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Association of the cognition with grip strength and functional clinical tests in community-dwelling older adults

Associação da cognição com força de preensão palmar e testes clínicos funcionais em idosos da comunidade

Asociación de la cognición con fuerza de prensión y pruebas clínicas funcionales en adultos mayores comunitarios

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Abstract

Objective: Explore the association of cognitive decline with handgrip strength and performance in clinical functional tests of Brazilian older adults living in the community. Methodology: Cross-sectional study community-dwelling, 101 community-dwelling older adults (45 men and 56 woman) aged 60 years or older with no mobility limitation. Cross-sectional study involving 101 individuals (45 men and 56 woman) aged 60 years or older with no mobility limitation. Cognition was assessed by the 10-point Cognitive Screener (10-CS). Grip strength was assessed using a manual dynamometer. Functional performance was assessed using gait speed (single and double task) and the Timed Up and Go (TUG) test (single and double task). Results: A significant positive association was found between cognition and handgrip strength, gait speed (single and double task), TUG (single and double task), maintaining the association even after adjustments for confounding variables. Conclusion: Decline in cognitive function is associated with low handgrip strength and worse performance in clinical tests of gait speed and TUG with a single and dual task. Prevention of cognitive decline is an important modifiable condition that must be addressed in clinical practice through cognitive-motor training to prevent functional loss and promote healthy aging.

Keywords: Grip strength; Gait speed; Timed up and go; Older adults; Cognitive function; Dual-task.

Resumo

Objetivo: Explorar a associação do declínio cognitivo com a força de preensão palmar e o desempenho em testes clínicos funcionais de idosos brasileiros residentes na comunidade. Metodologia: Estudo transversal de moradores da comunidade, 101 idosos da comunidade (45 homens e 56 mulheres) com 60 anos ou mais sem limitação de mobilidade. Estudo transversal envolvendo 101 indivíduos (45 homens e 56 mulheres) com 60 anos ou mais e sem

limitação de mobilidade. A cognição foi avaliada pelo Cognitive Screener de 10 pontos (10-CS). A força de preensão foi avaliada usando um dinamômetro manual. O desempenho funcional foi avaliado por meio da velocidade da marcha (tarefa simples e dupla) e do teste Timed Up and Go (TUG) (tarefa simples e dupla). Resultados: Foi encontrada associação positiva significativa entre cognição e força de preensão manual, velocidade de marcha (tarefa simples e dupla), TUG (tarefa simples e dupla), mantendo a associação mesmo após ajustes para variáveis de confusão. Conclusão: O declínio da função cognitiva está associado à baixa força de preensão manual e pior desempenho nos testes clínicos de velocidade da marcha e TUG com uma e dupla tarefa. A prevenção do declínio cognitivo é uma importante condição modificável que deve ser abordada na prática clínica por meio do treinamento cognitivo-motor para prevenir a perda funcional e promover o envelhecimento saudável.
Palavras-chave: Força de preensão; Velocidade da marcha; Timed up and go; Idosos; Função cognitiva; Dupla tarefa.

Resumen

Objetivo: Explorar la asociación del deterioro cognitivo con la fuerza de prensión manual y el rendimiento en pruebas clínicas funcionales de ancianos brasileños residentes en la comunidad. Metodología: Estudio transversal con residentes de la comunidad, 101 adultos mayores (45 hombres y 56 mujeres) de 60 años o más, sin limitación de movilidad, residentes en la comunidad. Estudio transversal en el que participaron 101 individuos (45 hombres y 56 mujeres) de 60 años o más y sin limitaciones de movilidad. La cognición se evaluó mediante el Cognitive Screener de 10 puntos (10-CS). La fuerza de agarre se evaluó utilizando un dinamómetro de mano. El rendimiento funcional se evaluó mediante la velocidad de la marcha (tarea simple y doble) y la prueba Timed Up and Go (TUG) (tarea simple y doble). Resultados: Se encontró una asociación positiva significativa entre la cognición y la fuerza de prensión manual, la velocidad de la marcha (tarea simple y doble), TUG (tarea simple y doble), manteniendo la asociación incluso después de los ajustes por variables de confusión. Conclusión: La disminución de la función cognitiva se asocia con una baja fuerza de prensión manual y un peor rendimiento en las pruebas clínicas de velocidad de la marcha y TUG en una y dos tareas. La prevención del deterioro cognitivo es una importante condición modificable que debe ser abordada en la práctica clínica a través del entrenamiento cognitivo-motor para prevenir la pérdida funcional y promover un envejecimiento saludable.
Palabras clave: Fuerza de prensión; Velocidad de marcha; Timed up and go; Personas mayores; Función cognitiva; Doble tarea.

1. Introduction

As the world population ages, age-related cognitive decline and the prevalence of dementia increase (Orgeta et al., 2018). Studies have shown a strong association between cognitive function decline and the presence of sarcopenia, in addition to an increased risk of progression to mild cognitive impairment and dementia in individuals with sarcopenia (Cabett, 2019; Hsu et al., 2014; Montero et al., 2017). On the other hand, low muscle mass can reduce the secretion of neurotrophic factors and interleukins resulting in cognitive problems such as learning deficits and neural plasticity (Pedersen, 2012).

Meta-analysis study using cross-sectional studies identified that sarcopenia is associated with an increased risk of cognitive impairment, regardless of the study population, however, only one study from South America was included (Peng et al., 2019). In the meta-analysis with longitudinal studies carried, a relationship was observed between the lowest values of handgrip strength (HS) with the highest risk of cognitive decline and dementia, but the studies from European and North America were negative result. Both studies reinforce the need to identify cognitive dysfunction early and promote outcome-modifying actions (Cui et al., 2021).

The Mini Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA) are widely used in international clinical research and include drawing tasks, writing skills, reading requirements, which become a barrier for low-educated participants or most often illiterate (Montero et al., 2017; Bertolucci et al., 1994). These characteristics are barriers to the implementation of cognitive screening in a healthy environment. The 10-point Cognitive Screener (10-CS) has a brief and simple screening strategy, it takes 2 min to complete, in addition to being suitable for low-educated populations as it does not require reading, writing, drawing, and other skills that are acquired through schooling. Thus, the 10-CS is an advantageous alternative for an initial cognitive screening for use in clinical practice (Apolinario et al., 2015).

The European Working Group on Sarcopenia in Older People advises for the screening of sarcopenia the use of the handgrip strength measurement (HS) and to determine the severity the application of functional tests such as gait speed (GS) and Timed up and Go (TUG) (Cruz et al., 2019). The HGS measurement is simple and non-invasive and can represent the global muscle strength in older adults in the community, regardless of confounding variables, such as education, gender, age, and physical activity (Porto et al., 2020). Reduced HS can predict early functional decline and morbidity, that is, without the need to obtain a self-report of functional impairment in the older adults (Snih et al., 2004; Bohannon, 2014).

GS assessment is important because it is associated with increased risk of falling (Lusardi, 2012; Middleton, 2015; Kyderlan et al., 2018), as well as, predicting functional disability, falls, institutionalization, mortality, and cognitive problems (Duran et al., 2020), since gait has been considered an extension of the cognitive state, especially in the older adults (Sheridan, 2007). Additionally, the link between gait and cognition suggests a sharing of sensorimotor processing and cognitive system (Srikanth et al., 2010).

The TUG, which consists of position transitions that can be easily and quickly applied (Bergquist et al., 2020), has been used to assess functional mobility, risk of falls (Almajid et al., 2020), and cognitive decline. The TUG can be an auxiliary tool in the diagnosis and staging of the pre-clinical and post-diagnosis stages of dementia (De Oliveira et al., 2019).

The performance of gait and TUG associated with cognitive tasks allow us to assess how dependent the motor system is on cognition, that is, the degree of interference of the cognitive state in the performance of functional tests (Montero et al., 2017).

Identifying better cognitive-functional screening tools can help to implement prevention strategies and treatments that involve cognitive exercises and functional performance, minimizing the associated negative outcomes. Thus, this study aims to explore the association between cognitive decline and physical function in Brazilian older adults living in the community.

2. Methodology

A cross-sectional design (Pereira et al. 2018) with 101 independent (45 men and 65 women), aged between 60 and 85 years, participated in this cross-sectional study. The study presents a convenience sample in which participants were recruited directly from the community and at events held for the older adult by the Federal University of Sergipe (UFS), Lagarto. 15 older adults were excluded for reporting recent hip fracture and use of a walking aid device. The study was approved by the Ethics Committee for Research with Human Beings at UFS (no. 2.825.059). All participants signed the Informed Consent Form before the initial assessments. The evaluations were carried out at the UFS's Clinic. The ineligibility criteria were older adults with acute muscle pain that could compromise the muscle function of the lower limb; the presence of hip and knee prosthesis; recent fractures; decompensated cardiovascular diseases; clinical conditions that contraindicated physical exertion; Parkinson's disease and not being able to understand simple requested commands.

Data were collected at the Center for Simulations and Practices of the UFS. Each participant attended the data collection site only once. The sample was characterized by the collection of the following data: age, marital status, income, sex, weight, height, body mass index, education, level of physical activity (IPAQ - International Physical Activity Questionnaire, short version) (Matsudo at al., 2001) and self-reported comorbidities (systemic arterial hypertension, type II diabetes mellitus; osteopenia/osteoporosis and falls in the last six months) Next, cognitive performance was assessed by the 10-CS (Apolinario et al., 2015) which includes questions about three-item temporal orientation (date, month, year), category fluency (naming animals in 1 minute) and three words (car, vase, and brick). The 10-CS is a brief screening tool to detect problems and cognitive impairment applicable to the Brazilian population, it takes 2-min to complete, where each correct question is equivalent to one point, while the animal naming score is scaled to four points, being 0-5: zero points, 6-8: one point 9-11: two points, 12-14: three points, equal to or greater than 15: four points.

Physical function, which included handgrip strength and functionality, was assessed through functional clinical tests: gait speed, dual-task gait speed, TUG, and dual-task TUG. Handgrip strength was assessed by a hand dynamometer (Jamar, Sammons Preston, Illinois, USA).

Grip strength (HPP) was measured by a hand dynamometer (Jamar, Sammons Preston, Illinois, USA), following the recommendations of the American Society of Hand Therapy and the American College of Sports Medicine (Acsms, 2014). During the test, the participant remained seated in a chair, with the trunk supported on the chair and the feet supported on the ground. The shoulder of the limb to be tested remained in the neutral position for rotation and adducted; elbow flexed to 90 degrees; neutral forearm for pronation-supination. Verbal encouragement was given during the test for the participant to use their maximum strength. Two attempts were made with the dominant upper limb and a one-minute rest interval between attempts. The higher of the two values was considered in the analysis (Bohannon, 2014).

The gait speed (GS) was measured in the single task and dual task situation. In the first situations, the participants were instructed to walk six meters at their usual speed. The time was recorded in seconds, only the central three meters, disregarding the acceleration period (initial 1.5 meters) and deceleration (final 1.5 meters). The gait speed value was obtained by dividing the distance into three meters by the time in seconds. In the second situation, the speed test was performed simultaneously with the cognitive task of naming animals. The participant was instructed to perform the cognitive task while walking and instructed to prioritize both the cognitive and the walking (motor) task.

The TUG was performed as a single task and dual task. Participants began the test sitting in a chair with a back. After the command provided by the evaluator, the participants were to get up from the chair, walk three meters, turn (after changing the gait on the floor), go back and sit on the chair again. In the dual-task TUG, the participant performed the test simultaneously with the cognitive task of naming animals. Participants were instructed to perform the cognitive task while walking and instructed to prioritize both the cognitive and the motor tasks. The time spent by the participant to perform the test with single and double tasks was timed.

Statistical analyzes were performed using the SPSS program (SPSS for Windows - Version 17.0 – SPSS Inc.) and the significance level was adjusted to 5% ($p \leq 0.05$). Means, standard deviations, and frequencies were used to characterize the sample. The association between the 10-CS score (independent variable) and the physical tests (dependent variables) was performed using the Pearson correlation test, followed by multiple linear regression, adjusted for the confounding variables sex, age, body mass index, level of physical activity, and the number of comorbidities. The association was determined by the regression coefficient (β) for non-standardized continuous measures and the overall performance of the final model was evaluated by Nagelkerke's R^2. The sample power of 95% was calculated considering the lowest determination index found ($R^2 = 0.10$), the effect size of 0.31, alpha value of 0.05, and the sample size used (n = 101), from the G program *Power software, version 3.1.92 (Universitat Kiel, Kiel, Germany).

3. Results

The sample was predominantly composed of older adults (mean age 73 years), non-obese participants (mean BMI 26.59 kg/m2), and women (67.32%). Systemic arterial hypertension (78.21%), diabetes mellitus type II (15.84%), osteopenia/osteoporosis (15.31%), and falls (14.22%) were the most reported comorbidities. The sociodemographic and behavioral characterization data of the older adults in the community are shown in table 1. Handgrip strength and performance in functional tests with single-task and dual-task are shown in table 2. In table 3 shows that there was an association between 10-CS and all physical tests. The higher the 10-CS score, after adjustment for the confounding variables sex, age, body mass index, level of physical activity, and the number of comorbidities, the greater the handgrip strength and the better the performance in the gait speed and TUG tests.

Table 1 - Sociodemographic characterization, health, and behavioral conditions of the older adults in the community. Values are represented as mean (standard deviation) and frequency.

Characteristics	**N = 101**
Age (years)	73.02 (7.77)
Marital status (with married life) (%)	47.52
Women (%)	67.32
Family income - minimum wage (%)	
1	41.48
>1 to 2	17.92
>2	43.56
Education (%)	
Illiterate	14.86
1 to 4 years	46.53
5 to 8 years	11.88
>9 years	26.73
10-CS (%)	
Normal (≥ 8 pontos)	32.7%
Possible cognitive impairment (6-7 points)	22.9%
Probable cognitive impairment (0-5 points)	44.4%
Weight (kg)	65.55 (10.54)
Height (m)	1.57 (0.08)
BMI (kg.m^2)	26.59 (3.64)
Physical activity level (%)	
Low	29.43
Moderate	67.21
High	3.36
Number of comorbidities	2.51 (1.05)
Number of medications	2.80 (1.97)
Comorbidities (%)	
Systemic Arterial Hypertension	78.21
Type II diabetes mellitus	15.84
Osteopenia/osteoporosis	15.31
Falls	14.22
Smoke (%)	
I dont' smoke	92.04
Smoker	4.95
Ex – smoker	3.01

Caption: *BMI: body mass index; 10-CS: 10-point Cognitive Screener. Source: Authors

Table 2 - Characterization of handgrip strength and performance in functional tests with single and double tasks. Values are represented as mean (standard deviation).

Characteristics	**N = 101**
Hand grip strength (kgf)	22.81 (7.95)
Women	19.94 (6.10)
Man	28.71 (8.13)
GS (seconds)	
Simple Task	0.84 (0.24)
Dual Task	0.63 (0.25)
TUG (seconds)	
Simple Task	12.95 (5.27)
Dual Task	17.24 (7.65)

Caption: TUG: Timed Up and Go; GS: gait speed. Source: Authors.

Table 3. Association between 10-CS and physical function in the older adults (n = 101).

	Pearson correlation		Multiple linear regression Adjusted		
	r	**P value**	**β**	**P value**	**R^2**
Hand grip strength (kgf)	0.53	0.000*	1.43	0.000#	0.55
GS simple task (m/s)	0.42	0.000*	0.03	0.000#	0.28
GS dual task (m/s)	0.43	0.000*	0.03	0.000#	0.25
TUG simple task(s)	-0.30	0.001*	-0.50	0.007#	0.12
TUG dual task(s)	-0.43	0.000*	-1.05	0.000#	0.27

*p < 0.05 according to Pearson's correlation test; #p < 0.05 according to adjusted multiple linear regression. TUG: Timed Up and Go; GS: gait speed. Source: Authors.

4. Discussion

The main findings of the study show an association between the decline in cognition with the reduction in handgrip strength (HS) and the decline in cognition with the worst performance in the gait speed test and the TUG with and without the inclusion of the dual task in Brazilian older adults living in the community. The results suggest that the older adult's cognitive status interferes with their physical function, including HS and simple and dual-task performance of GS and TUG. Both strength (HG) and functionality (GS and TUG) was related with risk of cognitive decline in Brazilian older adults.

The presence of associations between cognition and poor physical function performance was observed even using an ultra-fast screening tool, the 10-CS, corroborating previous studies in the literature that observed the association between cognition and physical function using the MMSE or MoCA as cognitive screening (Montero et al., 2017; Kueper et al., 2020).

Our results corroborate previous studies that demonstrated that 10-CS can be a simple, brief and adequate cognitive function tracker for uneducated or low-educated populations (Carvalho et al., 2021; Aprahamian et al., 2018). In addition, the test is free and does not include visual cues and motor tasks, therefore, they are not disadvantaged in subjects with motor or sensory impairments that are common in old age. Reinforce that cognitive assessment using rapid screening tools, such as the 10-CS, can help physicians in decision-making and provide individualized care for patients with greater limitations (Fortes et al., 2021).

Our results corroborate with previous studies that also observed an association between handgrip strength and cognitive function. Analyzing 28,980 older adults Americans from the proxy for Health and Retirement Study from 2006-2016 observed a bidirectional association between handgrip strength and cognitive function. The authors concluded that the decline in cognitive function occurs concomitantly with the reduction in HS. This association can be explained by the fact that muscle weakness is another decreased product of the neural system, that is, less neuromuscular activation and less recruitment of units motor skills resulting from the decline in nerve function generate less muscle strength by not fully activating the muscle when the handgrip test is performed. Thus, the assessment of muscle weakness using a portable dynamometer could be a simple clinical marker to predict the risk of cognitive impairment and monitor the decline in strength and cognition in older adults with cognitive impairment (McGrath et al., 2020). The cohort study totaling 1.009 participants with a mean age of 71.7 years, also found that reduced levels of handgrip strength were related to a higher prevalence of mild cognitive impairment (Liu et al., 2020). In their cross-sectional study of 5.237 older adults aged ≥ 60 years show that older adult with handgrip strength greater than the muscle weakness cutoff points had a lower chance of presenting cognitive impairment and depression (Ramírez et al., 2019).

The cutoff points for handgrip strength to limit mobility are not a consensus in the literature. In 2019, the European Working Group on Sarcopenia in Older People suggested that low muscle strength for men is < 27 kg and < 16 kg for women. In a longitudinal study presented handgrip strength cutoff points < 32 kg as a reference for men and < 21 for women among the

Brazilian population. The authors argue that higher cutoff points can infer early diagnosis, as well as early interventions that preserve functional capacity and reduce public spending on health (Ramírez et al., 2019). An important point in the study is the application of these HS results in the older adult population in Brazil and England. Considering the cutoff values established, for the Brazilian population, both men (28.71± 6.10 kg) and women (19.94±8.13 kg) in our study had reduced handgrip strength (Delinocente et al., 2021).

Evealed that gait speed and handgrip strength are determinants of physical frailty, which, in turn, may be associated with cognitive decline (Cruz et al., 2019). Followed for 10 years older adults in the community with low gait speed and reduced HS and observed an association with cognition, however, the authors highlight that the MMSE was only able to predict decline when associated with HS. The authors justify the use of other cognitive scales with the hypothesis that there are different mechanisms between the brain and physical functions (Chou et al., 2019). Variables such as female gender, older age, less education, low income, presence of chronic diseases contributes to slower gait speed (Ortiz et al., 2017). Reinforce the importance of specifying the covariates that can interfere with the results of clinical tests, such as gender, age, and country or region of the sample (De Oliveira et al., 2019). Identified gender differences in functional performance, which were justified by the presence of multivariates, such as quadriceps strength, history of falls, height, age, and level of physical activity (Carvalho et al., 2021).

In our study, cognition assessed by the 10-CS was associated with low GS, in single-task and dual-task, and reduced HS even after adjustments for confounding variables. This can be explained by the reduction of synapses and chronic inflammation in the older adult, which can be intensified with the presence of multiple comorbidities.

The performance in the GS test with the single and double tasks may be related to the neurodegeneration of the aging process. The gait activity is a complex task and when associated with dual task results in a greater overload of the neural network and can predict an early decline in cognition. Observed that the gait task performed in conjunction with the cognitive task allows for evidence of the interference of lower cognitive reserve in functionality since that dual-task gait performance is associated with apolipoprotein E4 and amyloid-β markers, biomarkers found in AD and smaller numbers in healthy older older adult. Our results showed an association of cognition with simple gait speed and cognitive dual task (Montero et al., 2017; Kueper et al., 2020).

TUG can provide information on cognitive impairment and risk of falls and stands out as a complex motor activity. Our results show an association between cognitive decline and worse performance on the TUG, corroborating the systematic review in which they observed that the TUG may be suitable for identifying the early stages of dementia, aiding in the diagnosis (De Oliveira et al., 2019).

A progressive cognitive decline can lead to disorganization of the network that controls locomotion, resulting in temporal impairment, which may justify the associations observed in our study between cognition and physical function. Thus, the use of an ultra-rapid screening tool for cognitive statuses, such as the 10-CS, in independent Brazilian older adults proved to be effective in identifying the association between cognition and physical function. Additionally, our results suggest that the improvement in the cognitive status of the older adult can positively influence the improvement of muscle strength and functional performance and, therefore, public health policies aimed at ensuring access for the older adult to an interprofessional care program in primary care should be considered a priority, as it can contribute to successful aging (Ansai et al., 2019).

As a limitation, the study design is cross-sectional and does not allow monitoring the influence of non-modifiable determining factors, such as age and gender; as well as modifiable factors such as lifestyle habits and health conditions, in the relationship between cognition, grip strength, and functional performance throughout aging. It is not possible to extrapolate the results to another population, such as people under 60 years old, obese, institutionalized older adult, mobility restriction, or with specific diseases. In addition, drug use, hormone replacement therapy, and nutritional status were not consistently assessed, which can be incorporated into the adjusted model.

5. Conclusion

Our results showed an association between cognition (assessed by 10-CS) and HS, GS and, TUG with single and double tasks in a sample of brasilian older adults. Thus, future clinical trials with multicomponent physical-cognitive training should be developed to investigate whether the improvement in cognitive status positively influences the physical function of older adults in the community.

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