huang et al., 1998; Konopack et al., 2008; Król-Zielińska et al., 2011; Langhammer & Stanghelle, 2011; Lobo, 2012; Marques et al., 2014; Rikli & Jones, 1999b; Santos et al., 2012; Wilkin & Haddock, 2011). Nevertheless, the cutoff points created by Rikli and Jones to point out the level of FF needed to be moderate-high functioning were created considering sex and age groups (Rikli & Jones, 2013), hence that could explain the lack of association between the aforementioned variables, which might be a limitation. Additionally, we observed that men had lower prevalences of low functioning than women in lower-body strength, aerobic endurance and agility which is an usual finding in the literature (Gouveia et al., 2013; Huang et al., 1998; Konopack et al., 2008; Król-Zielińska et al., 2011; Langhammer & Stanghelle, 2011; Lobo, 2012; Marques et al., 2014; Rikli & Jones, 1999b; Santos et al., 2012; Wilkin & Haddock, 2011); but women were less low functioning prevalent than men in upper-body strength, which could be explained by the observations reported in others studies where increased rates of upper-body strength and upper-body muscle quality losses were reported in men compared to women (Hughes et al., 2001; Lynch et al., 1999). Agility was the most affected functional ability for the entire sample, which could be explained by the fact that agility is the result of a combination of other physical abilities such as strength and balance (Donath, van Dieen, & Faude, 2016). Thus, the sum of losses of several physical abilities should be greater than the loss of each one separately. In this sense, to improve agility in older adults a model has been proposed in which strength and balance training should be included, not neglecting the importance of endurance training to sustain the energy requirements of such multimodal intervention (Donath et al., 2016).

Otherwise, for those UF older subjects the odds to be obese and/or central obese were more than four times higher than for those HF individuals, while for those MF older subjects the odds were more than twofold higher than for the HF group. There is a clear evidence on the negative effects of adiposity and its distribution on the functional status in the elderly, and vice versa. A significant dose-response gradient between increasing levels of BMI and reduced function was observed in middle- and old-aged women, even after adjusting for age, race, smoking status, menopausal status, physical activity and alcohol consumption (Coakley et al., 1998). In a sample of older adults from the NHANES III study (Davison et al., 2002), women in the highest quintile of BF% and women with a BMI of 30 or greater were two times more likely to report functional limitations than women in the comparison groups; meanwhile, men in the highest quintile of body fat and men with a BMI ≥ 35 kg/m^2 were 1.5 times more likely to report functional limitations. Other authors observed that obese subjects (by BMI) had a significantly greater number of instrumental activities of daily living's (IADL) impairments compared with the underweight and normal-weight groups, and the group with a BMI ≥ 30 kg/m^2 had the worst walking performance (Woo et al., 2007). They also reported that increasing fat mass was associated with worsened physical function. In addition, Koster et al. (2008) observed that those older adults who had a higher BMI, a higher BF%, or a high waist circumference, had a significantly higher risk of mobility limitations than normal-weight subjects. These results have also been reported longitudinally, where obesity (by BMI) but not overweight was associated with lower levels of physical function (Riebe et al., 2009).

Regarding to sarcopenic obesity, the odds for the UF group were 2.1 higher than for the HF group, while there were no significant differences between the MF and HF groups. This result coincides with a longitudinal study where those older adults who were sarcopenic obese at baseline were significantly more likely to develop a loss in functional status than those who were not, and the time to drop in IADL was also shorter in the sarcopenic obese group compared with the other groups (Baumgartner et al., 2004). In other study, both high fat mass and low lean mass were significantly associated with IADL impairments and low grip strength; nevertheless, when each condition was analyzed individually, fat mass, but no muscle mass was associated with walking speed after adjusting for BMI (Woo et al., 2007). Although there is evidence supporting the notion than sarcopenic obesity has a greater impact on FF than either body composition abnormality alone, there is a considerable number of studies which do not support the premise that sarcopenic obesity is a worse condition than obese alone (Bouchard, Dionne, & Brochu, 2009; Davison et al., 2002; Pedrero-Chamizo et al., 2015; Zoico et al., 2004). In this sense, in a longitudinal study, Bouchard et al. (2009) reported that the sarcopenic obese and the non-sarcopenic obese older subjects had similar scores in different tests measuring physical capacity, and had lower global physical capacity compared to non-sarcopenic/non-obese individuals, thus they concluded that obesity per se appeared to contribute more to lower physical capacity than sarcopenia. Pedrero-Chamizo et al. (2015) demonstrated that older subjects suffering from obesity alone were as mobility-limited as those suffering from sarcopenic obesity, confirming the previous results. However, comparing data from sarcopenic obesity prevalences is difficult due to the different research definitions used in the literature (Batsis et al., 2013). It is clear that having sarcopenic obesity has a negative impact on FF in comparison to having normal levels of body fat and muscle mass (Baumgartner et al., 2004; Bouchard et al., 2009; Davison et al., 2002; Woo et al., 2007), but a more clear association between dynapenic obesity (low muscle strength in combination with obesity) and functional limitations compared with sarcopenic obesity has been observed in several studies (Bouchard et al., 2009; Scott et al., 2014; Visser et al., 2005). In this sense, further research on the effects of dynapenic obesity over the physical functioning of older adults, or the inclusion of muscle strength as an additional screening tool for sarcopenic obesity identification is needed, as it has been proposed by the European Working Group on Sarcopenia in Older People (Cruz-Jentoft et al., 2010).

Finally, criterion referenced standards used in this study were extracted from those reported by Rikli and Jones in a sample of non-institutionalized older Americans (Rikli & Jones, 2013). Therefore, future research should focus on the development of specific criterion-referenced clinically relevant fitness standards for the Spanish elderly. However, since cutoff points created by Rikli and Jones were calculated based on objective values of physical functioning, the cutoff points for a similar sample of non-institutionalized older adults might be of similar nature when using the same methodology. In addition, future research should include institutionalized older adults. Due to our sample consisted solely of non-institutionalized independent older adults, it would be expected to find a higher prevalence of UF people among the Spanish elders. This fact should be considered when interpreting the results.

In conclusion, a novel global FF score was created including the main FF components (strength of lower- and upper-limbs, endurance and agility) for the elderly. We observed a 7% of UF subjects in a representative Spanish sample of non-institutionalized older adults. Moreover, a strong relationship between a lower FF score and higher levels of adiposity (obesity, central obesity and sarcopenic obesity) was observed. This fact strengthens the use of this novel FF score to assess the physical performance in older people. In order to provide a greater independence, quality of life and health in the elderly, we should emphasize about the need for concerted efforts to prevent and treat the FF decline with aging than just its associated comorbidities, overall in those older adults with a decreased FF score. In this regard, promoting higher physical activity levels and applying multimodal exercise programs for older adults have been found optimal to prevent and treat the negative consequences of aging on future societies.

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