Advanced Activities of Daily Living (AADLs) and cognitive performance in community-dwelling elderly persons: Data from the FIBRA Study - UNICAMP

Giovana Sposito[1]
Anita Liberalesso Neri[2]
Mônica Sanches Yassuda[3]

Abstract

Objective: The aim of this study was to investigate the relationship between participation in advanced activities of daily living (AADLs) and cognitive performance in community-dwelling elderly persons. *Method:* The data presented is drawn from the population-based study entitled Frailty Profile of Elderly Brazilians (FIBRA-Unicamp). The sample comprised 2,549 older adults without cognitive impairments suggestive of dementia. Data was collected relating to socio-demographic characteristics (sex, age, years of education and family income), health status (number of diseases and depressive symptoms), cognitive performance (Mini-Mental State Examination – MMSE) and self-reported social, physical and intellectual AADLs. *Results:* Mean MMSE scores were significantly higher among men, younger individuals and those with more years of education, higher income, fewer diseases and fewer depressive symptoms. Multivariate linear regression analysis and hierarchical regression analysis showed that years of education, family income and participation in intellectual AADLs were positively associated with cognitive performance. *Conclusion:* The findings suggest that these factors may have a protective role in cognitive aging and that participation in intellectual AADLs can represent a feasible strategy for the promotion of mental health among older adults.

Key words: Activities of Daily Living; Social Participation; Motor Activity; Cognition; Elderly.

[1] Universidade Estadual de Campinas, Faculdade de Ciências Médicas, Programa de Pós-graduação em Gerontologia. Campinas, SP, Brasil.

[2] Universidade Estadual de Campinas, Faculdade de Educação, Departamento de Psicologia Educacional. Campinas, SP, Brasil.

[3] Universidade de São Paulo, Escola de Artes, Ciências e Humanidades, Programa de Pós-graduação em Gerontologia. São Paulo, SP, Brasil.

Correspondence
Mônica Sanches Yassuda
E-mail:yassuda@usp.br

INTRODUCTION

Successful aging includes not only the absence of disease and the maintenance of functional capacity, but also active engagement with life.[1] Active aging can involve physical, social and intellectual activities,[2] collectively known as advanced activities of daily living (AADLs). AADLs are part of a complex set of behavioral skills associated with functionality, motivation and previous experiences.[3] For this degree of functionality an individual requires more than just skills of self-care and survival, as the ability to perform AADLs is dependent on the preservation of physical and cognitive functions. It is additionally influenced by gender, age, health conditions, education, marital status and place of residence.[2-4] Consequently, a decline in the health of an individual often precludes their ability to perform AADLs, predisposing them to social isolation.[5]

The term AADLs encompasses activities of varying degrees of complexity, which are usually grouped into physical, social and intellectual categories.[6-8] Selection of these activities is often affected by socio-cultural and motivational influences.[7,8] Most of the activities are non-obligatory and often involve leisure, entertainment and social interaction.[8]

Studies suggest that engagement in AADLs can be a preventative factor for symptoms of depression and disability, as well as reducing the risk of mortality.[2,9] In their study of the benefits provided by such engagement, Buchmann et al.[9] found that a low level of participation in these activities was associated with a more rapid decline in motor function, increased risk of disability and increased risk of death.

Aging can lead to a decline in cognitive performance, such as a decrease in attention levels and in information processing speed.[10] The adoption of an active lifestyle, including involvement in AADLs, can help protect cognitive functions, decreasing the risk of developing dementia.[8] Besides being beneficial for the maintenance and/or improvement of physical health and psychological well-being, literature suggests a strong relationship between physical activity (activities with caloric, aerobic and anaerobic expenditure) and chronic diseases, as well as a further association with cognitive performance and a reduction in the incidence of dementia.[6,11-13] Social activities (participation and/or social engagement) allow an elderly individual to develop multiple social roles, feel useful and maintain his or her mental health and quality of life.[2,6,14] Maintenance of cognitive performance and an decreased incidence of dementia have also been associated with engagement in intellectual activities.[6,8,12]

Scarmeas et al.[15] reported that elderly individuals in the community who did not already suffer from dementia could delay the onset of the syndrome by seven years through the performance of AADLs. Each additional activity performed brought a specific decrease in risk, with intellectual activities having the strongest influence. However, a systematic review showed that some studies did not identify a significant correlation between performance of AADLs and preservation of cognitive function.[8] The lack of standardization of the frequency, intensity and duration of activities, as well as the batteries of cognitive tests used, may explain the inconsistencies in results.

Although literature indicates an association between engagement in AADLs and improved cognitive function, a deeper knowledge of this relationship and of the relevance of the sociodemographic and health conditions of the elderly is required. Accordingly, this study is aimed at examining the relationship between the performance of physical, social and intellectual AADLs and cognitive performance, using a representative sample from seven Brazilian cities and controlling the effect of sociodemographic (age, gender, education and family income) and health (number of diseases and depressive symptoms) variables.

METHOD

This study was developed using the database of the Estudo Rede FIBRA (an acronym for

Fragility in Elderly Brazilians) (FIBRA Network Study), UNICAMP (the State University of Campinas) hub, a study which aimed to analyze the relationship between frailty and psychosocial and sociodemographic variables, including health, function and cognition, among elderly individuals in the community. The data was collected between June 2008 and September 2009, in a cross-sectional population-based study, the design of which was approved by the Comitê de Ética em Pesquisa (Research Ethics Committee) of the Faculdade de Ciências Médicas (Faculty of Medical Sciences) at the Universidade Estadual de Campinas (CEP/FCM/UNICAMP), under registration no. 208/2007. All participants signed a Free and Informed Consent Form prior to participating.

Participants

The sample consisted of 2,549 elderly persons not suffering from cognitive impairment suggestive of dementia. Participants with scores below the cut-off point of the Mini Mental State Examination (MMSE) were excluded. Data collection, led by the Universidade Estadual de Campinas (UNICAMP) took place in seven cities with varying levels of urban development: Belém in the state of Pará, Campina Grande in Paraíba, Parnaíba in Piauí, Pocos de Caldas and Campinas in São Paulo, Ermelino Matarazzo (a subdistrict of the city of São Paulo in the state of São Paulo) and Ivoti in Rio Grande do Sul. For a detailed description of the methods used by FIBRA-UNICAMP, see Neri et al.[16] The study's main methodological characteristics are highlighted below.

In each city, the sample was organized using several procedures, taking into account primary sampling units (PSU) and families. Families from randomly selected PSUs were visited in order to survey elderly individuals aged 65 years or over. Those individuals who complied with the inclusion criteria while not meeting the exclusion criteria were invited to participate in the study. The inclusion criteria were: 1. aged 65 or over, 2. a permanent resident in a home which fell within the census area and 3. able to understand the instructions. The exclusion criteria were: 1. the presence of problems suggestive of cognitive impairment and related to memory, attention, spatial or temporal orientation or communication; 2. a permanent or temporary inability to walk except with the use of a walking stick or other device; 3. a localized loss of strength and aphasia resulting from a stroke; severe impairment of motor, speech or affective skills associated with advanced Parkinson's disease; 4. severe hearing or visual deficits 5. suffer from the terminal stage of an illness. The inclusion and exclusion criteria followed the methodological recommendations of the *Cardiovascular Health Study*.[17]

The individuals chosen were invited to participate in a single data collection session held in a community center close to their homes which lasted between 40 to 120 minutes. They were assessed for sociodemographic variables, blood pressure, anthropometry, fragility indicators and cognitive status using the MMSE.[18] The following were adopted as cutoff scores for the MMSE: 17 for illiterate individuals; 22 for those with between one and four years of education; 24 for those with between five and eight years of education; and 26 for individuals whose education totaled nine years or more. These cut-off points were based on the averages found by Brucki et al.[19] for each educational group, minus one standard deviation. Participants who scored above the MMSE cut-off point went through a second set of measurements based on the self-reporting of health status, functionality, engagement in AADLs, expectations of care, depressive symptoms, perceived social support and satisfaction.

Instruments and measures

For the present study, the following variables were used:

MMSE: dementia screening test composed of 30 questions assessing the following cognitive functions: episodic memory, language, constructive praxis and spatial and temporal orientation.[18,19] The total score is the sum of the points of the correct answers given. Higher values indicate better cognitive performance.

Frequency with which an individual performs AADLs of a social nature:[2] this was composed of eight structured questions that addressed an individual's participation in activities such as the following: receiving or making visits, attending church or temple, attending meetings and parties, participating in cultural events, driving cars and taking trips. The possible responses were "never did", "stopped doing" and "still do."

The frequency with which an individual performs AADLs of a physical or intellectual nature: questions were taken from the *Minnesota Leisure Time Activity Questionnaire* (MLTAQ).[20,21] Physical AADLs included activities with caloric expenditure, such as fitness exercises, sport, housework, cooking and cutting the grass, among other activities. The intellectual AADLs involved included: watching television, sewing or craftwork, playing board games and reading. The possible answers were 'yes' (perform the activity) and 'no' (do not perform the activity). The number of activities carried out by each individual in the physical and intellectual categories was counted.

Sociodemographic variables: age, grouped into age bands (65-69 years, 70-74 years, 75-79 years and ≥80 years); gender (male and female), education (years of study) and monthly family income (gross reported, converted into units equaling the value of the minimum wage in Brazil in 2008 (R$450.00).

Number of diseases: the sum of the number of chronic diseases diagnosed in an individual during the 12 month period prior to the interview, as reported by the elderly individuals themselves when asked to consider a list of nine chronic diseases (heart disease, stroke, myocardial infarction or ischemia, hypertension, diabetes, osteoporosis, arthritis or arthrosis, lung disease and cancer).

The Geriatric Depression Scale (GDS)[22] was used. This consists of 15 questions about depressive symptoms, in response to which the elderly persons chose either "yes" or "no" to indicate their mood over recent weeks. The cutoff score of ≥6 was taken to suggest the presence of depression.

Data analysis

The frequencies of the variables of interest were tabulated, and measurements of position (mean) and dispersion (standard deviation) were calculated. The analysis of the categorical variables was performed using Fisher's Chi-squared test, also known as the exact test. For comparison of numeric variables between two groups, such as men and women, the Mann-Whitney test was used. Where there were three or more possible categorizations, as for *years of schooling* and *family income*, the Kruskal-Wallis test was used.

The variables associated with cognitive performance were investigated using multivariate linear regression analysis, with the *Stepwise* criterion used for the selection of variables. Total MMSE score was considered a dependent variable, while physical, social and intellectual AADLs; gender; age; education; family income; number of diseases and depressive symptoms were all included as independent variables.

Due to the sample size, and because the AADLs do not provide a grading of the activities required in order to influence cognitive performance, the frequency distributions of the physical, social and intellectual AADLs were divided into quartiles (less active, quite active, very active and super active).[23] The 'male' gender, 'EDG<6' and 'less active' variable responses were used as references for the multivariate linear regression analysis.

To confirm the results shown in the multivariate linear regression analysis, hierarchical regression analysis was performed. Blocks were inserted according to gerontological literature on the subject under study. The first block analyzed in relation to cognitive score was sociodemographic variables (block 1), before the variables of health condition and the AADLs (physical, social and intellectual) were inserted in blocks 2 and 3 respectively.[24] During regression analysis (multivariate and hierarchical), numeric variables were transformed into points (rankings**)** due to the absence of normal

distribution. The test for multicollinearity showed that inflation factors varied between scores of 1.02-1.71, remaining well below 10, the cut-off point for potential multicollinearity.[25] The significance level adopted for all statistical tests was 5% ($p<0.05$). All data was analyzed using the SPSS Statistics package, version 15.0.

RESULTS

The sample consisted of 2,549 elderly individuals (65.71% of whom were women) with a mean age of 72.32 (±5.55). Just under half (49.23%) had 1-4 years of education and reported a family income of between 1.1 and 3 minimum wages (48.41%). Additionally, 53.65% reported having one or two diseases while 79.54% did not present depressive symptoms. As for AADL, 38.01% participated in three or four physical AADLs and 33.42% performed four or fewer social AADLs. A total of 33.42% of the individuals took part in only one intellectual AADL, while 799 individuals (31.35%) practiced nine or less AADLs. The descriptive analyzes are shown in Table 1.

Table 1. Distribution of sociodemographic variables, the number of self-reported diseases, the score for depressive symptoms and engagement in AADLs (N=2.549). Rede FIBRA, UNICAMP hub, 2008-2009.

Variable	Category	n (%)	Average (±sd)
Gender	Male	874 (34.29)	
	Female	1.675 (65.71)	
Age (years)	65-69	965 (37.86)	72.32 (±5.55)
	70-74	796 (31.23)	
	75-79	483 (18.95)	
	80+	305 (11.97)	
Years of study	0	504 (19.79)	4.37 (±3.99)
	1-4	1.254 (49.23)	
	5-8	458 (17.98)	
	≥9	331 (13.00)	
Family Income (MS)	≤1	242 (10.99)	3.97 (±4.92)
	1.1-3	1.066 (48.41)	
	3.1-5	485 (22.03)	
	5.1-10	274 (12.44)	
Number of diseases	0	313 (12.29)	2.02 (±1.33)
	1-2	1.366 (53.65)	
	≥3	867 (34.05)	
Depressive symptoms	No	2.022 (79.54)	3.53 (±2.68)
	Yes	520 (20.46)	

Variable	Category	n (%)	Average (±sd)
Physical AADLs	0-2	679 (26.64)	3.94 (±2.15)
	3-4	969 (38.01)	
	5	352 (13.81)	
	≥6	549 (21.54)	
Social AADLs	0-4	852 (33.42)	5.53 (±2.21)
	5-6	836 (32.80)	
	7	360 (14.12)	
	≥8	501 (19.65)	
Intellectual AADLs	0-1	852 (33.42)	2.19 (±1.04)
	2	836 (32.80)	
	3	360 (25.89)	
	≥4	250 (9.81)	
Total number of AADLs	0-9	799 (31.35)	11.67 (±4.03)
	10-11	514 (20.16)	
	12-14	634 (24.87)	
	15	602 (23.62)	

n=number of subjects; sd=standard-deviation; MS= minimum salary; AADLs=advanced activities of daily living.

Table 2 displays the variations in the average results of the MMSE for the elderly individuals, in relation to sociodemographic variables, number of self-reported diseases and depressive symptoms. The averages were significantly higher among men, younger individuals, those with higher levels of education and with higher incomes and those with fewer diseases and without depressive symptoms.

Table 2. Comparison of the average MMSE scores obtained by the elderly individuals, considering sociodemographic variables, the number of self-reported diseases and depressive symptoms (N=2.549). Rede FIBRA, UNICAMP hub, 2008-2009.

		Total MMSE	
	n	Average (±sd)	*p*-value
Gender			<0.001
Male	874	25.40 (±2.97)	
Female	1.675	**24.76** (±3.11)	
Age (years)			**<0.001**(A)
65-69	965	25.43 (±2.94)	
70-74	796	25.03 (±3.06)	
75-79	486	**24.54** (±3.16)	
≥80	305	**24.14** (±3.14)	

	n	Total MMSE Average (±sd)	*p*-value
Years of study			**<0.001**(B)
0	504	**21.06** (±2.84)	
1-4	1.254	25.21 (±2.23)	
5-8	458	26.55 (±1.76)	
≥9	331	27.91 (±1.27)	
Family income (MS)			**<0.001**(C)
≤1	242	**23.48** (±3.23)	
1.1-3	1.066	**24.21** (±3.12)	
3.1-5	485	25.76 (±2.67)	
5.1-10	274	26.66 (±2.34)	
>10	135	27.60 (±1.68)	
Number of diseases			**0.006**(D)
0	313	25.14 (±2.88)	
1-2	1.366	25.13 (±3.05)	
≥3	867	**24.70** (±3.17)	
Depressive symptoms			<0.001
No	2.022	25.26 (±2.98)	
Yes	520	**23.95** (±3.20)	

p-value refers to the Mann-Whitney test for comparison of numerical variables between two groups and the Kruskal-Wallis test for comparison of numeric variables between three or more groups; n=number of subjects; sd= standard deviation; *p*= significance level; SM=minimum salary; MMSE = Mini-Mental State Examination; A=65-69≠75-79, ≥80,70-74≠≥80. B=0≠1-4, 5-8, ≥9; 1-4≠5-8, ≥9; 5-8≠≥9. C= ≤1≠3.1-5, 5.1-10, >10; 1.1-3≠3.1-5, 5.1-10, >10; 5.1-10≠>10. D=1-2≠≥3.

Table 3 shows a comparison in the average levels of engagement in AADLs (physical, social, intellectual and total), according to sociodemographic and health variables. Women performed more physical and intellectuals AADLs and had a higher overall total. Participation levels in physical ADDLs were significantly higher among younger elderly individuals. The three younger groups showed a considerably higher level of engagement than did the group of older elderly persons. The group aged 80 years and over also had a significantly lower level of engagement for overall AADLs than those displayed by the younger groups. There was also a lower level of engagement in social, intellectual and physical AADLs and overall scores among individuals with no education. The group with a monthly income equating to higher than 10 minimum salaries showed a higher level of engagement in both social and intellectual AADLs. Regarding the number of diseases reported by the individuals, those with three or more diseases had less engagement in physical, social and overall number of AADLs than the other groups. The group of individuals who scored <6 on the GDS showed greater engagement in physical, social, intellectual and the overall number of AAVDs.

Table 3. Comparative analysis of engagement in ADLs (physical, social, intellectual and total) according to sociodemographic variables, number of self-reported diseases and depressive symptoms (N=2.549). Rede FIBRA, UNICAMP hub, 2008-2009.

	Physical AADLs	Social AADLs	Intel. AADLs.	Total AADLs
	Average (±sd)			
Gender				
Male (n=874)	3.65 (2.45)	5.51 (2.20)	2.03 (0.92)	11.19 (4.12)
Female (n=1.675)	4.10 (1.97)	5.54 (2.22)	2.28 (1.09)	11.91 (3.96)
p	**<0.001**	0.730	**<0.001**	**<0.001**
Age (years)				
65-69 (n=965)	4.30 (2.22)	5.73 (2.24)	2.26 (1.07)	12.29 (4.19)
70-74 (n=796)	3.92 (2.10)	5.55 (2.15)	2.17 (1.03)	11.64 (3.92)
75-79 (n=483)	3.74 (2.04)	5.43 (2.15)	2.16 (1.05)	11.33 (3.81)
≥80 (n=305)	3.19 (1.99)	5.01 (2.28)	2.11 (0.91)	10.31 (3.76)
p	**<0.001** (A)	**<0.001** (B)	0.142	**<0.001** (C)
Years of study				
0(n=504)	3.63 (2.00)	4.74 (1.99)	1.43 (0.75)	9.80 (3.51)
1-4 (n=485)	4.07 (2.12)	5.32 (2.11)	2.23 (0.98)	11.61 (3.91)
5-8 (n=458)	4.07 (2.24)	6.03 (2.14)	2.51 (0.99)	12.60 (3.86)
≥9(n=331)	3.79 (2.32)	6.82 (2.29)	2.79 (1.06)	13.40 (4.26)
p	**<0.001** (D)	**<0.001 (E)**	**<0.001**(E)	**<0.001** (F)
Family income (MS)				
≤1(n=242)	3.95 (2.07)	4.95 (2.12)	1.88 (0.96)	10.77 (3.76)
1.1-3(n=1.066)	3.83 (2.09)	5.19 (2.08)	2.00 (1.01)	11.00 (3.86)
3.1-5(n=485)	4.19 (2.27)	5.80 (2.19)	2.32 (1.01)	12.30 (4.04)
5.1-10(n=274)	4.08 (2.23)	6.32 (2.26)	2.65 (0.98)	13.05 (4.05)
>10 (n=135)	3.96 (2.39)	7.07 (2.30)	2.77 (1.09)	13.79 (4.36)
p	0.096	**<0.001** (G)	**<0.001**(H)	**<0.001** (I)
Number of diseases				
0(n=313)	4.06 (2.39)	5.65 (2.29)	2.14 (0.95)	11.86 (4.20)
1-2 (n=1.366)	4.06 (2.15)	5.61 (2.22)	2.23 (1.06)	11.90 (4.05)
≥3(867)	3.71 (2.03)	5.36 (2.15)	2.15 (1.04)	11.22 (3.88)
p	**<0.001** (J)	**0.020** (L)	0.195	**<0.001** (M)
Depressive symptoms				
No (n=2.022)	4.07 (2.18)	5.80 (2.19)	2.27 (1.04)	12.14 (4.04)
Yes (n=520)	3.45 (1.94)	4.50 (1.95)	1.90 (0.97)	9.84 (3.42)
p	0.001	0.001	0.001	**0.001**

p-value refers to the Mann-Whitney test for comparison of numerical variables between two groups and the Kruskal-Wallis test for comparison of numeric variables between three or more group; AADLs=advanced activities of daily living.; Intel.= Intellectual; n=number of subjects; sd=standard deviation; *p*=significance level; MS=minimum salary; A=65-69≠70-74,75-79,≥80; 70-74≠≥80; 70-74≠≥80; 75-79≠≥80. B=65-69≠≥80; 70-74≠≥80,75-79≠≥80. C=65-69≠75-79,≥80; 70-74≠≥80; 75-79≠≥80. D= 0≠1-4,5-8,≥9; 1-4≠≥9. E=0≠1-4,5-8,≥9; 1-4≠5-8,≥9; 5-8≠≥9 F=0≠1-4,5-8,≥9; 1-4≠5-8,≥9. G= ≤1≠3.1-5,5.1-10,>10; 1,1-3,≠3.1-5,5.1-10,>10; 3.1-5≠5.1-10,>10; 5.1-10≠>10; H=≤1≠3,1-5,5.1-10,>10; 1,1-3≠3,1-5,5.1-10,>10; 3.1-5≠5.1-10,>10. I=≤1≠3.1-5, 5,1-10,>10; 1.1-3≠3.1-5,5.1-10,>10; 3.1-5≠>10. J=1-2≠3;L=0≠≥3. M= ≥3≠0.1-2.

Multivariate (linear) regression analysis (Table 4), found that the variables of education, family income, gender, age, participation in intellectual AADLs and depressive symptoms were significantly related, taken together to the performance on the MMSE. Education was the variable that best explained the variations in total MMSE score.

Table 4. Multivariate linear regression analysis with socio-demographic variables, number of diseases, depressive symptoms and intellectual AADLs as independent variables and the MMSE score as the dependent variable (N=2.193). Rede FIBRA, UNICAMP hub, 2008-2009.

Variable	Category	Beta (SE)	p	R^2
Education		0.55 (0.02)	<0.001	0.4305
Family income		0.11 (0.02)	<0.001	0.0117
Gender	Female	-149.54 (24.49)	<0.001	0.0076
Age		-0.08 (0.02)	**<0.001**	0.0060
Intellectual AADLs	Less active	164.42 (30.07)	**<0.001**	
	Very active	238.22 (34.36)	**<0.001**	
	Super active	225.79 (46.19)	**<0.001**	0.0143
Depressive symptoms	Yes	-90.57 (29.19)	**0.002**	0.0023

Beta= value of estimated or slope coefficient (slope) at the line of regression; SE=standard error of beta; *p*= significance level; R^2= determination coefficient; Intellectual AADLs =Advanced intellectual activities of daily living.

The hierarchical linear regression analysis, including three groups of variables (Table 5), returned similar results to those from the multivariate linear regression analysis. Education, family income, gender, age, participation in intellectual AADLs and depressive symptoms were strongly related to performance in the MMSE.

Table 5. Hierarchical linear regression analysis with sociodemographic variables, health conditions and AADLs as independent variables and total MMSE score as the dependent variable (N=2.193). FIBRA network, UNICAMP hub, 2008-2009.

		Block 1			Block 2			Block 3		
Variables	Categories	Beta (SE)	p	R^2 (partial)	Beta (SE)	p	R^2 (partial)	Beta (SE)	p	R^2 (partial)
				0.4557			0.4593			0.4724
Education		0.60 (0.02)	<0.001	0.4305	0.59 (0.02)	<0.001	0.4305	0.58 (0.002)	**<0.001**	0.4305
Family income		0.13 (0.02)	<0.001	0.0117	0.12 (0.02)	<0.001	0.0117	0.11 (0.2)	**<0.001**	0.0117
Gender	Female	-140.30 (234.46)	<0.001	0.0076	-133.07 (24.46)	<0.001	0.0076	-149.54 (24.49)	**<0.001**	0.0076
Age		-0.08(0.02)	<0.001	0.0059	-0.08 (0.02)	<0.001	0.0059	-0.08 (0.02)	**<0.001**	0.0059
Depressive s.	Yes				-111.85 (29.38)	<0.001	0.0036	-90.57 (29.19)	**0.002**	0.0036
Intel. ADDLs.	Less active							164.42 (30.07)	**<0.001**	
	More active							238.22 (34.36)	**<0.001**	
	Super active							225.79 (46.19)	**<0.001**	0.0131

Beta= value of estimated or slope coefficient (slope) at the line of regression; SE= standard error of beta; *p*= significance level; R^2= determination coefficient; R^2=0.4557 (block 1); R^2=0.4593 (block 2); R^2total=0.4724 (block 3); Depressive s = depressive symptoms; Intel. AADLs.= Advanced activities of daily living.

DISCUSSION

The present study evaluated the relationship of engagement in AADLs, grouped into the categories of physical, social and intellectual, with cognitive performance, monitoring the effect of the sociodemographic and health conditions of elderly people, without pre-existing cognitive impairment suggestive of dementia, living in the community.

Replicating results from other studies, total MMSE score and levels of engagement in AADLs was significantly higher among younger elderly individuals, those with more education and higher family income and those with the lowest number of reported illnesses and fewer depressive symptoms.[26-30] Total MMSE scores were higher among men, while engagement levels in AADLs were higher among women.[27-30]

Education was the variable that best explained the variance in MMSE scores in the present study, followed by family income and participation in intellectual AADLs. These results may indicate that environmental circumstances in conjunction with socioeconomic factors are related to the preservation of cognitive function in aging. Similar results have been explained by a number of authors using the cognitive reserve model.[31,32] This model suggests that exposure to education and complex activities throughout life is beneficial for the preservation of cognitive ability and resistance to nerve damage.[33,34] Engagement in complex activities can help to counteract the cerebral damage associated with aging, through both the continued use of existing brain pathways and the additional creation of alternatives.[34] According to a systematic review by Wang et al.,[8] participation in intellectual activities has a protective effect on cognitive performance. These findings agree with the results of this study, in which there was a positive association between performance of intellectual AADLs and MMSE scores.

Petroianu et al.,[35] observed a relationship between a lack of physical or intellectual stimulation and dementia in 303 elderly individuals aged 80 and over living in the community. The results indicated that individuals who did not practice any such activity had a relative risk of 4.27 of developing dementia when compared with those who practiced intellectual activity, and of 2.21 compared with those who practiced physical activities. Those who practiced only physical activities had a relative risk of 1.93 of developing dementia when compared to individuals who practiced intellectual activities. The authors concluded that the regular practice of physical and intellectual activities can reduce the risk of dementia, with intellectual activities being most effective.

For Churchill et al.,[36] mental stimuli that integrate intellectual activities could foster a selective increase in the number of synapses, aiding cognition, while physical activities are associated with non-neural components, such as an increase in cerebral blood flow, with less specific effects. A systematic review by Wang et al.[8] showed in observational studies that engagement in physical activity resulted in a decreased risk of cognitive decline and dementia. However, this effect has been less evident in interventional studies. In the present study, engagement in vigorous physical AADLs was not associated with better performance on the MMSE in multiple models.

Engagement in social activities can provide a stimulating environment by offering opportunities for dealing with complex social issues that require the processing of information.[8,36] However, in this study the relationship between engagement in social AADLs and total MMSE score was not statistically significant, according to multivariate analysis. The reason for this may be linked to the fact that the study evaluated participation in simple social activities, such as receiving or making visits, rather than in more cognitively demanding activities, such as participation in reading groups or political associations.[27,37]

Similar results were encountered by Di Rienzo's[27] longitudinal population-based study of elderly individuals in the community in the city of São Paulo, São Paulo state. The author found a positive association between the practice of intellectual activities and overall cognitive functioning. When sociodemographic variables were considered using the multivariate analysis model, an inverse

relationship was observed between engagement in physical activity and cognitive performance, and there was also no association between performance of social activities and cognitive performance. The SABE[38] project assessed the impact of AADLs (physical, social, productive and leisure) on the incidence of cognitive decline among non-institutionalized elderly over a mean period of four years. The results showed that elderly individuals who did not develop cognitive decline, on average performed significantly more AADLs than those who did. However, individual analysis of each AADL was not significant in the multivariate model. According to the authors, these results can be explained by the diversity of stimuli involved in each type of AADL studied and the differences of intensity, frequency and duration in the performance of those activities.[38]

This study has some limitations. First, the engagement in AADLs was measured through the self-reporting of the elderly individuals. It is suggested that future studies measure the frequency, intensity and duration of the performance of the AADLs, since the magnitude of the influence of AADLs goes beyond the type of activity performed and may depend on the duration of lifelong exposure.[8] Additionally, AADLs were evaluated by self-reporting, as there is no standard instrument for such measuring, and the different methods discussed in the literature make comparison across studies difficult. The sample of the present study consisted of older adults without cognitive deficits suggestive of dementia, which is why reverse causality cannot be ruled out. Another limitation to be emphasized would be the assessment of cognition by a cognitive screening tool. Further studies on this theme would benefit from a more comprehensive assessment of cognitive performance.

CONCLUSION

In conclusion, this study found that education, income and engagement in intellectual activities were the factors that best explained the variance of total scores of the Mini Mental State Examination. We would suggest that future studies be preferably longitudinal in design, and continue to investigate active lifestyles and their impact on cognitive function in aging. The results of the present study suggest that engagement in advanced intellectual activities of daily living could be the focus of public policies aimed at promoting the mental health of elderly people.

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