Association between physical capacity and likelihood of hospitalization in community-living older adults

A associação entre capacidade física e probabilidade de internação hospitalar em idosos que vivem na comunidade

La asociación entre la capacidad física y la probabilidad de ingreso hospitalario en ancianos que viven en la comunidad

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ABSTRACT | The growth of older population requires political, economic and social rearrangement, particularly in health, considering its impact on this matter. The assessment of Likelihood of Hospitalization (LOH) is used as an indicator for the health condition of older adults. However, variables of physical capacity (PC) have not yet been associated with LOH. Thus, the association between PC and LOH was analyzed. This study was epidemiological, cross-sectional, and analytical. The sample was randomly selected from one of the Family Health Teams in Passo d'Areia neighborhood, municipality of Porto Alegre. 317 older adults aged ³65 years were evaluated. PC was evaluated by tests of strength, flexibility, and balance on upper and lower limbs. LOH was evaluated with the Boult rapid screening instrument. For the statistical analysis, LOH has been adjusted in two groups: low-medium and medium high-high (MHH), and the Poisson multivariate regression analysis was used. The adopted significance level was p≤0.05. Among the results found, the physical variables that stayed attached to the LOH-MHH were the strength of lower limbs (PR=1.78; 95%CI=1.04 – 3.04) and flexibility (PR=2.13; 95%CI=1.28 – 3.56). There was a negative association between low levels of lower limb strength and flexibility with LOH-MHH. The prevalence of LOH-MHH among individuals with altered strength for the lower limbs was 78% greater when compared with those with normal strength, and it was 113% greater for those with altered flexibility.

Keywords | Health Services for the Aged; Hospitalization; Muscle Strength, Postural Balance.

RESUMO | O crescimento da população idosa exige reorganização política, econômica e social, em especial na área da saúde, devido ao impacto sobre esta. A avaliação da Probabilidade de Internação Hospitalar (PIH) é usada como indicador da condição de saúde do idoso. Entretanto, variáveis de capacidade física (CF) ainda não foram associadas com a PIH. Analisou-se a associação entre CF e a PIH de idosos. O estudo realizado foi epidemiológico, transversal e analítico. A seleção da amostra ocorreu de forma aleatória em uma das Equipes de Saúde da Família no bairro Passo d'Areia, no município de Porto Alegre, sendo avaliados 317 idosos com idade ≥ 65 anos. A CF foi avaliada por testes de força de membros superiores e inferiores, flexibilidade e equilíbrio. A PIH foi avaliada pelo

instrumento de triagem rápida de Boult. Para análise estatística, a PIH foi ajustada em dois grupos: baixa-média e média alta-alta (MAA) e realizada a análise multivariada de regressão de Poisson. O nível de significância adotado foi de p ≤ 0,05. Nos resultados encontrados, as variáveis físicas que permaneceram associadas à PIH-MAA foram a força de membros inferiores (RP = 1,78; IC 95% = 1,04 – 3,04) e flexibilidade (RP = 2,13; IC 95% = 1,28 – 3,56). Houve associação negativa entre os baixos níveis de força de membro inferior e de flexibilidade com PIH-MAA. A prevalência da PIH-MAA entre indivíduos com força alterada para membros inferiores foi 78% maior em relação àqueles com força normal e 113% entre aqueles com alteração de flexibilidade.

Descritores | Saúde do Idoso; Internação Hospitalar; Força Muscular; Equilíbrio Postural.

RESUMEN | El crecimiento de la población anciana exige reorganización política, económica y social, en especial en el área de la salud, debido al impacto sobre ésta. La evaluación de la Probabilidad de Ingreso Hospitalario (PIH) es usada como indicador de la condición de salud del anciano. Mientras tanto, variables de la capacidad física (CF) todavía no fueron asociadas con la PIH. Se analizó la asociación entre la CF y la PIH de ancianos. El estudio realizado fue epidemiológico, transversal y analítico. La selección de la muestra ocurrió de manera aleatoria en uno de los Equipos de Salud de la Familia en el barrio Passo d'Areia, en el municipio de Porto Alegre, siendo evaluados 317 ancianos con edad ≥ 65 años. La CF fue evaluada por pruebas de fuerza de miembros superiores e inferiores, flexibilidad y equilibrio. La PIH fue evaluada por el instrumento de triaje rápido de Boult. Para el análisis estadístico, la PIH fue ajustada en dos grupos: baja-mediana y mediana alta-alta (MAA) y realizado el análisis multivariado de regresión de Poisson. El nivel de significancia adoptado fue de p ≤ 0,05. En los resultados encontrados, las variables físicas que permanecieron asociados a la PIH-MAA fueron la fuerza de miembros inferiores (RP = 1,78; IC el 95% = 1,04 – 3,04) y la –flexibilidad (RP = 2,13; IC el 95% = 1,28 – 3,56). Hubo asociación negativa entre los bajos niveles de fuerza de miembro inferior y de flexibilidad con la PIH-MAA. La prevalencia de la PIH-MAA entre los individuos con la fuerza alterada para los miembros inferiores fue un 78% más grande en relación a los con la fuerza normal y un 113% entre los con alteración de flexibilidad.

Palabras clave | Salud del Anciano; Hospitalización; Fuerza Muscular; Balance Postural.

INTRODUCTION

Physical capacity (PC), or physical fitness, is defined by the ability to perform normal activities of daily living safely and independently, without undue fatigue. The evaluation of PC components, such as strength, flexibility, balance, and aerobic conditioning, is a useful tool for measuring the health status of older people, given that its correlation with capacity is adjusted to the environment. Therefore, it can be an indicator of adverse events in the health of older adults, such as hospitalization, acute diseases, falls, fractures and high mortality[1-3].

To find predictive indicators of the intense use of health resources and of future hospitalizations[4], Boult et al.[3] created a tool to identify the Likelihood of Hospitalization (LOH) in older adults. This instrument is significantly correlated with the higher cumulative incidence of hospital readmission, with the largest number of hospitalization days among the survivors, and with the costliest hospitalization during the period of use.

Although studies associate the physical assessment to hospitalization[2], the LOH instrument for older people by Boult et al.[3] does not consider PC variables.

Therefore, the objective of this study was to analyze the association between PC and LOH in older adults.

METHODOLOGY

Our research was a cross-sectional, population-based, and analytical study. The conglomerate sampling was drawn from the attached territories of Family Health Strategy (FHS) teams in Passo d'Areia neighborhood, municipality of Porto Alegre (RS), Brazil. For the random selection, numbers for each FHS were inserted in sealed envelopes, and the draw was conducted by an external subject. The drawn region refers to the third FHS team, on sectors 431490205001612, 431490205001613, 431490205001615, and 431490205001616 of IBGE census tracts.

The addresses were actively sought by the researcher. In cases of failure of the first contact, there were up to three callbacks to find the subjects of the research in their households.

Individuals aged 65 years or more, of both sexes, living for at least 12 months in the research area, were included in the sample, regardless of their connection, access or frequency of calls to FHS.

The older adults that presented acute and serious illness, unstable hemodynamic conditions, or physical and/or mental conditions that would constrain the realization of physical tests, were excluded. Individuals that for some reason did not want to participate in the research were considered sample loss.

The sample calculation was 317 subjects to a 95% confidence level, 4% margin of error, and 90% power for detecting a difference of at least 20% between the groups (1) Low-Medium Likelihood of Hospitalization (LOH-LM) and (2) Medium High-High Likelihood of Hospitalization (LOH-MHH). Thus, a population of 673[5] older adults was estimated (IBGE, 2011), but only 498 subjects were found in their households through active search.

Of these, 84 subjects were excluded for not presenting physical testing conditions, 4 (four) subjects were hospitalized and one older person was institutionalized. Ninety-two other seniors who meet the selection criteria were found, but did not accept to participate in the research, and then were considered sample loss. In the end, 317 elderlies were evaluated, from December 2011 to July 2012.

The study was approved by the Ethics Committee of UFCSPA (protocol 1466/11) and all subjects signed an informed consent form.

Instruments and procedures

The evaluations happened during meetings at the subject's own household. First, a socio-demographic interview was held for sample characterization, followed by a physical exam to evaluate height, weight, and Body Mass Index.

The upper limb maximal strength was assessed by a digital *hand grip* dynamometer[6], DayHome brand, model EH 101. The strength of the lower limbs was evaluated by the sitting-rising test, and, for flexibility assessment, the modified sitting-rising test (without a bench) was used. Both tests were previously validated[7,8] and present their results through the classifications "normal" or "altered" according to cut-off points that are related to sex and age group.

The evaluation of postural balance was tested through the Berg Balance Scale, an international instrument, previously translated and validated to Portuguese[9]. For evaluation of LOH in older adults, an instrument created by Boult et al.[3] was used, after being translated and validated to Portuguese[10]. LOH was calculated by

a logistic regression model, and the value obtained as probability score (PRS) was divided into four categories through standardized cut-off points[3].

Data analysis

To verify the sample distribution, Kolmogorov-Smirnov and Levene normality tests were conducted. To evaluate the association between categorical variables, Pearson's Chi-square test was used.

Aiming to control the confusion factors and assess factors independently associated with LOH-MHH, the Poisson multivariate regression analysis was conducted. The criterion to include a variable in the template was to present a p<0.20 value in the bivariate analysis. The adopted significance level was p≤0.05.

RESULTS

Data relating to sample characterization are presented in a descriptive form in Table 1. Table 2 describes the results of absolute strength, flexibility and balance for the sample of this study, according to sex and age group.

Data referring to LOH of the older people are listed in Table 3, classified into strata (Boult et al., 1993). To compare strength, flexibility and balance parameter, the LOH was adjusted in two groups (1) LOH-LM and (2) LOH-MHH.

The bivariate analysis done through Pearson's Chi-square test refers to the correlation between strength, flexibility, and balance, and to LOH. Subjects who showed changes in lower limb strength (p=0.001), flexibility (p<0.001) and balance (p=0.002) had a greater prevalence of LOH-MHH. No association was found between the strength of the upper limbs and the prevalence of LOH-MHH (p=0.772).

However, when inserted into the Poisson multivariate regression model, the physical variables that remained independently linked to LOH-MHH were: strength (PR=1.78; 95%CI=1.04-3.04; p=0.034) and flexibility (PR=2.13; 95%CI=1.28-3.56; p=0.004), which indicates that the prevalence of LOH-MHH between individuals with altered strength in the lower limbs was 78% greater compared with those with normal strength, and 113% greater among those with flexibility alterations.

Table 1. Characterization data of the older adults sample of one of the Family Health Teams from the municipality of Porto Alegre, RS, 2012

Variable	Absolute frequency (n)	Relative frequency (%)	Mean/Median	Standard Deviation/ P25-P75
Age (years)*	-	-	75,4	6,9
Education level (years)#	-	-	7,00	(5,00-11,00)
Body Mass Index*	-	-	27,2	4,8
Number of children#	-	-	2,00	(1,00-3,00)
Income (minimum wages)#	-	-	2,00	(1,00-3,00)
Retirees	241	76,0	-	-
Pensioners	40	12,6	-	-
With occupation	43	13,6	-	-
Marital status			-	-
Single	40	12,6	-	-
Married/Stable Union	126	39,7	-	-
Widower	126	39,7	-	-
Divorced	25	7,9	-	-
Sex			-	-
Male	81	25,6	-	-
Ethnicity			-	-
White	275	86,8	-	-
Black	17	5,4	-	-
Mixed race	24	7,6	-	-
Yellow	0	0	-	-
Indigenous	1	0,3	-	-

(*) – variables presented by mean and standard deviation
(#) – variables presented by median and interquartile range
(P25-P75) – Interquartile Range 25-75%

Table 2. Parameters of physical capacity by sex and age group of older adults of one of the Family Health Teams, municipality of Porto Alegre, RS, 2012

Variable	n	Flexibility* (cm)	Lower limb strength* (number of repetitions)	Upper limb strength* (Kg)	Balance* (points)
Male					
65–69	20	-10,4±10,6	10,6±4,05	32,3±8,40	53,1±2,82
70–74	18	-7,22±11,2	11,6±2,33	35,1±6,51	53,3±3,66
75–79	18	-13,2±13,9	11,1±2,67	31,9±10,4	51,2±4,72
– 80	25	-10,8±10,0	10,3±3,73	28,4±8,86	47,7±5,27
Female					
65–69	61	-5,12±10,5	11,3±3,48	23,3±4,82	53,5±3,94
70–74	46	-2,04±7,59	11,4±4,35	21,3±4,81	52,3±4,83
75–79	57	-5,65±9,26	9,12±2,93	19,8±3,83	49,4±6,11
≥80	72	-6,29±9,33	8,58±2,88	18,4±4,36	47,7±5,77

*Mean±Standard deviation

Table 3. Identifying the likelihood of Hospitalization in the older adults sample of one of the Family Health Teams in the municipality of Porto Alegre, RS, 2012

Stratification of Probability	PRS	N	%
Low	< 0,300	191	60,25
Medium	0,300–0,399	73	23,03
Medium High	0,400–0,499	31	9,78
High	≥ 0,500	22	6,94

PRS=Probability score

DISCUSSION

The identification of LOH becomes relevant as it provides predictive characteristics of the intense use of health resources. The findings of this study were in accordance with the studies by Veras[11] and Estrella et al.[12], who found most older adults to be LOH-LM.

However, the morbidity is a usual condition in old age, causing long coexistence with chronic diseases and the need for frequent and prolonged hospitalizations[13]. Thus, although the elderlies stand for a small part of the population, their health care is intensely expensive.

Concerning the definition of cut-off points for the LOH assessment tool, Boult et al.[3] pointed the value of 0.40 (medium high) as a decisive sign of older people referrals to evaluation units and geriatric rehabilitation[14]. For this reason, taking this value as a reference, this study organized the strata of LOH in two groups: LOH-LM and LOH-MHH.

Regarding the evaluation of muscle strength, the tests conducted for upper and lower limbs in this research present distinct characteristics. The test in the palmar grip dynamometer develops through the request of type I muscle fibers, while the sitting-rising test for lower limbs strength assessment requests predominantly type II muscle fibers[15].

Such difference being found only on lower limbs assessment is justifiable when the process of sarcopenia in older adults is considered. This process is associated with the phenomena of muscle hypoplasia and hypertrophy that comes with age, especially in type II fibers. Type I fibers also suffer atrophy but in inferior proportion[16]. For such reason, it is understandable that the loss of movement speed, evidenced in older adults, may be attributed to the decrease of fast twitch fibers.

Therefore, the effect of aging on muscle fibers can be a justification, in this research, for the association between muscle strength and LOH-MHH observed only in the lower limbs.

It is noteworthy that the muscle strength loss, both in upper and lower limbs, is a strong predictor of functional deficits and sarcopenia[17,18]. However, strength and muscle mass do not regress simultaneously, being muscular strength a more efficient indicator of muscle changes[19].

Another important finding of the study was that no association was found between balance and LOH-MHH on the analysis of the correlation. For Helbostad et al.[20], muscle fatigue, especially in the lower limbs and torso, significantly impairs the performance of functional activities and postural balance, being a slower recovery in older people than in adults. However, the test performed through the Berg Balance Scale evaluates the balance alone, not considering the effect of muscle fatigue in the final performance, and, as a result, it could not show that bond. In addition, the Berg Balance Scale, despite being widely used in assessing the balance of older adults, features controversial and non-specific cut-off points for age groups[21,22].

Regarding the loss of muscle flexibility due to aging, its causes are associated with decrease in muscle elasticity, and with deterioration of cartilage, ligaments, tendons and synovial fluid[23]. Flexibility in old age, especially the hamstring muscles, is fundamental in the development of dynamic and static postural balance, and in the latter, similarly, there is interference from sensory-motor system dysfunctions[24]. The reduction in muscle activity, with the sedentary lifestyle, is related to changes in the structure, such as reduced muscle mass and cross-sectional muscle area, altering the pennation angle and decreasing the length in the muscle fiber, consequently affecting its function and triggering muscular weakness[25].

Thus, the results found in this research regarding the higher prevalence of the medium high-high probability of hospitalization, and the decline in muscle flexibility and loss of muscle strength in older adults are understandable. Lower limbs flexibility and muscle strength present positive linkage with the physical activity level[26,27], which presents, in turn, a robust association with morbimortality[28].

We believe that older adults independence assessment in factors that comprise the PC produces less onerous interventions that meet the needs of this population[29]. This way, the findings of this research reinforce the need to encourage the practice of physical activity in older adults, especially multi-component training, as it interferes positively in physical and functional capacity[30], and therefore influences health protection and longevity[28].

As limitations of this research is important to highlight (1) the hemodynamically unstable older adults or the ones that presented severe acute illness were excluded from the sample, due to insecurity in physical testing at home; (2) despite the aerobic conditioning being a component of the PC, we chose not to perform the evaluation, since it was impossible to perform a test without emergency support, and

because of the difficulty in adapting a controlled environment for sub maximal exercises at home; (3) the associative analysis of PC and LOH were developed from a cross-sectional study. A longitudinal study is required to better understand this association.

CONCLUSION

The loss of lower limb strength and flexibility were associated with LOH-MHH. These findings become relevant as these parameters are understood not only as evaluation of the PC, but also as indicative of LOH, showing the older adults that require greater attention from health services. Besides, it is an important guide for planning prevention and health promotion actions, confirming the importance of physical activity.

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