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Depressive symptoms and motor performance in the elderly: a population based study

Sintomas depressivos e desempenho motor em idosos: estudo de base populacional

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Abstract

Blackground: There is a growing incidence of depression in the elderly, and this impairment interferes directly in the reduction of motor skills. **Objective:** This study aims to examine the association between depressive symptoms and motor performance in community-dwelling elderly. **Method:** This is a cross-sectional study that analyzed data from 316 elders of a home and population-based epidemiological survey. The information used was: socio-demographic characteristics; motor performance tests; physical activity; and Geriatric Depression Scale. The data were analyzed using the Statistical Package for Social Sciences. Mann-Whitney U test, chi-square, Spearman correlation and Poisson regression, with a confidence interval of 95%, were calculated. **Results:** For all motor tests, motor performance was negatively associated with depressive symptoms, regardless of gender, age, literacy and illiteracy, *per capita* income and physical activity. Elderly people with depressive symptoms have between 58% and 82% more functional limitation, depending on the motor performance test compared to those who were not depressed. **Conclusions:** There is an inverse relationship between depressive symptoms and motor performance in the elderly.

Keywords: depression; mental health; health of the elderly; movement; motor activity.

Resumo

Contextualização: É crescente a ocorrência de depressão em idosos, e esse acometimento interfere diretamente na redução da capacidade motora. **Objetivo:** Analisar a associação entre sintomas depressivos e desempenho motor em idosos residentes na comunidade. **Método:** Trata-se de um estudo transversal que analisou dados de 316 idosos de uma pesquisa epidemiológica de base domiciliar e populacional. As informações usadas foram: características sociodemográficas; testes de desempenho motor; atividade física e Escala de Depressão Geriátrica. Os dados foram analisados no *The Statistical Package for Social Sciences*, sendo realizados testes U de Mann-Whitney, qui-quadrado, Correlação de Spearman e regressão de Poisson, com intervalo de confiança de 95%. **Resultados:** Para todos os testes motores, o desempenho motor foi negativamente associado à sintomatologia depressiva, independentemente do sexo, idade, saber ler e escrever, renda familiar *per capita* e atividade física. Idosos com sintomas depressivos possuem entre 58% e 82% mais limitação funcional, a depender do teste de desempenho motor. **Conclusões:** Conclui-se que existe uma relação inversa entre sintomas depressivos e desempenho motor em idosos.

Palavras-chave: depressão; saúde mental; saúde do idoso; movimento; atividade motora.

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Introduction

Population aging is accompanied by an increase in psychiatric disorders; among these, depressive symptoms deserve greater attention because of their negative consequences for the individuals affected[1]. The prevalence of depression among elderly Brazilians ranges between 20 and 26%[2,3] and it is estimated to be the second biggest global cause of disability in 2020[4].

Individuals with depression often presented depressed mood, loss of interest or pleasure, feelings of guilt or low self-esteem, disturbed sleep, low energy and poor concentration[4]. In the elderly population it is one of the most common morbidities, with characteristics that often hinder its diagnosis, but which frequently occasion decline in motor performance and physical activity[1,5] and increased functional dependence[3,6].

Among the factors associated with depressive symptoms, the impairment of motor performance, i.e., the limitation to perform activities of daily living (ADLs) can considerably affect the quality of life[4]. In addition to this, low motor performance is bi-directionally associated with depressive symptoms, and may be an indicated either as a risk factor and a resulting factor[7].

In view of the above and the shortage of studies that evidence the relationship between harm to mental health and physical performance, the need for a better understanding of the relationship between depression and motor performance in the elderly is needed. This understanding will contribute to a better planning of health professionals' behaviors involved in rehabilitation. In this perspective this study aims to analyze the association between depressive symptoms and motor performance in elderly residing in the community.

Method

This is a cross-sectional study that analyzed data from a home-based epidemiological research, called Nutritional status, risk behaviors and health conditions of elderly in Lafaiete Coutinho, BA, Brazil. The city studied, located 356 km from the state capital, in the South Central mesoregion, had 4,162 inhabitants at the period of data collection, distributed in urban (52.9%) and rural (47.1%) zones, all enrolled in the Family Health Strategy (FHS). The city has low socio-demographic and educational indicators, which can be observed by the low education and socioeconomic status of the population, which consists mostly of agricultural workers and service providers.

A complete census was conducted in the city of Lafaiete Coutinho in January, 2011, for the identification of elderly participants in the study. All residents in the urban zone aged ≥60 years (n=355) were contacted for interviews and tests (blood tests, measurement of blood pressure, anthropometric measurements and motor tests). The location of the residences was conducted using information from FHS. Of the 355 elders who comprised the study population, 316 (89.0%) participated in the survey; 17 (4.8%) refusals were recorded and 22 (6.2%) individuals were not located after three home visits on alternate days, and were considered as loss.

We used a form based on the questionnaire used in the survey on Health, Well-being, and Aging - SABE - (http://hygeia.fsp.usp.br/sabe/Questionario.html) used in seven countries of the Latin America and the Caribbean[8], with the exception of questionnaires on physical activity and food consumption that, in this study, were more ample.

The following information was used in this study: (1) socio-demographic characteristics (age, gender, literacy and illiteracy and *per capita* income), (2) cognitive assessment, (3) depressive symptoms, (4) mobility and flexibility (chair stand test, pick up a pen test, walk test and balance test), (5) handgrip strength, (6) physical activity.

The study protocol was approved by the Research Ethics Committee of Universidade Estadual do Sudoeste da Bahia, Jequié, BA, Brazil (nº 064/2010). Participation was voluntary, and all subjects signed an informed consent.

Depressive symptoms

Depressive symptoms were assessed using the Geriatric Depression Scale (GDS) in the abbreviated form of 15 items. The scale consists of 15 questions of dichotomous responses (yes/no) on depressive symptoms. Each positive response added one point. We used the following score for the definition of depressive symptoms[9]: <6 points=negative (absence of depressive symptoms) and ≥6 points=positive (presence of depressive symptoms).

In this study, GDS was not applied to people who showed evident cognitive impairment, assessed using a modified version of the Mini Mental State Examination[10] and Pfeffer Functional Activities Questionnaire[11].

Motor performance tests

Individuals unable to perform tasks due to physical limitations were included in this study: those who could not walk or needed help to keep standing, had paralysis on either extremities, used prosthetic leg, or could not keep up balance did not perform tests related to the lower limbs; those who underwent eye surgery in the last six weeks did not perform the pickup a pen test; individuals who had undergone surgery of the arm or hand in three months prior to data collection were not tested for handgrip strength. Individuals who refused to perform the

tests or were unable to understand the instructions due to cognitive problems were excluded from the analysis.

The handgrip strength was assessed by a hydraulic dynamometer (Saehan Corporation SH5001, Korea). The test was performed using the arm that the individual felt that they have more strength. Each individual performed two trials, with 1-minute interval, and the highest value (kg) was considered for this study. Participants were encouraged to develop maximum strength. To evaluate the performance in this test, the values was distributed in percentiles (P_k), according to the gender[12]: unable = score 0 (unable); ≤P_{25} (women: ≤15 kg; men: ≤22 kg) = score 1 (weak); > P_{25} to ≤P_{75} (women: >15 to ≤21 kg; men: >22 to ≤34 kg) = score 2 (medium); > P_{75} (women: >21 kg; men >34 kg) = score 3 (good).

The chair stand test was used to assess the strength/endurance of the lower limbs. Participants were invited to cross their arms and stand up and sit in the chair five times as fast as possible; time was recorded in seconds (s). Individuals were considered capable of performing the test, when they could complete it in ≤60 s.

The pick up a pen test was used to verify mobility/flexibility. For this task, participants were asked to try to remain standing with feet side by side and when the interviewer asked to start the test, they should bend over and pick up a pen, which was placed on the floor, 30 cm in front of their feet, and return to starting position; the time was recorded in seconds. Individuals were considered capable of performing the test when they could complete it without any support in ≤30 seconds.

The walk test was used to verify the ability of movement of the elderly. To test walk speed we used a path of 2.44 meters, in which the participant was instructed to walk from one end to another in his usual speed, as if walking down the street. Participants could use assistive devices, if necessary; the test was performed twice, and time was recorded in seconds. The shortest time was considered in the analysis. Individuals were considered capable of performing the test when they could complete it in ≤60 s.

To evaluate the performance on the chair stand, pick up a pen, and walk tests, we used the criteria adopted by Barbosa et al.[12], Reuben and Siu[13] (adapted) and Guralnik et al.[14] (adapted), respectively, establishing a score according to the distribution of the time in P_k: unable or did not conclude = score 0 (unable); >P_{75} (chair stand: >17 s; pick up a pen: >3 s; walk tests: >4 s) = score 1 (weak); >P_{25} to ≤P_{75} (chair stand: >10 to ≤17 s; pick up a pen: >1 to ≤3 s; walk tests: >3 to ≤4 s) = score 2 (medium); ≤P_{25} (chair stand: ≤10 s; pick up a pen: ≤1 s; walk tests: ≤3 s) = score 3 (good).

The balance was determined through four phases in which the individual was asked to perform each task for 10 seconds: (1) maintain the balance standing with both feet together; (2) maintain balance standing with the heel of one foot in front of the toes of the other foot; (3) maintain the balance standing only supported in the right leg; (4) maintain the balance standing only supported on the left leg. To evaluate the performance in this test, we established the following scoring[12]: unable to perform any of the tasks = score 0 (unable); able to perform only task 1 = score 1 (weak); able to perform tasks 1 and 2 = score 2 (medium); able to perform tasks 1 and 2 and also 3 and/or 4 = score 3 (good).

For all tests of motor performance, functional limitation were determined as follows: score 0 or 1 = with limitation, and scores 2 or 3 = no limitation.

Adjustment variables

Socio-demographic: gender, age (as continuous variable), literacy or illiteracy (yes or no) and *per capita* family income on collection date (≤ US$ 112.91; US$ 112.92 to US$ 187.82; US$ 187.83 to US$ 281.74; > US$ 281.74).

Habitual physical activity: the instrument used was the *International Physical Activity Questionnaire* (IPAQ), long version[15]. We considered insufficiently active the individual who performed less than 150 minutes per week in moderate or vigorous physical activity; and active the individual who performed 150 minutes or more per week[16].

Statistical procedure

The associations between the GDS scores and scores on tests of motor performance were observed using Spearman correlation. The scores of motor performance, according to depressive symptoms, were compared by using Mann-Whitney U test. The prevalence of functional limitation according to depressive symptoms was compared using the chi-square test. The association between functional limitation (dependent variable) and depressive symptoms (independent variable) was tested by Poisson regression technique. We calculated simple robust (crude) and adjusted models to estimate prevalence ratios (PR), with their respective 95% confidence intervals (95% CI).

In all tests the significance level was 5% (α=0.05). Data was analyzed in Statistical Package for Social Sciences for Windows (SPSS. 15.0, 2006, SPSS, Inc, Chicago, IL).

Results

The study population consisted of 174 women (55.1%) and 142 men (44.9%). The age ranged from 60 to 105 years, with mean of 74.2±9.8. The mean age was 74.8±10.0 (range 60-103) for women and 73.5±9.4 for men (p=0.256). Only 33.6% of the

elderly could read and write. It was also observed that only 11.9% presented *per capita* family income higher than US$ 281.74, and 25.1% received less than US$ 112.92. Regarding the classification of the elderly as to the level of physical activity, it was noticed that 52.3% were inactive. The other characteristics of the study population are presented in Table 1. We observed that 8.2% of the elderly did not respond the GDS because they have obvious cognitive impairment. The prevalence of functional limitations ranged from 24.8% to 34.7%, depending on the motor test.

Negative correlations between GDS scores and motor performance scores are presented in Table 2. Depressive symptoms were significantly correlated with all the motor tests; the strongest relationship was observed for the walk test.

Differences in scores on tests of motor performance according to the depressive symptoms are shown in Table 3. Older people with positive depressive symptoms presented mean scores significantly lower on all tests of motor performance.

Figure 1 shows the distribution of the elderly, according to functional limitation in tests of motor performance and depressive symptoms. For all tests of motor performance we observed that older adults with positive depressive symptoms showed statistically higher prevalence of functional limitation than those with negative depressive symptoms.

Table 4 presents the results of the crude and adjusted analysis for functional limitation on tests of motor performance in relation to depressive symptoms. For all motor tests the functional limitation was positively associated with depressive symptoms, regardless of gender, age, literacy and illiteracy, *per capita* income and physical activity. The data of the adjusted analysis showed that elders with positive depressive symptoms have from 58% to 82% more functional limitation than those with negative depressive symptoms, depending on the motor performance test.

Table 1. Descriptive characteristics of the study population. Lafaiete Coutinho, BA, Brazil, 2011.

Variables	% response	n	%
Depressive symptoms			
Positive	91.8	58	20.0
Negative		232	80.0
HGS			
With limitation	97.8	87	28.2
Without limitation		222	71.8
Chair stand			
With limitation	99.4	109	34.7
Without limitation		205	65.3
Pick up a pen			
With limitation	90.5	71	24.8
Without limitation		215	75.2
Walk			
With limitation	95.9	78	25.7
Without limitation		225	74.3
Balance			
With limitation	99.4	95	30.3
Without limitation		219	69.7

HGS=Hangrip strength.

Discussion

The functional limitation in the elderly ranged from 24.8% to 34.7% depending on the test used and the results of the investigation showed that depressive symptoms are associated with the occurrence of these limitations, which are

Table 2. Spearman correlation coefficients between GDS score and the scores on tests of motor performance. Lafaiete Coutinho, BA, Brazil, 2011.

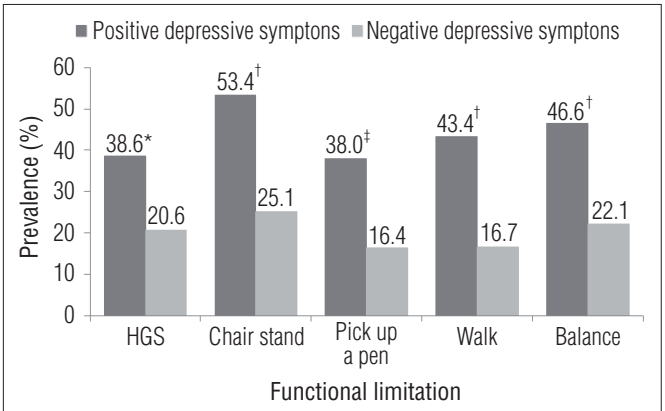
Motor performance	GDS Score	
	$r_{Spearman}$	P-value
HGS	-0.15	0.010
Chair stand	-0.27	<0.001
Pick up a pen	-0.26	<0.001
Walk	-0.32	<0.001
Balance	-0.18	0.002

HGS=Hangrip strength; GDS=Geriatric Depression Scale.

Table 3. Means and standard deviations for scores on tests of motor performance, according to depressive symptoms. Lafaiete Coutinho, BA, Brazil, 2011.

Motor performance	Depressive symptoms		P-value
	Positive	Negative	
HGS	1.81±0.83	2.03±0.68	0.05
Chair stand	1.31±1.01	1.95±0.83	<0.01
Pick up a pen	1.64±0.92	2.24±0.79	<0.01
Walk	1.72±1.03	2.38±0.82	<0.01
Balance	1.72±1.04	2.25±0.88	<0.01

HGS=Hangrip strength.



HGS=Handgrip Strength. *p=0.008; †p <0.001; ‡p=0.001 (chi-square test).

Figure 1. Prevalence of functional limitation in motor performance tests, according to depressive symptoms. Lafaiete Coutinho, BA, Brazil, 2011.

Table 4. Association between functional limitation in motor performance tests and positive depressive symptoms in the elderly. Lafaiete Coutinho, BA, Brazil, 2011.

Depressive symptoms	RP_{crude} (95% CI)	P-value	$RP_{adjusted}$ (95% CI)*	P-value
Handgrip strength				
Positive	1.87 (1.24 - 2.83)	0.003	1.58 (1.06 - 2.38)	0.026
Negative	1		1	
Chair stand				
Positive	2.13 (1.53 - 2.95)	<0.001	1.73 (1.22 - 2.46)	0.002
Negative	1		1	
Pick up a pen				
Positive	2.31 (1.45 - 3.68)	<0.001	1.82 (1.12 - 2.98)	0.016
Negative	1		1	
Walk				
Positive	2.59 (1.70 - 3.96)	<0.00 1	1.75 (1.16 - 2.64)	0.007
Negative	1		1	
Balance				
Positive	2.10 (1.46 - 3.04)	<0.001	1.60 (1.10 - 2.35)	0.015
Negative	1		1	

*Adjusted for gender, age, literacy and illiteracy, *per capita* family income and physical activity.

consistent with the results from the study of Everson-Rose et al.[17]. Spearman Correlation coefficients showed that there is a weak, but significant, relationship between GDS scores and motor performance tests.

It was possible to observe that the strongest relationship was found in the walk test (r=-0.32), whereas handgrip strength was the weakest (r=-0.15), suggesting that the influence of depressive symptoms affects lower limbs more severely than upper limbs, which can be explained by some reasons: (1) weakness is one of the first signs of frailness due to age[18], and maximum force has a more pronounced decline from 40 years[19]; thus the elderly will present naturally and initially reduced handgrip strength, and depressive symptoms will not cause major damage; (2) habits of physical activity and leisure during aging favor maintaining the appropriate motor performance and greater physical capacity[20,21], however, it is reported that the presence of depressive symptoms contributes to the decreased activity and physical function[22], which will directly interfere in tests that require speed, aerobic capacity and performance of the lower limbs.

In addition to try to explain this higher relationship of depressive symptoms in tests for the lower limbs, Deshpande et al.[23] demonstrated that depressed individuals tend to move more slowly due to fear of falling, which is strongly associated with depressive symptoms.

In relation to the scores on tests of motor performance, it was observed that individuals with positive depressive symptoms had lower average scores on all tasks, and handgrip strength test was again the less influenced by the presence of depressive symptoms.

We observed that older people with positive depressive symptoms presented significantly higher prevalence of functional limitations. A similar result was found in a longitudinal study of National Institute on Aging Established Populations for Epidemiologic Studies of Elderly (EPESE)[24] stating that higher levels of depressive symptoms contribute to greater restrictions in daily activities. This can be explained due to the typical symptoms of depression such as loss of interest and low energy[6]. In addition, depression causes persistent fatigue, usually causing mild activities to become strenuous physical exertion[25].

Regression analysis showed that the functional limitation was positively associated with positive depressive symptoms in all performance tests after adjustment for gender, age, literacy and illiteracy, per capita income and physical activity, which demonstrates that the presence of depressive symptoms is a predictor of low motor performance in the elderly, regardless of socio-demographic and physical activity level. According to the results of this study, individuals with depressive symptoms have a prevalence of functional limitation up to 82% higher when compared to subjects without depressive symptoms.

Recent evidence show that in the presence of geriatric depression there is a deficiency in functional connectivity between the cerebellum and cerebral cortex in several neural networks[26], and this can interfere directly in the motor performance, especially in balance and tests requiring coordination.

Menkes et al.[27] observed that there is a reduced activity of the frontal lobe, which results in impairment of planning activities in depressed individuals. However, the main point in the association of depression with motor performance appears to be in the deficiency of the neurotransmitter dopamine. Depressed people have decreased neurotransmitters such as serotonin, norepinephrine and dopamine[28]. With the reduction in dopamine, motor skills can suffer a progressive decrease resulting in stiffness, loss of strength and balance and difficulty in walking[29].

Among the limiting factors of this study, we can point out the cross-sectional research design, which prevents ensuring implied causality relationships between studied variables; however, as the results find grounds in the literature the hypothesis that depressive symptoms impair the motor performance in elderly is quite plausible.

The information found in this study may contribute to the planning of careful and elaborate behavior of health professionals aimed at rehabilitation, allowing for better understanding of the possible interferences of depressive symptoms in the motor deficit of the elderly and its consequences in the musculoskeletal systems, favoring both prevention and recovery.

Considering the results of this study it was observed that the symptoms of depression are related to the loss of motor performance in community dwelling elderly, also contributing to an increase of functional limitations in motor performance tests with these individuals.

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