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original article

Functional capacity and its association with age and sex in an elderly population

Capacidade funcional e sua associação com idade e sexo em uma população idosa

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Abstract – The objective this study was to check the association of functional capacity with age and sex in an elderly population. This study is a cross-sectional household survey conducted with elderly people of both sexes enrolled in the Family Healthcare Strategy of Campina Grande, Brazil, from August 2009 to July 2010. Variables were checked for functional capacity (handgrip strength [HS], flexibility/mobility, and balance) and demographic (sex and age). The association of functional capacity with sex and age group was verified by bivariate analysis using Pearson´s chi-squared test ($\chi 2$), with the significance set at $p < 0.05$. Were evaluated 420 elderly (68.1% women), whose ages ranged from 60 to 104 years. In the HS test, a higher proportion of both women (45.6%) and men (47.8%) showed regular scores. In the flexibility/mobility test, 63.0% of women and 57.4% of men had a regular score. Balance tests showed a similar percentage in all scores, in both sexes. In the bivariate analysis between indicative variables of functional ability and sex, only flexibility / mobility showed significant association ($p<0.05$). In the association between markers of functional capacity and age, balance showed a significant association with age in both sexes ($p <0.01$), and flexibility only in females ($p<0.05$). The elderly in this study showed satisfactory performance for the variables of functional capacity. There was a significant association of sex only with flexibility. The age group showed significant influence on balance, in both sexes, and on flexibility in women.

Key words: Elderly; Flexibility; Muscular strength; Postural balance.

Resumo – *O objetivo deste estudo foi verificar a associação da capacidade funcional com a idade e o sexo em uma população idosa. Este estudo é transversal, domiciliar, realizado com idosos, de ambos os sexos, cadastrados na Estratégia Saúde da Família de Campina Grande, PB, de agosto/2009 a julho/2010. Foram verificadas variáveis de capacidade funcional (força de preensão manual (FPM), flexibilidade/mobilidade e equilíbrio) e demográficas (sexo e grupo etário). A associação entre a capacidade funcional o sexo e o grupo etário foi verificada por meio de análise bivariada, utilizando-se o Teste Qui-quadrado de Pearson (χ^2), com nível de significância fixado em $p<0,05$. Foram avaliados 420 idosos (68,1% mulheres), cuja idade variou de 60 a 104 anos.No teste de FPM, maior proporção, tanto de mulheres (45,6%) como de homens (47,8%), apresentou escore regular. No teste de flexibilidade/mobilidade, 63,0% das mulheres e 57,4% dos homens apresentaram escore regular. O equilíbrio mostrou percentual semelhante em todos os escores, em ambos os sexos. Na análise bivariada entre as variáveis indicativas de capacidade funcional e sexo, apenas a flexibilidade/mobilidade apresentou associação significativa ($p<0,05$). Na associação entre as variáveis indicativas de capacidade funcional e grupo etário, o equilíbrio apresentou associação significativa em ambos os sexos ($p<0,01$), e a flexibilidade/mobilidade apenas no sexo feminino ($p<0,05$). Pode-se concluir que os idosos deste estudo mostraram desempenho regular para as variáveis indicativas de capacidade funcional. Houve associação significativa do sexo apenas com a flexibilidade. O grupo etário apresentou influência significativa no equilíbrio, em ambos os sexos, e na flexibilidade de mulheres.*

Palavras-chave: *Equilíbrio postural; Flexibilidade; Força muscular; Idoso.*

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INTRODUCTION

The aging process contributes to changes and decline in the function of multiple systems, causing significant anatomic changes in the elderly. Among these changes, decreased muscle strength, flexibility and balance have great impact on the functional capacity of the elderly, predisposing them to frailty and loss of autonomy for daily life activities (DLA)[1,2].

In this context, functional capacity has been identified as an important marker of health in the elderly, given that the presence of limiting factors such as diseases or immobility can lead to great impacts on their quality of life[3]. Thus, this topic has aroused the interest of researchers seeking to verify the functional capacity and possible factors associated to its commitment, such as age, sex, BMI, among others[4-7]. However, there are few studies with representative samples of the elderly population investigating this relationship[5,8,9].

Fiedler and Peres[10] conducted a cross-sectional study with a representative sample of the elderly population of Joaçaba / SC, Brazil and observed higher prevalence of functional limitations in elderly individuals with older age and among females. In England, the English Longitudinal Study Ageing[12] showed association between functional capacity and older age groups, with women showing greater prevalence of functional disability compared to men.

To evaluate functional capacity, often due to the facility in obtaining data, studies have used self-report[10] to assess the independence for performing daily life activities[4,12]. Physical tests are important markers of functional capacity[5]. These tests, commonly used in studies with elderly, assess: muscular strength[9,13,14], flexibility[9,14-17], and balance[9,13-15,18], given their importance in the performance of daily activities. However, there are few studies in Northeastern Brazil evaluating the functional capacity in the elderly through physical testing[12,19], which impairs knowing the situation of this population in this aspect and make the comparison on data difficult, either with elderly from different states or with international studies, considering the physical and socioeconomic differences among elderly people from different locations.

In this context, this study seeks to fill a gap in epidemiological studies, contributing to obtain information regarding the functional capacity of an elderly population in a city in northeastern Brazil. In addition, research and dissemination of information specific to each region enable health services to better understand diseases and associated factors, thus contributing to the planning of actions aimed at the prevention of disabilities and greater control and delay of complications and sequelae, often avoiding the individual to require a higher level of care. Thus, this study aimed to determine functional capacity and its association with sex and age in an elderly population.

METHODS

This is a household-based cross-sectional study with primary data collection, which is part of a broader study that aimed to perform a multidimensional assessment of the health of an elderly population enrolled in the Family Healthcare Strategy - PB.

Individuals aged 60 years or more of both sexes were selected to composed the sample. Elderly with disease without therapeutic possibility, with severe clinical weakness and elderly who were out of Campina Grande-PB for longer than the field research at the Basic Unit of Family Health (UBSF) were excluded from the research. Furthermore, specific exclusion criteria for each functional test (handgrip strength, flexibility and balance) were established. The fieldwork was carried out by three pairs of trained interviewers.

For sample selection, prevalence of the outcomes of at least 25% was estimated. The sample size calculation was performed using the following equation: $\{[E^2 \times p\ (1-p)] \times c\}/ A^2$, where *E* is the confidence limit (1.96), *c* is the sample correlation coefficient (2 1), since the sample is a conglomerate, and *A* is the acceptable accuracy for the estimated prevalence (A = 6%). The sample was proportional to each Health District, including 420 elderly individuals.

The variables evaluated in this study were functional capacity, age group and sex. The tests used to assess functional capacity were: handgrip strength, flexibility / mobility and balance. Before each test, one interviewee explained and made a practical demonstration to ensure that the task was performed correctly and without any risk for the elderly. Individuals unable to understand instructions or those who refused to perform the functional tests were not included in the analysis.

Handgrip strength (HS) was measured using a manual hydraulic dynamometer (Takei dynamometer KikiKogyo® TK 1201, Japan), adjusted for each individual according to the size of hands. The test was performed according to techniques of Rantanen et al.[2], who proposed the use of the limb considered by the elderly as of greater strength. During test execution, the elderly remained sat with elbow resting on a table, forearm extended forward, palm up, and then he was asked to exert the greatest possible hold. This procedure was performed twice, with an interval of one minute between sessions. Elderly submitted to some surgery on arm or hand three months prior to data collection were excluded from the test. To evaluate the performance in this test, the classification described in Barbosa et al.[5], which considers values (kg) distributed into percentiles according to sex was used: poor (≤ P25), regular (> P25 and P75 ≤) and good (> P75).

The flexibility / mobility test used was the "squatting and picking up a pen on the floor" test[20]. The individual was instructed to stand upright, feet together, and when informed about the start of the test, he should squat

and pick up a pen placed on the floor 30 cm in front of his feet. From the moment the elderly reported being ready to perform the test, the timer was activated and the time spent between squatting and standing up again with the pen in hand was recorded. The test was considered completed when the elderly managed to finish the exercise without any help on time ≤ 30 seconds. Individuals undergoing cataract or retina surgery in the six weeks prior to the interview, those who were bedridden or wheelchair users who for some reason could not stand the test were excluded.: For data analysis, the classification given by Barbosa et al.[5] adapted from Reuben and Siu, which ranks flexibility / mobility according to the test runtime was used: poor (> 6 and ≤ 30 seconds), regular (> 2 and ≤ 6/2) and good (≤ 2 seconds).

The test to check balance was proposed by Guralnick et. al.[21], which consisted of four static balance measurements. Each measurement was performed only once. In the first measure, the elderly should remain standing, keeping feet together and eyes open. In the second, the elderly should remain standing, placing the heel of one foot in front of the other, keeping eyes open. In the third, the elderly should remain standing with one leg raised, leaning on the other leg, without using any other type of support. In the fourth, the previous exercise was performed, but shifting the position of legs. Each measure was considered successful when the elderly could remain 10 seconds in the mentioned position. If the elderly could not perform the first, he should not perform the second and so on. Bedridden, wheelchair users or who, for some reason, could not stand were excluded from the test. To evaluate the performance in this test, the classification described in Barbosa et al.[5], which assesses the elderly from the number of measurements performed in the test was used: poor (one measure), regular (two measures) and good (three or four measures).

Data were entered using the method of double entry to ensure accuracy of data. Statistical data were obtained with the aid of the statistical application Statistical Package for the Social Sciences (SPSS) version 17.0. Subjects were grouped according to sex (male and female) and age group (60-69 years, 70-79 years and 80 years or more). The proportion of elderly according to sex, age and performance on HS, flexibility / mobility and balance tests was verified. Individuals were distributed according to variables indicative of functional capacity according to sex and age group. Association between variables indicative of functional capacity and sex and age group was verified by bivariate analysis using the chi-square test ($\chi 2$). The level of statistical significance was set at $p < 0.05$.

The broader study from which this study is part was approved by the Ethics Research Committee of the State University of Paraíba (CAAE: 0228.0.133.000-08). By accepting to participate, elderly individuals signed the informed consent form according to Resolution 196/96 of the National Health Council.

RESULTS

The study included 420 older adults with mean age of 71.57 years (± 9.19), whose age ranged from 60 to 104 years. Of the 420 older adults included in the study, 417 performed the handgrip test, 368 the flexibility / mobility test and 393 the balance test. The difference between samples for these variables is due to exclusion criteria specific for each test.

The study subjects were mostly female (68.1%) with age of 60-69 years (48.6%). Most individuals showed handgrip strength (46.3%), flexibility / mobility (61.4%) and balance (34.4%) scores classified as regular. Good handgrip strength score (25.7%) showed the lowest percentage. Among functional capacity variables, balance showed the highest percentage of individuals with poor score (32.8%) (Table 1).

Table 1. Distribution of the elderly according to functional capacity, age group and sex. Campina Grande, PB. Brazil.

Variable	n	%
Sex		
Female	286	68,1
Male	134	31,9
Age group		
60- 69 years	204	48,6
70-79 years	136	32,4
80 years or older	80	19,0
Functional capacity		
Handgrip strength		
Poor	117	28,1
Regular	193	46,3
Good	107	25,7
Flexibility / mobility		
Poor	21	5,7
Regular	226	61,4
Good	121	32,9
Balance		
Poor	129	32,8
Regular	135	34,4
Good	129	32,8

The bivariate analysis among variables indicative of functional capacity and sex is shown in Table 2. Among women, higher percentage (45.6%) showed regular HS, as well as among men (47.8%). There was no statistically significant association between HS and sex. Similarly, a greater proportion of women (63.4%) and men (57.4%) showed regular flexibility / mobility. The flexibility / mobility test showed statistically significant association with sex. The performance on the balance test was similar in all scores in both sexes. There was no significant association between sex and balance.

Table 3 shows the results of the association between functional capacity variables and age group according to sex. Both for males and females, all age groups showed higher proportion of elderly with regular performance in the HS test. Good HS showed lower percentage in older age groups (70-79 years and 80 years or more). No significant association was observed between HS and age group in both sexes.

Table 2. Distribution of the elderly according to the association between functional capacity and sex (%). Campina Grande, PB. Brazil.

	Sex		
Functional capacity tests	Female	Male	p
Handgrip strength			0,90
Poor	28,6	26,9	
Regular	45,6	47,8	
Good	25,8	25,4	
Flexibility / mobility			0,05*
Poor	3,7	9,8	
Regular	63,4	57,4	
Good	32,9	32,8	
Balance			0,89
Poor	33,6	31,3	
Regular	34,0	35,2	
Good	32,5	33,6	

* = Significant association (χ2)

Similarly to HS, flexibility / mobility presented, for both sexes, higher percentage of elderly with regular score. Poor score was more prevalent among males in both age groups. Statistically significant association between flexibility / mobility and age group was observed only among females.

In more advanced age group (80 years or more), higher proportion of elderly with poor balance was observed In the youngest age group (60-69 years), higher percentage of elderly with good balance was observed. There was a statistically significant association between balance and age group in both sexes.

Table 3. Association between functional capacity and age group distributed by sex (%). Campina Grande, PB, Brazil.

	Sex							
Functional capacity	Female				Male			
Age (years)	60-69	70-79	80 or older	p	60-69	70-79	80 or older	p
Handgrip strength				0,73				0,05
Poor	25,4	33,3	28,8		35,9	20,9	14,8	
Regular	46,4	44,1	46,2		45,3	41,9	63,0	
Good	28,3	22,6	25,0		18,8	37,2	22,2	
Flexibility / mobility				0,02*				0,70
Poor	5,3	0,0	5,9		11,3	8,1	8,7	
Regular	55,3	73,8	70,6		54,8	54,1	69,6	
Good	39,4	26,3	23,5		33,9	37,8	21,7	
Balance				<0,01*				<0,01*
Poor	20,3	36,9	69,8		21,0	35,0	50,0	
Regular	30,4	42,9	27,9		30,6	42,5	34,6	
Good	49,3	20,2	1,2		48,4	22,5	15,4	

HS = handgrip strength; * = Significant association ($\chi 2$)

DISCUSSION

Muscle strength, aerobic resistance, balance and flexibility are physical aspects directly related to the health of elderly individuals and involved in their ability to perform daily tasks[22]. Thus, the maintenance of functional capacity is an important aspect in the life of the elderly given its influence on health and quality of life. Functional capacity allows verifying its distribution and characteristics of associated factors.

In this study, it was observed that a higher proportion of elderly showed regular score for handgrip strength and flexibility / mobility. Higher prevalence of regular score for HS among the elderly was observed in the Health, Well-being and Aging Study (SABE) performed in Bridgetown (Barbados) and Havana (Cuba)[14]. Survey with elderly individuals in Lafaiete Coutinho / BA showed higher prevalence of regular score for HS and flexibility / mobility in both sexes[9], which is an important data, since functional capacity may be an important mortality predictor in the elderly[23].

As for balance, the percentage of elderly in this study with poor, regular or good scores were similar, with slight predominance of regular score. Unlike other measures of functional assessment such as flexibility / mobility and muscle strength, balance classified as regular can bring serious harm to the elderly population. Balance deficit indicates the presence of some degree of oscillation in these individuals caused by changes in the center of mass and in the stabilizing factors, which may predispose them to falls[18,24].

Although studies have shown association between handgrip and sex[5,23] and between balance and sex[19], in this study, these associations were not observed. A study with elderly individuals in Santa Cruz / RN showed significant association between sex and balance deficit, being observed in 46.1% of subjects. The study also showed that females were 3.7 times more

likely to have balance deficits when compared to males[19]. Other studies have observed better performance of males in the balance test[6,9,13]. Research assessing the functional capacity and anthropometry of an elderly population showed significant association between balance and body mass index (BMI) in females, suggesting that bodily changes such as increased fat and body size could interfere with balance[15].

In this study, the balance scores showed similar distribution in both sexes. However, this information is somewhat worrisome, given that more than half of the elderly evaluated showed regular or poor balance, indicating possible postural instability in these individuals. Data observed may be due to the greater degree and frequency of postural sway (static balance) in the elderly population when compared to younger individuals[18,19].

In the present study, the only variable associated with sex was flexibility / mobility. This finding supports the research conducted in Botucatu, SP[23], in which a significant association between trunk flexibility and sex was found. Study with older adults in Canada found that women had better hip flexibility scores than men, and this difference was significant between sexes[16]. This association may be explained by differences in the density of body tissues, which is higher in women than in men and influence flexibility / mobility[25].

Studies with elderly have observed association between handgrip strength and age group[5,9,23], which was not observed in this study. Peak muscle strength is reached at around 30 years of age and remains stable until 40-45 years, age from which it starts to decline[26]. This reduction in muscle strength is expected at around 50 years, and is mainly associated with muscle atrophy resulting from the sarcopenia process. In addition, low levels of physical activity in the elderly contribute to the disuse of muscles, resulting in weakness[27], which could explain the higher prevalence of regular handgrip strength.

In this study, all age groups showed regular flexibility / mobility in both sexes. However, significant association between flexibility / mobility and age group was found among females. A study with elderly individuals in Cuba showed higher percentage of regular score among individuals of older age groups. In the age group 60-69 years, there was a higher percentage of elderly with good scores[14].

Decreased flexibility/mobility is associated with musculoskeletal changes resulting from the aging process. Changes in periarticular connective tissues such as decreased elastin and collagen stiffening are the main responsible for reduced flexibility and movement range[2,19]. In addition, constant use of joints over the years contributes to reduce mobility[16] and immobilization and the lack of physical activity contributes to reduce flexibility[2].

Based on information obtained in this study on the association between balance and age, it was observed that both for males and females, those aged 60-69 years showed increased proportion of good score. However,

those aged 80 years or more showed greater proportion of poor score for this variable. This high proportion of balance deficit in older age groups was also observed in other studies[5,6,8,13,14]. In a study conducted with elderly individuals in Lafaiete Coutinho,bBA, individuals aged 80 years or more showed poor performance or inability to complete the test, with significant association between balance and age group[9]. Maciel and Guerra[19] found in their study that elderly over the age of 75 years were 6.2 times more likely to have balance deficits when compared to younger individuals (between 60 and 75 years). In the English Longitudinal Study of Ageing conducted with individuals aged from 50 years, it was observed that elderly individuals aged 80 years or more were 6.99 times more likely to have balance deficits compared to those aged 65-69 years[8].

Balance deficits are caused by sensory and motor changes due to aging, which can suppress steps of posture control and generate instability[26]. In the nervous system, disturbances in the function of specific muscles (muscular strength), as those in the ankle area responsible for postural control, could cause loss of balance, considering that muscle atrophy and bone deformities can change the base of support of the foot[18]. Furthermore, weight gain, common in the elderly, may also influence the loss of dynamic balance as it contributes to the collapse of the plantar arch, whose function is related to shock absorption and distribution of load over the entire foot[28].

Thus, the results of this study show differences and similarities with other studies conducted with elderly populations both in Brazil and abroad. These differences among studies that evaluate functional capacity are due to the diversity among populations possibly as a result of the different conditions of life such as type of occupational activity, access to health care services, inequality in income distribution and educational level[11,20,29].

The differences observed in the functional performance of older adults from different localities may be also due to uncontrolled factors and to the lack of standardization among studies conducted in different locations. Barbosa et al.[5] point out that factors such as selection or exclusion criteria, number of subjects, differences in body composition, social and economic conditions can influence the functional capacity behavior of elderly individuals in different locations.

This study, like other studies, has limitations inherent to the cross-sectional design, because despite verifying the functional performance of elderly individuals, it does not allow inferring what factors could influence the functional capacity behavior. Thus, further longitudinal studies assessing functional capacity should be carried out, providing information on factors associated with reduced functional capacity.

CONCLUSIONS

In most of elderly individuals investigated in this study, functional capacity was classified as regular for handgrip strength, flexibility/mobility and balance, and balance showed the highest percentage of individuals with poor performance. Only flexibility/mobility was significantly associated with sex. In the association between functional capacity and age group, only balance showed significant association in both sexes, and flexibility/mobility in females.

The data presented here can help understanding functional limitations inherent to the aging process and existing differences among elderly individuals. Changes in functional capacity reinforce the importance of research aimed at physical assessment in the elderly, as well as the factors associated with changes in functional capacity. Moreover, given the importance of functional capacity as a morbidity/mortality predictor, this topic should be treated in an evaluation plan for the elderly. Therefore, health professionals should include this issue into the routine care to the elderly in order to detect risk factors for functional disability and to prevent it whenever possible.

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