DOI: 10.1590/1809-2950/e22000523en

Contributions of social participation to the dynamic balance, mobility, and muscle strength of different age groups of older people: a cross-sectional study

Contribuições da participação social para equilíbrio dinâmico, mobilidade e força muscular de diferentes faixas etárias de idosos: um estudo transversal

Contribuciones de la participación social al equilibrio dinámico, la movilidad y la fuerza muscular de diferentes grupos de edad de ancianos: un estudio transversal

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ABSTRACT | This study aimed to investigate the contributions of social participation in health promotion groups and regular physical exercise programs to the physical and functional performance of different age groups of community-dwelling older adults. This is a cross-sectional study including 266 older adults. Physical and functional performances (dependent variables) were characterized based on dynamic balance (alternate step test), mobility (timed up and go test), upper (handgrip dynamometer) and lower limbs muscle strength (Sit-to-stand test). Participants were questioned about active social participation in primary care groups and in physical exercise programs. The data were analyzed by linear regressions. Among individuals aged over 80 years, women participated in less health promotion groups and both sexes practiced less physical exercise. Age combined with regular exercise significantly explained 18.7% of dynamic balance and 22.8% of lower limb muscle strength in women. Despite social participation, for men, age alone explained 11.9% of lower limb strength and 11.5% of mobility. Therefore, social participation in physical exercise programs was a protective factor for these physical and functional differences between women's age groups. Among men, mobility and lower limb strength performance reduced with aging, regardless of social participation.

Keywords | Aged; Physical Functional Performance; Social Participation; Exercise.

RESUMO | O objetivo deste estudo foi investigar as contribuições da participação social em grupos de promoção de saúde e programas de exercícios físicos regulares para o desempenho físico e funcional de idosos comunitários de diferentes faixas etárias. Para tanto, realizou-se um estudo transversal com 266 idosos. O desempenho físico e funcional (variáveis dependentes) foi caracterizado com base no equilíbrio dinâmico (teste de degrau alternado), na mobilidade (teste timed up and go), na força muscular dos membros superiores (dinamômetro de preensão manual) e inferiores (teste de sentar e levantar). Os participantes foram questionados sobre sua participação social ativa em grupos de atenção primária e em programas de exercícios físicos. Os dados foram analisados por regressões lineares. Entre os indivíduos com 80 anos ou mais, as mulheres participaram menos de grupos de promoção de saúde,

The study was carried out during monthly primary care programs in Brasília (DF). It is part of Maringolo and Gabriel's graduation dissertation at the Physical Therapy of the Universidade de Brasília, presented in 2020: "Mudanças relacionadas à idade no equilíbrio corporal, na mobilidade e na força muscular de idosos comunitários". This study was presented at the 1st *Congresso Internacional Online de Fisioterapia Músculoesquelética* in 2021.

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e ambos os sexos praticaram menos exercícios físicos. A idade combinada com o exercício regular explicou significativamente 18,7% do equilíbrio dinâmico e 22,8% da força muscular dos membros inferiores em mulheres. Para os participantes do sexo masculino, independentemente da participação social, apenas a idade explicou 11,9% da força dos membros inferiores e 11,5% da mobilidade. Verificou-se que a participação social em programas de exercícios físicos foi um fator protetor, entre as mulheres, para essas diferenças físicas e funcionais entre faixas etárias. Entre os homens, o desempenho de mobilidade e força dos membros inferiores foi piorando conforme o aumento da idade, independentemente da participação social.
Descritores | Idoso; Desempenho Físico Funcional; Participação Social; Exercício Físico.

RESUMEN | El objetivo de este estudio fue investigar las contribuciones de la participación social en grupos de promoción de la salud y en programas de ejercicio físico regular para el desempeño físico y funcional de ancianos residentes en comunidad de diferentes grupos de edad. Para ello, se realizó un estudio transversal con 266 ancianos. El rendimiento físico y funcional (variables dependientes) se caracterizó con base en el equilibrio dinámico (prueba de escalón alterno), en la movilidad (prueba timed up and go), en la fuerza muscular de los miembros superiores (dinamómetro de agarre manual) y miembros inferiores (prueba de levantarse y sentarse). Las preguntas del cuestionario versaban sobre la participación social activa de los encuestados en grupos de atención primaria y en programas de ejercicio físico. Los datos se analizaron mediante regresiones lineales. Entre las personas de 80 años o más, las mujeres participaban menos en los grupos de promoción de la salud y ambos sexos practicaban menos ejercicio físico. La combinación edad y ejercicio regular explicó significativamente el 18,7% del equilibrio dinámico y el 22,8% de la fuerza muscular de los miembros inferiores en las mujeres. Para los participantes del sexo masculino, independientemente de la participación social, la edad por sí sola explicó el 11,9% de la fuerza de los miembros inferiores y el 11,5% de la movilidad. Se encontró que la participación social en programas de ejercicio físico fue un factor protector entre las mujeres para estas diferencias físicas y funcionales entre los grupos de edad. Entre los hombres, el rendimiento de la movilidad y fuerza de las extremidades inferiores empeoró conforme el aumento de la edad, independientemente de la participación social.
Palabras clave | Anciano; Rendimiento Físico Funcional; Participación Social; Ejercicio Físico.

INTRODUCTION

Human aging is a complex, dynamic, individualized, and irreversible process that results in significant biological, psychological, and social changes[1,2]. Biologically, aging can be defined as a wide variety of bone, cartilage, muscular, and neurologic changes that contribute to postural instability, movement incoordination, and reduced physical performance[3]. Psychosocial aging is how individuals perceive the aging process by changes in their environment, social isolation, and how they relate to those around them[2].

During aging, people are more likely to experience functional limitations such as difficulty walking, going up and down stairs, standing up from a chair, crossing a room, rising from a horizontal position, balancing, and impaired fine motor skills[4]. These limitations occur because aging promotes important musculoskeletal alterations, such as the loss of motor units and changes in type and area of muscle fibers, affecting the speed, force, and power of movements, and reducing physical performance[5]. These changes can lead older adults to reduce social participation and avoid physical activities[6].

Social participation is the act of being involved in a vital situation and participating in aspects of community social life and in programs that involve recreation and leisure, such as physical exercise programs[7]. Continued social participation by older populations promotes healthy aging because it influences mental and physical well-being[6]. Social participation encompasses cultural, behavioral, and social aspects of an individual's interaction with society[8]. For example, participating in regular physical exercise programs improves and preserves physical function, mental health, social relationships, satisfaction with life, self-care behavior, and the ability to remain independent[2]. Functional limitations and restricted social participation negatively affect health in different aspects, including loss of independence, poor quality of life, depression, dementia[4], falls[9], institucionalization[9], and death[4].

Although the association of physical and functional decline with aging and sex is well-established in the literature, there is still limited evidence regarding the extent to which it is mediated by the restricted social participation of aging older adults in activities at primary care units and regular physical exercise programs[10-13]. In clinical practice, knowledge of this relationship in each sex would contribute to a better understanding of the functional impairments observed with aging, to implement social participation strategies to maintain or improve functional capacity in this population. Thus, this study aimed to investigate the contributions of social participation in activities at primary care units and regular physical exercise programs to the physical and the functional performance of different age groups of community-dwelling older adults.

METHODOLOGY

Study design

This is a secondary analysis of a cross-sectional study that follows the recommendations of the STROBE statement[14]. The study procedures were in accordance with the Helsinki Declaration of 1975, revised in 2013. All participants provided written informed consent.

Setting and participants

Community-dwelling older adults were recruited by convenience sampling from a monthly primary care program (from 2014 to 2016), an initiative promoted by the State Health Department of the Federal District in partnership with the University of Brasília. The program offers educational activities and screening for older adults at risk of falling and functional disabilities.

Prospective participants were eligible if they: (1) were aged 60 years or older; and (2) had participated in at least one primary care program from 2014 to 2016. Those with missing data on age and all physical performance tests were excluded.

Sample size was calculated based on the associations observed by Ibrahim, Singh, and Shahar[11] between age and performance-based tests, including lower limb muscle strength (R^2=0.1089), handgrip strength (R^2=0.0961), and mobility (R^2=0.1089) in older women. A sample size of 107 participants was estimated, considering R^2=0.096, three independent variables, an 80% power, and a 95% alpha(two-tailed).

Variables, instruments, and procedures

All participants' data were collected on a single day, for about one hour. The evaluation tools showed good reliability. All questions and evaluations were performed by examiners trained for research and followed a standard protocol. Data collection took place at the primary care events in a center for social activities belonging to the Health Department. Participants were questioned about their age, sex (i.e., male, female), participation in health promotion groups, and regular physical exercise. Then, they completed a battery of performance-based tests, including dynamic balance, lower and upper limb muscle strength, and mobility assessment. For all tests, participants received verbal encouragement and were first allowed to complete each test for familiarization purposes.

Dynamic balance

Dynamic balance was evaluated using the alternate step test[15], in which participants had to alternately place their feet on a step (18cm high and 40cm long) eight times, as fast as possible[15]. The time to complete the task was recorded using a stopwatch and continuous measurements were used in the analyses. The values obtained show very good reliability for the step test (ICC=0.78)[16].

Lower limb muscle strength

Lower limb muscle strength was assessed with the five times sit-to-stand test[17]. Participants were instructed to stand up five times from an armless chair (45cm high) as fast as possible, with their arms folded. A digital stopwatch was started when participants raised their buttocks off the chair and stopped when they were seated at the end of the fifth stand. The five times sit-to-stand test exhibits excellent test-retest reliability (ICC=0.957)[18] with a minimal detectable change (MDC) within 3.6 to 4.2s[19,20]. Continuous measurements were used in the analyses.

Upper limb muscle strength

Upper limb muscle strength was measured using the isometric handgrip strength test. Participants were seated in a chair with their shoulders adducted and neutrally rotated, elbows flexed at 90°, forearms in a neutral position, and wrists extended up to 30°, with maximum ulnar deviation of 15°. They performed three maximal isometric contractions with their dominant hand using a Saehan® handheld hydraulic dynamometer (Saehan Corporation, Masan, Korea)[19]. Verbal encouragement was given during the test. Handgrip strength test exhibits excellent test-retest reliability (ICC=0.954)[19] and changes from 5.0

to 6.5Kgf can be considered reasonable estimates of meaningful changes in grip strength[19]. The average of three measurements was used in the analyses.

Mobility

Mobility was evaluated using the timed up and go (TUG) test[21]. Participants were instructed to rise from a chair when they heard the word "go," walk 3m, turn around, then return to the initial position, and sit back down on the chair. The test was performed as fast as possible without running and compromising safety. Timing began when participants got up from the chair and stopped when their back touched the backrest of the chair[21]. Using walking aids was allowed. TUG exhibits excellent test-retest reliability (ICC=0.97)[22] with an MDC of 2.08s[17]. Time was recorded in seconds.

Social participation

Social participation involved two major domains: (1) participation in health promotion groups and (2) regular physical exercise. Participants were asked about their participation in local meetings promoted by primary care units that discuss methods for maintaining and improving health parameters in older adults. Older adults who reported regularly participating in (1) HiperDia Group (guidance on high blood pressure and diabetes mellitus) and/or (2) Integrative health practices group were considered socially active. Regular physical exercise was characterized as engaging in at least 150 minutes of moderate-intensity physical exercise (walking, resistance training, or multi-component exercise) or 75 minutes of vigorous physical exercise (running, high-intensity interval training) per week, according to recommendations for older adults[23]. Exercise intensity was explained to the participants as: while doing moderate-intensity exercise people can generally talk, but not sing; whereas those doing vigorous exercise typically cannot say more than a few words without pausing for a breath[23].

Missing data

Imputation was not performed for missing data. For participants with missing values on some of the dependent variables (performance-based tests), the data were analyzed using pairwise deletion, i.e., only missing data from each case were disregarded from the analyses, rather than all data from that case that contained any missing data. Thus, all available cases could be included in the data analysis, minimizing the risk of bias.

Statistical analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS; version 22.0; Chicago, IL, USA) and G. Power version 3.1 (Franz Faul, Universität Kiel, Germany). Descriptive statistics, normality tests (Kolmogorov-Smirnov), and homogeneity of variances (Levene) were calculated for all the outcomes. Parametric data (upper limb muscle strength) are presented as mean and standard deviation, and nonparametric (age, dynamic balance, lower limb muscle strength and mobility) as median and interquartile range (25th; 75th percentiles). Categorical data are presented as percentages (absolute frequency). Age was considered an independent variable and categorized into 60 to 69 years old (Group 1), 70 to 79 years old (Group 2), and 80+ years old (Group 3). All the performance-based tests were considered dependent variables. The analyses were stratified by sex, and social participation (participation in health promotion groups and regular physical exercise) was used as a covariate. Differences in continuous variables between age groups stratified by sex were assessed via one-way analysis of variance (ANOVA with post hoc Bonferroni) and the Kruskal–Wallis test, according to data distribution. The Mann-Whitney U-test was used to determine the presence of significant intergroup differences. Categorical variables stratified by sex were compared using χ^2 statistics. For intergroup comparison of nonparametric data, the Bonferroni correction was used to protect against type 1 error. Significance level was set at 0.05 and 0.017 for parametric and nonparametric data, respectively. Graphs were constructed for each sex to explore age-related trends in physical and functional performance. Univariate linear regression was performed to investigate the association between performance-based tests and age according to sex. When age was associated with performance at a p-value lower than 5% in univariate regression, age was included in multivariate linear regression (stepwise method) stratified by sex, with the social participation variables (health promotion groups and regular physical exercise) as covariates. All analyses were conducted by an independent researcher not involved in the data collection and blinded to participants' identification.

Cohen f and f^2 values were calculated as a measure of the between-group and multiple regression effect size, with results interpreted as small (>0.10), medium (>0.25), or large (>0.40) for f, and small (>0.02), medium (near 0.15), or large (>0.35) for f^2[24]. The statistical power was calculated in GPower version 3.1.

RESULTS

In total, 274 older adults participated in primary care events from 2014 to 2016 and they were evaluated according to eligibility criteria. Eight participants did not have information regarding age. Data on 266 older adults was used in the analysis. Figure 1 shows a flowchart of the study.

Participants' age ranged from 60 to 91 years old and 75.6% of the sample were women. Most participants were not involved in health promotion groups (71.6%) and did not practice regular physical exercise (54.9%).

Table 1 and Figure 2 show comparisons between age groups of older men and women. In older women, dynamic balance was lower in the 80+ and 70–79 age groups when compared to those aged 60–69 years. Participants in the 80+ group also had less upper and lower limb muscle strength than those in the 60–69 and 70–79 groups. Men in the 80+ group had reduced lower limb strength than those in the 60–69 group. The lowest levels of social participation in both health promotion groups among women and the lowest level of regular physical exercise, regardless of sex, were observed in the 80+ group. A large effect size was observed for the difference in physical and functional performance and a small to medium effect size for the difference in social participation between sexes for all age groups.

Table 2 shows the results of univariate and multivariate linear regression (stratified by sex) for physical function and age according to social participation (health promotion groups and regular physical exercise). In univariate regression, age was significantly associated with dynamic balance ($F[1,167]=20.131$, $p<0.001$; $R^2=0.108$), mobility ($F[1,138]=5.599$, $p=0.019$; $R^2=0.039$), and upper ($F[1,185]=6.587$, $p=0.011$; $R^2=0.034$) and lower limbs muscle strength ($F[1,188]=39.125$, $p<0.001$; $R^2=0.172$) in women. However, age was only significantly associated with mobility ($F[1,45]=5.138$, $p=0.025$; $R^2=0.102$) and lower limb muscle strength ($F[1,55]=6.152$, $p=0.016$; $R^2=0.101$) in men.

In adjusted multivariate regression, age (ß=0.300, t=3.419, p=0.001) combined with regular physical exercise (ß=−0.251, t=−2.858, p=0.005) significantly explained 18.7% of dynamic balance and 22.8% of lower limb strength (ß=0.361, t=4.541, p<0.001 for age and ß=−0.240, t=−3.015, p=0.003 for regular physical exercise) in women. In men, adjusted variables did not modify the multivariate regression associations, thus age alone explained 11.9% of lower limb muscle strength (ß=0.345, t=2.383, p=0.022) and 11.5% of mobility (ß=0.340, t=2.043, p=0.049). In multivariate regression, participation in health promotion groups did not explain the results in performance-based tests.

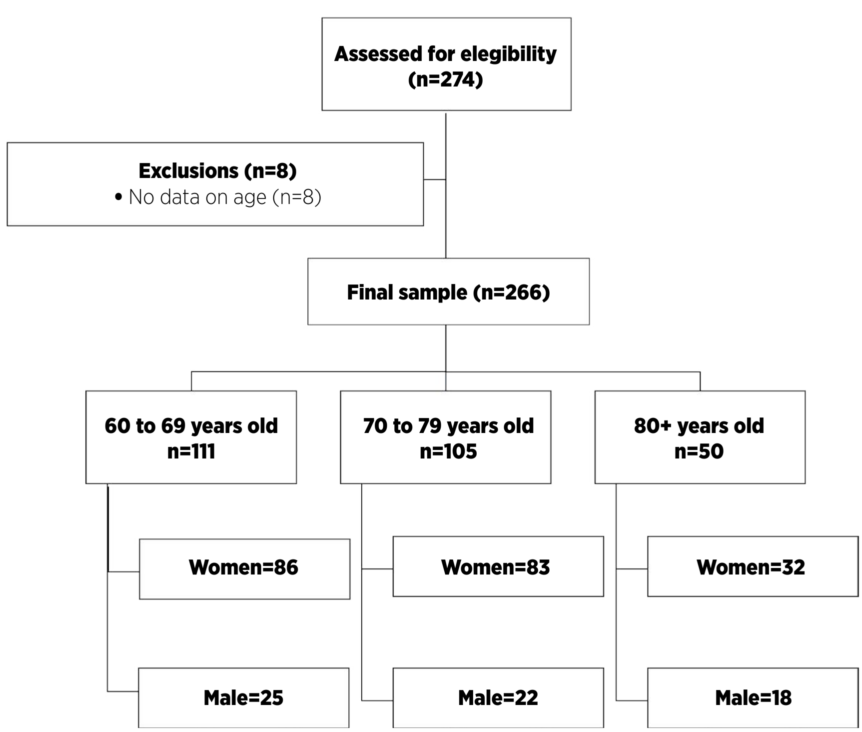

Figure 1. Flowchart of the study

Table 1. Comparison of physical and functional performance and social participation between age groups of older men and women, Brasília (DF), Brazil, 2014–2016 (n=201)

Charateristic	Valid data (n)	Groups			p-value	Effect size	Power (%)
		60 to 69 (G1)	70 to 79 (G2)	80+ (G3)			
Older women (n=201)							
Age (years old)[b]	201	64 [62; 66]	74 [72; 75]	84 [83; 89]	-	-	-
Physical-functional performance							
Dynamic balance (s)[b]	169	10.26 [8.32; 12.93]	13.31 [9.28; 16.61]$^{>G1**}$	17.21 [12.82; 23.72]$^{>G1**}$	<0.001**	2.78	100
Lower limb muscle strength (s)[b]	190	12.69 [10.70; 15.48]	12.71 [10.28; 17.97]	18.32 [14.10; 31.86]$^{>G1; >G2**}$	<0.001**	2.92	100
Upper limb muscle strength (Kgf)[a]	187	19.97 (5.39)	21.72 (6.36)	17.91 (6.30)$^{<G1; <G2**}$	0.010*	1.21	100
Mobility (s)[b]	140	10.25 [8.0; 16.41]	11.91 [9.24; 15.22]	13.50 [8.95; 19.05]	0.104	2.12	100
Social participation							
Participation in health promotion groups (yes)[c]	160	43.1 (28)	25.7 (19)	19.0 (4)$^{<G1; <G2*}$	0.036*	0.20	71
Regular physical exercise (active)[c]	161	58.6 (41)	42.4 (28)	20.0 (5)$^{<G1; <G2*}$	0.003*	0.27	97
Older men (n=65)							
Age (years old)[b]	65	65 [62; 66]	73 [72; 75]	84.50 [82.25; 87]	-	-	-
Physical-functional performance							
Dynamic balance (s)[b]	52	8.75 [8.27; 11.33]	12.08 [10.74; 16.66]	14.63 [8.77; 20.75]	0.069	2.27	100
Lower limb muscle strength (s)[b]	57	11.19 [9.68; 15.34]	14.66 [11.04; 21.29]	15.55 [13.10; 23.17]$^{>G1**}$	0.005**	2.57	100
Upper limb muscle strength (Kgf)[a]	61	28.06 (9.17)	24.43 (4.21)	25.52 (10.09)	0.572	1.14	100
Mobility (s)[b]	57	9.28 [8.51; 11.80]	12.21 [10.55; 18.19]	12.97 [10.34; 18.42]	0.081	3.33	100
Social participation							
Participation in health promotion groups (yes)[c]	58	19.0 (4)	14.3 (3)	25.0 (4)	0.712	0.11	12
Regular physical exercise (active)[c]	54	54.5 (12)	53.3 (8)	17.6 (3)$^{<G1; <G2*}$	0.042*	0.34	56

[a] Mean (Standard deviation). Comparison with one-way ANOVA (post hoc Bonferroni). Effect size *f*. *p<0.05 for intergroup comparison.
[b] Median [25^{th}; 75^{th} percentiles]. Comparison with the Kruskal Wallis test (post hoc Mann–Whitney U-test). Effect size *f*. **p<0.017 for intergroup comparison (Bonferroni correction).
[c] Percent (Absolute frequency). Comparison with the chi-squared test. Effect size *w*. *p<0.05 for intergroup comparison.

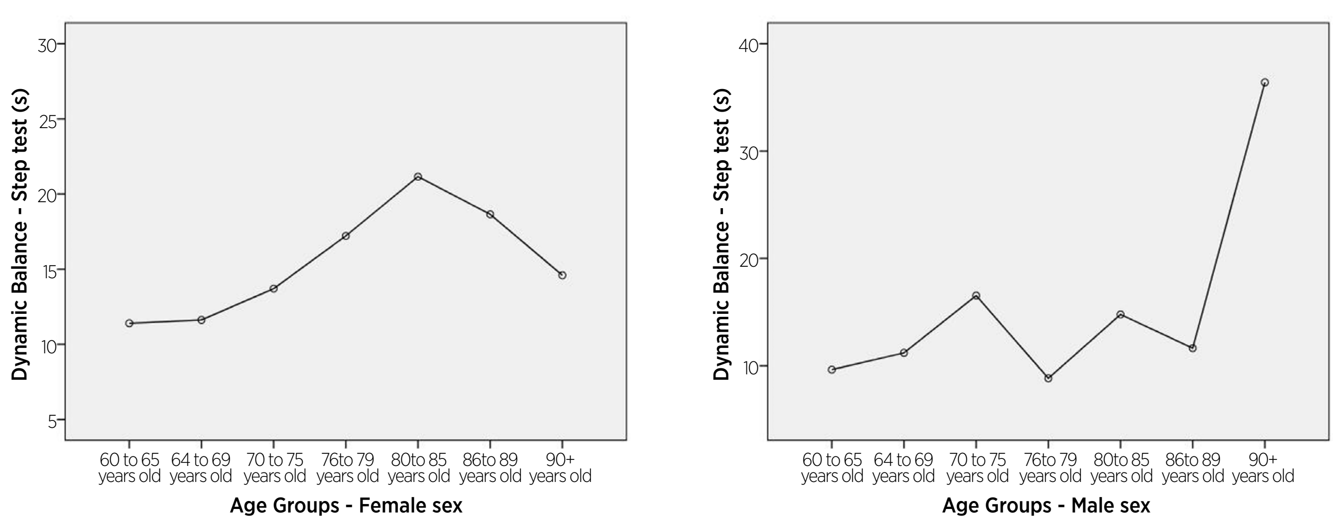

Figure 2. Age-related trends of physical-functional performance

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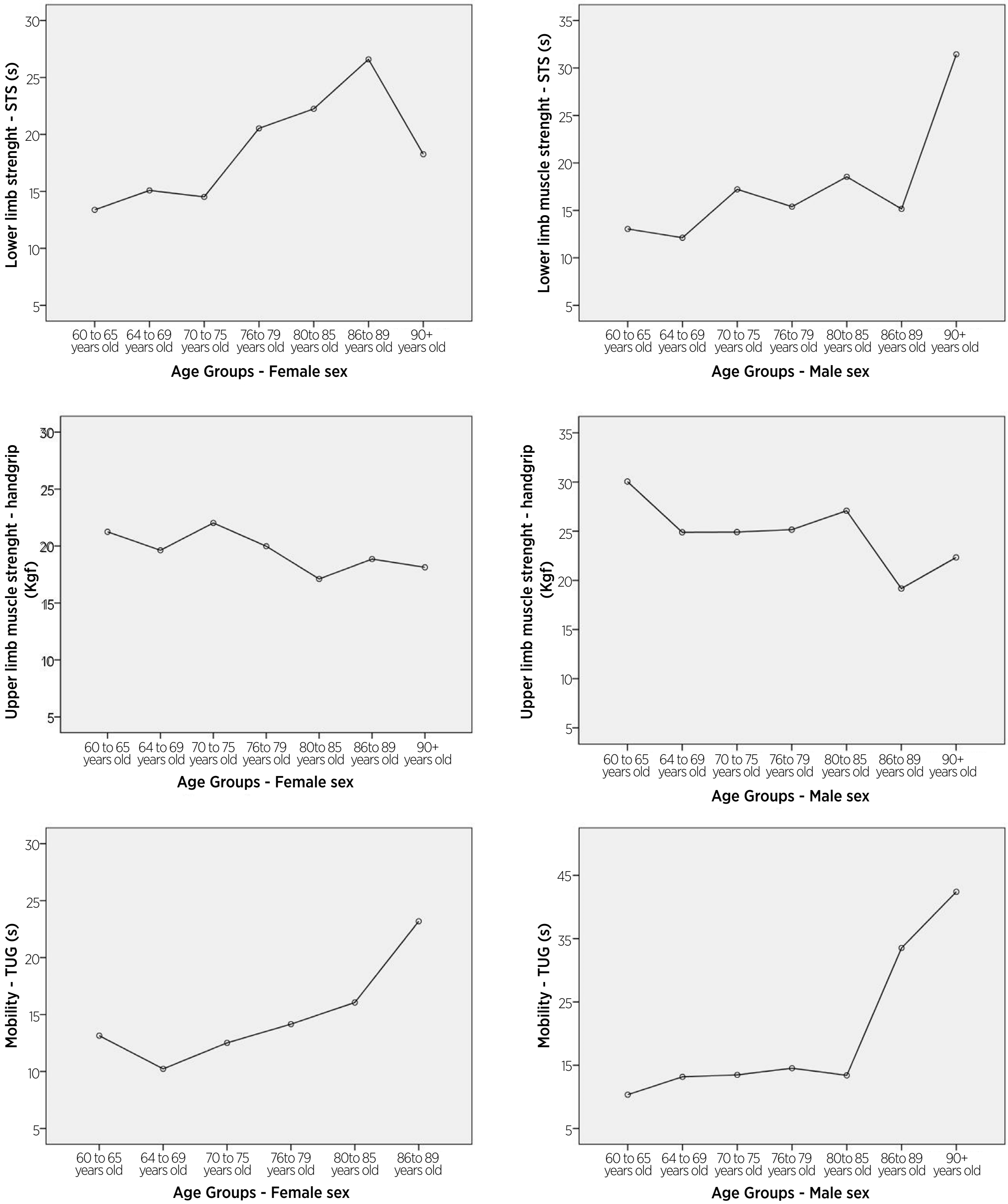

Figure 2. Continuation

Table 2. Univariate and multivariate linear regression analysis in older adults, Brasília (DF), Brazil, 2014–2016

	Valid data (n)	Dependent variable	Independent variables	Univariate Regression		Multivariate Regression			
				R^2 (R^2_{adj})	p-value	R^2 (R^2_{adj})	Standardized Coefficients (ß) [95% CI]	Individual significance (*p-value*)	Power % (Effect Size f^2)
Women	114	Dynamic balance	Age	0.108 (0.102)	<0.001*	0.187 (0.172)	0.297 [0.125; 0.469]	0.001*	99 (0.23)
			Regular Physical Exercise	-	-		−3.591 [−6.081; −1.101]	0.005*	
			Health promotion groups	-	-		-	-	
	132	Lower limb muscle strength	Age	0.172 (0.168)	<0.001*	0.228 (0.216)	0.366 [0.206; 0.525]	<0.001*	99 (0.29)
			Regular Physical Exercise	-	-		−3.482 [−5.766; −1.197]	0.003*	
			Health promotion groups	-	-		-	-	
	127	Upper limb muscle strength	Age	0.034 (0.029)	0.011*	No variables were included in the equation.			55.5 (0.03)
			Regular Physical Exercise	-	-				
			Health promotion groups	-	-				
	91	Mobility	Age	0.039 (0.032)	0.019*	No variables were included in the equation.			47.6 (0.04)
			Regular Physical Exercise	-	-				
			Health promotion groups	-	-				
Men	39	Dynamic balance	Age	0.034 (0.015)	0.188	-	-	-	20.7 (0.03)
			Regular Physical Exercise	-	-	-	-	-	
			Health promotion groups	-	-	-	-	-	
	44	Lower limb muscle strength	Age	0.101 (0.084)	0.016*	0.119 (0.098)	0.295 [0.045; 0.544]	0.022*	66.2 (0.13)
			Regular Physical Exercise	-	-		-	-	
			Health promotion groups	-	-		-	-	
	45	Upper limb muscle strength	Age	0.025 (0.009)	0.222	-	-	-	52.5 (0.09)
			Regular Physical Exercise			-	-	-	
			Health promotion groups			-	-	-	
	34	Mobility	Age	0.102 (0.083)	0.028*	0.115 (0.088)	0.535 [0.002; 1.069]	0.049*	52.9 (0.13)
			Regular Physical Exercise	-	-				
			Health promotion groups	-	-				

*p<0.05

DISCUSSION

This study investigated the contributions of social participation to physical and functional performance of different age groups of community-dwelling older adults. The oldest women showed less muscle strength and worse dynamic balance than the younger ones. The oldest men showed less upper limb strength than younger men. In the oldest age groups, we also observed lower participation in health promotion groups among women and lower regular physical exercise among the oldest men and women. Analyses showed that lower social participation in physical exercise groups contributes to worse lower limb strength and worse dynamic balance in women aged 80 and over. Although oldest men showed less mobility and lower limb strength than younger men, participation in health promotion groups or regular physical exercise does not seem to contribute to such finding.

We found a clinically important difference (>3.6s)[19,20] in lower limb strength between age groups in both sexes, evident at the Group 3 due to their worse performance rising from a chair. The contribution of physical exercise was evident among female participants, for whom age combined with physical exercise explained 22.8% of lower limb strength. In women, one-year increase in age was associated with a 0.36s increase, and a regular exercise practice was associated with a decrease of 3.48s in the performance of the sit-to-stand test. This contribution was not observed for men, with age explaining 11.9% of lower limb strength, as well as each additional year of age generating an expected increase of 0.29s in rising from and sitting on a chair. Our findings are consistent with previous studies[10,13,25,26], which showed that women are significantly slower at 80 years old than their younger peers, whereas the effect of age on this task is less evident in men[13]. The results also confirm the protective role of social participation in regular physical exercise, contributing to a 3.48s decrease in the time of rising rapidly from a chair, which exceeds the minimum clinical important difference[19,20] and reinforces that age-related changes in muscle strength can be sensitive to detraining[27].

The results obtained demonstrated that reduced dynamic balance was associated with increased age and with less exercise only in women. Women in the 80+ and 70–79 years groups showed worse dynamic balance than those in their sixties. Furthermore, age alone explained 10.8% of dynamic balance in older women and 18.7% when analyzed with regular physical exercise. A one-year increase in age was associated with a 0.30s slower performance and regular exercise with a 3.59s faster performance on the step test in older women. In this way, age has been reported as one of the main predictors of balance problems in older adults[28] and it is related to an approximately 1% decrease in dynamic balance per year[29]. This poorer balance performance among those aged over 80 years was also observed in some previous studies using different assessment tools[26,29-32]. This poorer performance can be explained by the decreased cognitive function, sensory inputs and motor responses, and the reduced integration of the systems responsible for postural balance[30]. Moreover, the strong contribution of regular physical exercise to shortening the step test by 3.59s demonstrates the protective role of social participation in physical exercise activities in postural balance during dynamic tasks among older women. Thus, effective exercises that challenge the balance[33] should be prioritized when planning physical exercise programs for older adults throughout aging.

Older age was related to lower upper limb muscle strength in female participants, regardless of social participation in health promotion or physical exercise groups. Among women, age alone explained 3.4% of handgrip strength in univariate analysis, with a lower muscle strength specifically at 80 years old. However, this relationship stopped when the analysis combined age and social participation, not exceeding the minimal clinically important difference. These results corroborate previous studies that report the small magnitude of the relationship between age and handgrip strength[13,25], which becomes negligible when considering social participation. Although most studies report a decline in upper limb strength with age in men,[10,25,34,35] with an average 3.1kg decrease every five years[35], a recent analysis with data on the Brazilian population also found no differences in this parameter among age groups[13].

In line with previous investigations, we found that increased age was accompanied by a linear reduction in mobility in both sexes[10-13,31], with no confirmed contribution of social participation, but exceeding the minimal clinically important difference between 80 and 60 years old. In men and women, age alone contributed to explain the variation in performance on the TUG test in univariate regression[11,12]. However, in the multivariate analysis, only older men showed differences in mobility among age groups. Among male participants, age explained 11.5% of mobility and for each additional year of age, there was an expected increase of 0.53s in the TUG test. This linear increase is similar to that observed in previous studies, in which every one-year increase in age resulted in an expected 0.62s increase in walking time in men[10] and 0.77s increase in the TUG test in both sexes[11]. There are still inconsistencies regarding the association of age and sex on mobility patterns in older adults[10-12], with evidence indicating varying probabilities of women exhibiting greater mobility impairment than men[12].

This study adopts a unique approach to investigate the behavior of upper and lower limb strength, mobility, and dynamic balance in community-dwelling older adults during aging, considering the contribution of social participation in health promotion and physical exercises groups. The main strength of this study is analyzing the contribution of physical exercise, participation in health promotion groups, and age to physical and functional performance in older individuals. However, the study also has limitations that should be discussed. As a cross-sectional study, age-related trends do not reflect longitudinal changes over time. The higher frequency of older people in the age groups of 60 and 70 years old and a much lower frequency of older people in the age groups of 80 and 90 years old contributed to the age variable appearing as non-parametric data, however this suggests that the older public usually participates in primary care programs. Nevertheless, the relatively small number of men and individuals older than 80 years old in the sample can be considered a limitation, since a small sample size increases the risk of type 2 errors in analyses with low statistical power, specifically in men. Missing data should also be cautiously interpreted; however, we attempted to minimize this bias via pairwise deletion. We consider socially participative those who frequently attended groups of Health Units and/or practiced regular physical exercise. Future studies should consider other groups and activities as a better way to characterize social participation. Although the use of self-reporting is a reliable tool to identify regular physical exercise, the failure to include objective assessment measures hampers the fully assessment of data regarding the association of physical exercise with functional and physical performance with aging. Furthermore, despite the wide use of battery of performance-based tests in the literature, the use of portable and low-cost devices to measure strength, balance, and mobility could elucidate associations not identified in this study.

Regarding the practical applicability of our findings, muscle strength, mobility, and postural balance should be monitored with advancing age and included in programs, which aim to prevent physical and functional disability. Physical therapists and other professionals who care for older adults should develop strategies to improve the adherence of this population to regular physical exercise and activities promoted by primary care units, paying special attention to long detraining periods. These strategies should preferably incorporate family, community, and managers, since factors such as proximity to home, social support, collective transport, and security have been identified as essential indicators of adherence[6].

CONCLUSION

Regardless of sex, the oldest adults had less social participation in health promotion and physical exercise groups. Older women showed worse dynamic balance and muscle strength performance than younger women and we identified social participation in regular physical exercise as a protective factor for these physical and functional differences. Oldest men showed worse strength and mobility performance than younger men, regardless of social participation.

ACKNOWLEDGEMENTS

The authors thank Luciana Lilian Lozada and Adrienne Catarina Otoni Vieira for their contributions to the conduct of primary care programs.

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