REFACS
Revista Família, Ciclos de Vida e Saúde no Contexto Social

Neuropsychological evaluation of elderly people investigated for dementia*

Avaliação neuropsicológica de idosos em investigação para demência

Evaluación neuropsicológica de ancianos en investigación para la demencia

Sabrina Martins Barroso[1]
Raphaela Campos de Sousa[2]

The objective of this study was to perform a neuropsychological evaluation of elderly people undergoing diagnostic investigation for dementia in the city of Uberaba/MG, Brazil. Thirty-five elderly individuals, with a mean age of 72.57 years, were studied. Most were females and with low schooling. The tests were: Mini-Mental State Examination, Clock-Drawing Test, Timed Walking Test, Nine-Hole Peg Test, CERAD Battery and a complementary questionnaire. The test results were dichotomized between "normal" and "deficit". Descriptive and correlational analyzes were conducted. The results showed preserved ability of immediate memory and memory, verbal fluency, grip and control of the upper limbs for the majority of the evaluated participants. Deficits were identified regarding temporal and spatial orientation, long-term memory, praxis, naming, visuospatial and planning skills, and control of the lower limbs. There was an association between performance in different tests. The research showed the relevance of the neuropsychological evaluation integrated to the investigation of demential pictures.
Descriptors: Aged; Neuropsychology; Executive function; Disability evaluation.

O objetivo deste estudo foi realizar a avaliação neuropsicológica de idosos em investigação diagnóstica para quadros demenciais na cidade de Uberaba, MG. Foram avaliados 35 idosos, com média de idades de 72,57 anos, sendo a maior parte do sexo feminino e baixa escolaridade. Utilizou-se os testes: Mini-Exame do Estado Mental, Teste do Relógio, Caminhada Cronometrada, Nove Pinos, Bateria CERAD e questionário complementar. Os resultados dos testes foi dicotomizada entre "normal" e "déficit". Foram conduzidas análises descritivas e correlacionais. Os resultados mostraram capacidade preservada de memória imediata e de reconhecimento, fluência verbal, preensão e controle dos membros superiores para a maioria dos avaliados. Déficits foram identificados quanto a orientação têmporo-espacial, memória de longo prazo, praxias, nomeação, habilidades visuoespaciais e de planejamento e controle dos membros inferiores. Houve associação entre desempenhos em diferentes testes. A pesquisa mostrou relevância da avaliação neuropsicológica integrada à investigação de quadros demenciais.
Descritores: Idoso; Neuropsicologia; Função executiva; Avaliação da deficiência.

El objetivo de este estudio fue realizar la evaluación neuropsicológica de ancianos en investigación diagnóstica para cuadros demenciales en la ciudad de Uberaba, MG, Brasil. Se evaluaron 35 ancianos, con promedio de edades de 72,57 años, siendo la mayor parte del sexo femenino y baja escolaridad. Se utilizaron las pruebas: Mini-Examen del Estado Mental, Prueba del Reloj, Caminata Cronometrada, Nueve Pines, Batería CERAD y cuestionario complementario. Los resultados de las pruebas fueron dicotomizadas entre "normal" y "déficit". Se realizaron análisis descriptivos y correlacionales. Los resultados mostraron capacidad preservada de memoria inmediata y de reconocimiento, fluencia verbal, asimiento y control de los miembros superiores para la mayoría de los evaluados. Los déficits fueron identificados como la orientación témporo-espacial, memoria de largo plazo, praxis, nombramiento, habilidades visu-espaciales y de planificación y control de los miembros inferiores. Hubo asociación entre desempeños en diferentes pruebas. La investigación mostró relevancia de la evaluación neuropsicológica integrada a la investigación de cuadros demenciales.
Descriptores: Anciano; Neuropsicología; Función ejecutiva; Evaluación de la discapacidad.

1. Psychologist. Specialist in Human Development. Master in Psychology. PhD in Public Health. Adjunct Professor, Department of Psychology and Coordinator of the Graduate Program in Psychology (PPGP), Federal University of Triângulo Mineiro (UFTM), Uberaba, MG, Brazil. ORCID: 0000-0003-1759-9681 E-mail: smb.uftm@gmail.com
2. Psychologist. Master student in Psychology from the PPGP/UFTM. Professor of Psychology, University of Uberaba (UNIUBE) Uberaba, MG, Brazil. ORCID: 0000-0002-3142-3044E-mail: rapha1618.rc@gmail.com

INTRODUCTION

In 2015, the elderly represented 14.3% of the Brazilian population[1], with projections that by 2070 Brazil will be the sixth country with the highest number of elderly people in the world, representing more than 35% of the country's total popiulation[1]. This increase in the elderly population has generated greater interest of researchers and professionals on the subject of aging [2].

Aging generates physical, cognitive and behavioral changes derived from cellular aging and life experiences. Some changes are perceived positively, linked to increased maturity and knowledge. Others involve loss of information processing speed and cognitive flexibility, or relate to neurocognitive disorders[3,4].

One of the aspects that has been highlighted in the investigations is regards the neurodegenerative disorders, that have multiple etiologies and represent a heterogenous group of pathologies. According to the DSM-5, the diagnosis of neurocognitive disorder encompasses memory impairment along with deficits in at least one of the following cognitive domains: language, praxis, gnosis, or executive functions[4]. These pathologies impair functional independence and create the elderly's dependence on an external caregiver[5-8].

Alzheimer's disease is the major responsible for the appearance of dementia among the elderly, accounting for 70% of the diagnosed cases of neurocognitive disorder in this population worldwide. Other common causes are Vascular Dementia, Dementia with Lewy Bodies and Frontotemporal Dementia[6].

As the neurocognitive disorders generate great limitations and respond better to treatment when discovered in earlier stages, it is relevant to identify them in these stages[9]. If there is early identification, drug and non-drug treatments, such as cognitive rehabilitation, may be initiated and contribute to delay or prevent the onset of symptoms[10], thus improving the quality of life of the elderly and caregivers[9].

Neuropsychological assessment is used as a tool to identify cognitive deficits and early dementia diagnosis. It also can evaluate functional aspects of performance, which may make it difficult to perform daily tasks[2]. The conduction of evaluations of this nature in small cities is hampered by the absence of skilled professionals to carry them out, which limits information of this nature in several regions.

There is no information on the neuropsychological characteristics of the elderly in the Triângulo Mineiro region to this date, which prevents the search for similarities and specificities in relation to other regions. In addition, it compromises the development of intervention plans adapted to the local reality, which important for the success of any cognitive intervention[4]. Considering the importance of early identification of cognitive deficits in the elderly, the present study aims to perform the neuropsychological evaluation of elderly people under diagnostic investigation for dementia in the city of Uberaba/MG, Brazil.

METHOD

This is a cross-sectional, descriptive and correlational study, based on quantitative methodology of data interpretation.

Participants were 35 elderly patients undergoing diagnostic investigation for mild cognitive impairment, Parkinson's disease, Alzheimer's disease or vascular dementia at the Neurology Outpatient Clinic of the Federal University of Triângulo Mineiro (HC-UFTM).

Participants represented all the elderly undergoing diagnostic investigation for the said pathologies during the second semester of 2016. Inclusion criteria were being aged 60 years or older, attending the HC-UFTM and having been submitted to diagnostic investigation for dementia of any nature, mild cognitive deficit or Parkinson's disease. There was no restriction regarding gender, presence of physical difficulty or physical comorbidities.

In terms of assessment instruments, the following were used: the interview, the Mini-Mental State Examination (MMSE), the Clock-Drawing Test, the Timed Walking Test, the Nine-Hole Peg Test, the CERAD Battery and clinical tests.

The interview used had a semi-structured script, developed for the present evaluation that approached health conditions, life history, symptoms, sociodemographic data and complaints. The MMSE is a set of clinical tests that evaluates the basic functions of spatial and temporal orientation, memory and language, with cut-off points established according to schooling, namely 13 points for the illiterates, 18 for people with 1 to 7 years of study and 26 points for people with more than 8 years of study[11-12].

The Clock Drawing Test used was the correction adopted version, developed by Sunderland[13] and validated for the elderly population in Brazil[14]. It evaluates visuospatial perception, planning ability and operational memory, through the evocation and reproduction of an analog clock. The score ranges from 0 to 10 points, in which scores up to 5 points indicate deficits and between 6 and 10 points indicate normal performance.

The Timed Walking Test and the Nine-Hole Peg Test, adapted and validated for the Brazilian population[15], evaluate the ability to control the upper and lower limbs. The walk is performed in a straight section of 7.62 meters, lasting up to 10 seconds. Upper limb control is verified by the repetition of a task of withdrawal and placement of nine wooden pegs in a board, with each hand separately. Upper limb control is considered normal if tasks are performed with total time of up to 150 seconds.

The CERAD Battery, developed by Morris[16], was adapted for Brazilian reality in 2001[17], being composed of verbal fluency tests - Animals, Boston Naming Test, word lists (immediate recall, delayed recall and recognition) and construction ability test. Each subtest has a specific cutoff point, defined according to schooling, to differentiate normal results from deficits.

In the clinical tests, or tests for evaluating voluntary behavior, we considered: inhibitory control, grip, conflicting instructions and thought chaining.

The project was approved by the Research Ethics Committee of the Federal University of Triângulo Mineiro (Protocol 2663/2010). After such approval, the elderly was invited to voluntarily participate in the study. All the elderly in diagnostic investigation that attended the HC-UFTM during the second semester of 2016 were invited.

The invitation was made face-to-face by a member of the research team, directly to the elderly, during the waiting time for neurological consultation. At that moment, the elderly who agreed to participate in the research scheduled with the researcher a time for data collection.

The data collection took place in two meetings, with an average duration of two hours each. These meetings were held in the facilities of the HC-UFTM or in the home of the elderly, according to the patients' preference, at previously scheduled times. There were no elderly under guardianship in the sample, so the participants themselves were invited and those who agreed to participate signed the Informed Consent Form. After correcting the instruments, the team systematized the results in individual reports that were returned to the elderly and, with their authorization, made available to the neurologists who followed the cases.

Descriptive analyzes of percentage, central tendency and dispersion were carried out to characterize the sample and the cognitive and physical conditions of the elderly. Spearman's correlation analysis was also performed, considering a significance of 5% between the performances of the elderly and their schooling.

The correlation with schooling was based on the influence of the years of study on the educational level, demonstrated in previous studies[18] and the correlation between the different performances was made considering the findings on the interconnection of the cognitive aspects[19].

RESULTS

The elderly participants (35) were predominantly female (71.4%), aged between 61 and 86 years and mean age of 72.57 ± 7.30 years, illiterate or with low educational level (77.2%) according to Table 1.

Table 1. Elderly participants according to sex and schooling. Uberaba/MG, Brazil, 2016.

Variable	n	%
Sex		
Female	25	71.4
Male	10	28.6
Schooling		
Illiterates	15	42.9
0-3 years of study	12	34.3
4-8 years of study	03	8.6
9 or + years of study	05	14.3

In upper limb motor control, it was observed that 92.3% of the participants presented control for the dominant hand and 91.7% for the non-dominant hand in the Nine-Hole Peg Test. The grip behavior was considered normal for most of the sample (88.6%) and 64.6% of the subjects were able to reproduce the hand movements performed by the evaluator. On the skills assessed by the clinical tests, most of the elderly had preserved ability of praxis evocation (54.3%), but showed a deficit in constructional praxis (66.7%), according to Table 2.

Regarding lower limb control, the timed walking test showed an average of 10.39 ± 6.72 seconds, which is a longer time than the expected to indicate preservation of this function. In relative terms, only 26.7% of the respondents showed preserved ability to control the lower limbs. In the cases of deficit (73.3%), 20% had no coordination between hands and feet, 13.3% showed problems walking straight and 6.7% presented unsteady gait (Table 2).

In the cognitive evaluation, most participants showed a deficit in the MMSE (51.4%), the average score being 19.54 ± 7.54 points. Deficits in the ability for chaining thoughts, necessary to tell stories with beginning, middle and end in a coherent way, was observed in 54.2% (Table 2).

In the conflicting instructions test, 57.6% of the sample copied the examiner's beats on a solid surface more than twice, indicating deficits in sensitivity to the environment. As to verbal fluency, participants had the expected performance in 62.9% of the cases. But there was a deficit in the naming ability for the majority of the evaluated ones (80.0%) (Table 2).

Regarding the planning ability, visuospatial perception and operational memory, the clock drawing test revealed a deficit in 59.3% of the evaluated elderly. But by providing an external clue to perform the task, using the model drawn by the evaluator, the number of people with normal performance reached 65.5%. Regarding recall, there was preserved ability for immediate memory in 57.1% of respondents and for recognition in 60%. However, there was a deficit for the majority of those assessed in the late recall ability (68.6%) (Table 2).

Table 2. Elderly participants according to neuropsychological tests and relation between normal and deficit. Uberaba/MG, Brazil, 2016.

Variable		n	%
Mini-mental			
	Normal	17	48.6
	Deficit	18	51.4
Immediate Recall			
	Normal	20	57.1
	Deficit	15	42.9
Delayed recall			
	Normal	11	31.4
	Deficit	24	68.6
Recognition memory			
	Normal	21	60.0
	Deficit	14	40.0
Clock evocation			
	Normal	11	31.4
	Deficit	16	45.7
	Not evaluated	08	22.9
Clock Copy			
	Normal	19	54.3
	Deficit	10	28.6
	Not evaluated	06	17.1
Gait			
	Normal	22	62.9
	Deficit	08	22.9
	Not evaluated	05	14.3
Verbal fluency			
	Normal	22	62.9
	Deficit	13	37.1
Constructional praxis			
	Normal	10	28.6
	Deficit	23	66.7
	Not evaluated	02	5.7
Praxis evocation			
	Normal	19	54.3
	Deficit	16	45.7
Thought chaining			
	Normal	11	31.4
	Deficit	24	68.6
Naming			
	Normal	03	20.0
	Deficit	32	80.0
Nine-Hole Peg - dominant hand			
	Normal	24	68.6
	Deficit	02	5.7
	Not evaluated	09	25.7
Nine-Hole Peg - non-dominant hand			
	Normal	22	62.9
	Deficit	02	5.7
	Not evaluated	11	31.4

The analysis of the relationships between the variables showed that the individual characteristics interfered with the performance of the elderly in the cognitive tests. Participants with higher schooling had better performance on the clock evoking task (rho = 0.43, p ≤ 0.05), better performance in the naming test (rho = 0.52, p ≤0.001) and in the constructional praxis evocation (rho = 0.51, p ≤ 0.001). In addition, the classification of normal cognitive ability in the MMSE showed association with preservation of

immediate recall ability (rho = 0.49, p ≤ 0.001), recognition memory (rho = 0.44, p ≤ 0.001), verbal fluency (rho = 0.39, p ≤ 0.05), inhibitory control (rho = 0.38, p ≤ 0.05) and grip behavior (rho = - 0.34, p ≤ 0.05) (Table 3).

The results also showed the relationship between the cognitive abilities of the elderly. The elderly who had better performance in the task of evoking the clock test also showed better performance in the task of copying the clock test (rho = 0.58, p ≤ 0.001), in immediate recall (rho = 0.53, p ≤ 0.001) and delayed recall (rho = 0.42, p ≤ 0.05). People who obtained normal scores in the task of copying the clock test also had better performance on delayed recall (rho = 0.44, p ≤ 0.05), immediate recall (rho = 0.42, p ≤ 0.05), verbal fluency (rho = 0.45, p ≤ 0.05), praxis evocation (rho = 0.48, p ≤ 0.05), constructional praxis (rho = 0.52, p ≤ 0.001) and naming (rho = 0.37, p ≤ 0.001) (Table 3).

On the language ability, people with normal classification in the naming ability also showed normal classification on verbal fluency (rho = 0.38, p ≤ 0.05), praxis evocation (rho = 0.68, p ≤ 0.001), conflicting instructions (rho = 0.36, p ≤ 0.05), inhibitory control (rho = 0.50, p ≤ 0.001) and thought chaining (rho = 0.51, p ≤ 0.05). The classification of normality in the test of verbal fluency was associated to normality in the test of conflicting instructions (rho = 0.54, p <0.001), inhibitory control (rho = 0.45, p <0.001), thought chaining (rho = 0.59, p < 0.001), praxis evocation (rho = 0.45, p < 0.05) and control of the upper limbs when performing the test with their dominant hand (rho = 0.39, p <0.05) (Table 3).

In the relation between the aspects, people with indication of preserved immediate recall ability showed to also have a preserved delayed recall (rho = 0.46, p <0.05) and recognition (rho = 0.47, p <0.05) (Table 3).

Memory also showed relation with other functions. There was a correlation between the normal classification in the immediate recall test and the praxis evocation ability (rho = 0.53, p <0.05), naming (rho = 0.43, p <0.001), verbal fluency (rho = 0.65, p <0.001), thought chaining (rho = 0.51, p <0.001) and inhibitory control (rho = 0.40, p <0.05) (Table 3).

Long-term memory was related to praxis evocation (rho = 0.51, p <0.05) and verbal fluency (rho = 0.39, p <0.05), ability to deal with conflicting instructions (rho = 0.44, p <0.001) and grip ability (rho = 0.43, p <0.001), apart from the relationships already indicated with the performance in the clock test (Table 3).

Table 3. Elderly participants according to correlations between cognitive performance. Uberaba/MG, Brazil, 2016.

	School	Immediate recall	Delayed recall	Regognition	Clock Evoc.[1]	Clock Copy	MMSE	Gait	Fluence	Praxis	Praxis Evoc.	Thought	Naming	9-hole peg - dominant
School	1													
Immediate recall	-0.30	1												
Delayed recall	-0.18	0.46**	1											
Regognition	-0.08	0.47**	0.17	1										
Clock Evocation	-0.43*	0.53**	0.45*	0.10	1									
Clock Copy	-0.33	0.42*	0.44*	0.03	0.58**	1								
MMSE	-0.12	0.49**	0.20	0.44*	0.28	0.17	1							
Gait	-0.18	-0.03	-0.01	0.21	-0.15	-0.06	0.81	1						
Fluence	-0.18	0.64**	0.39*	0.33*	-0.37	0.45*	0.39*	0.21	1					
Praxis	-0.34	0.29	0.33	0.12	0.37	0.52**	0.11	0.13	0.22	1				
Praxis Evocation	-0.51**	0.24	0.25	-0.04	0.23	0.36	-0.14	0.00	0.12	-0.37*	1			
Thought	0.27	-0.53**	-0.23	-0.19	-0.11	-0.43	-0.19	-0.12	-0.59**	-0.41*	-0.19	1		
Naming	-0.50**	-0.43**	0.27	0.26	0.28	0.37*	0.22	0.30	0.38*	0.46*	0.31	-0.51*	1	
9-hole peg - dominant	-0.03	0.31	-0.15	0.36	0.16	0.26	0.31	0.17	0.39*	0.12	-0.06	-0.59**	0.14	1
9-hole peg – non-dominant	-0.26	0.35	0.17	0.10	0.24	0.38	0.05	-0.17	0.13	0.19	0.23	-0.19	0.15	0.69**

Notes: [1]Evoc. = Evocation. ** p < 0.001; * p ≤ 0.0

DISCUSSION

The results of the present study identified problems in memory ability and in other cognitive abilities in the evaluated elderly. They also showed relationships between performances in different tests. These correlations illustrate how the different cognitive aspects interact and must be considered in an integrated way for any diagnostic evaluation[3,6,18].

A previous study[20] investigated executive functions in the elderly and demonstrated that there is a relationship between cognitive components, particularly between working memory, information processing speed, long-term memory and fluid intelligence.

The major memory deficits were observed in long-term memory, which is not expected in early dementia. Short-term memory is generally affected in people with neurocognitive disorders, and long-term memory deficits can be perceived later[3,5].

The elderly had no established diagnosis. This served to raise new diagnostic hypotheses to explain their self-reported and measured symptoms. When presenting these results to the medical team, they requested for tests that had not been thought initially, such as vitamin B12 and D levels, evaluation of hypothyroidism and referral of some elderly people for evaluation of emotional status.

These evaluations are important because the lack of these vitamins, clinical conditions linked to the thyroid and unidentified pictures of depression, may affect memory performance[4]. Memory deficits are prerequisites for diagnosis of any dementia syndrome, but the identification of other cognitive dysfunctions and the level of impairment may aid in the differential diagnosis and in the identification of the stage of the pathology[4]. Early identification of dementia increases the effectiveness of interventions and contributes to the maintenance of functional independence for longer periods[9].

The initial cognitive screening was done through the MMSE. This is a screening test with sensitivity to identify only moderate or severe cases of cognitive impairment[21]. The evaluated elderly were relatively young (mean of 72.57 years), but coming from a population under investigation for dementia syndrome.

This particularity may help to understand why the majority of respondents showed impairment in this evaluation. In addition, most participants were illiterate or had low levels of education, which was associated with poorer performance in the tests. Previous studies[7-8,22] had already indicated that greater schooling influences the maintenance of cognitive functions in the elderly, as well as, that early schooling contributes in an important way to the creation of a cognitive reserve, which minimizes the impact of brain lesions[7,8,23,24].

When assessing language, fluency was preserved, but there was a lack of naming ability. These results show the importance of the reduction of vocabulary when evaluating cases of suspected dementia and its possible impact on the structuring of thought. The observed correlation between the naming results and the chain of thought corroborate the findings of another study[5], in which language deficits in people with mild and moderate dementia affected the thought processes.

In the clock test as a measure of visuospatial perception, operational memory and planning ability, the elderly's performance showed that their ability to spontaneously evoke these functions was already impaired, but could still be accessed through environmental clues. This pattern had already been described in another study[14]. On the other hand, the clock test was associated with performance in language and memory, again indicating the importance of considering cognitive abilities in an integrated way.

The comparison with the performance of the elderly of other regions showed a similar profile of sociodemographic characteristics and cognitive performance, showing a similar profile between the elderly living in Uberaba and other investigated in other areas.

CONCLUSION

The results observed in the elderly under diagnostic investigation for dementia syndromes showed preserved cognitive abilities, among them verbal fluency, visuospatial perception and operational memory with the help of external clues, immediate and recognition memory, as well as control of the upper limbs.

However, deficits that may contribute to diagnostic refinement have also been observed, such as difficulties for temporal and spatial orientation, long-term memory deficits, praxis, naming, visuospatial perception and work memory without assistance, sensitivity to environmental interference, and control of lower members. Cognitive performance was not independent, as there was a significant association between the different tasks evaluated.

The present study had limitations on the sample and only used cognitive screening tests. These conditions, adopted for being an initial study of the theme in the region, limit the generalization capacity of the findings and the identification of more subtle deficits.

Despite this, there was relevance when investigating cognitive functions in an integrated way and contribution of the neuropsychological evaluation for dementia diagnoses.

Future studies with larger samples and more sensitive tests may improve understanding of the cognitive conditions of the elderly in the city of Uberaba and contribute to more accurate and early neurological or psychiatric diagnoses.

REFERENCES

1. Instituto Brasileiro de Geografia e Estatística. Síntese de indicadores sociais: uma análise das condições de vida da população brasileira: 2016 [Internet]. Rio de Janeiro: IBGE; 2016 [cited in Dec 19, 2017]. Available from: https://biblioteca.ibge.gov.br/visualizacao/livros/liv98965.pdf
2. Veras R. Envelhecimento populacional contemporâneo: demandas, desafios e inovações. Rev Saúde Pública. 2009; 43(3):548-54.
3. Hamdan AC, Pereira APAM, Sá Riechi TIJ. Avaliação e reabilitação neuropsicológica: desenvolvimento histórico e perspectivas atuais. Interação Psicol. 2011; 15(Esp):47-58.
4. Associação Americana de Psiquiatria. DSM-5: manual diagnóstico e estatístico de transtornos mentais. Porto Alegre: Artmed; 2014.
5. Koehler C, Gindri G, Bós AJG, Mancopes R. Alterações de linguagem em pacientes idosos portadores de demência avaliados com a Bateria MAC. Rev Soc Bras Fonoaudiol. 2012; 17(1):15-22.
6. Nascimento ERN, Barbosa MA, Brasil VV, Sousa ALL, Amaral GF, Jácomo PJ. Qualidade de vida de quem cuida de portadores de demência com corpos Lewy. J Bras Psiquiatr. 2013; 62(2):144-52.
7. Burlá C, Camarano AA, Kanso S, Fernandes D, Nunes R. Panorama prospectivo das demências no Brasil: um enfoque demográfico. Ciênc Saúde Coletiva. 2013; 18(10):2949-56.
8. Sobral M, Pestana MH, Paúl C. Cognitive reserve and the severity of Alzheimer's disease. Arq Neuropsiquiatr. [Internet]. 2015 [cited in Dec 22, 2017]; 73(6):480-6. doi: http://dx.doi.org/10.1590/0004-282X20150044
9. Sobral M, Paúl C. Reserva cognitiva, envelhecimento e demências. RevE-Psi. [Internet]. 2015 [cited in Dec 22, 2017]; 5(1):113-34. Available from: https://revistaepsi.com/wp-content/uploads/artigos/2015/Ano5-Volume1-Artigo6.pdf
10. Caixeta L, Peleja AC, Barros N. Doença de alzheimer: contribuições neuropsicológicas para o diagnóstico precoce. In: Caixeta L, Ferreira SB. Manual de neuropsicologia: dos princípios à reabilitação. Belo Horizonte: Atheneu; 2012. p. 235-250.
11. Gondim AS, Coelho Filho JM, Cavalcanti AA, Roriz Filho JS, Nogueira CB, Peixoto Junior AA, et al. Prevalence of functional cognitive impairment and associated factors in Brazilian community-dwelling older adults. Dement neuropsychol. [Internet]. 2017 [cited in Dec 22, 2017]; 11(1):32-9. DOI: http://dx.doi.org/10.1590/1980-57642016dn11-010006

12. Brucki SM, Campacci SR, Juliani Y. The mini-mental state examination in a general population: impact of educational status. Arq Neuropsiquiatr. [Internet]. 1994 [cited in Dec 22, 2017]; 52(1):1-7. DOI: http://dx.doi.org/10.1590/S0004-282X1994000100001

13. Lourenço RA, Veras RP. Mini-exame do estado mental: características psicométricas em idosos ambulatoriais. Rev Saúde Pública. [Internet]. 2006 [cited in Dec 22, 2017]; 40(4):712-9. DOI: http://dx.doi.org/10.1590/S0034-89102006000500023

14. Sunderland T, Hill JL, Mellow AM, Lawlor BA, Gundersheimer J, Newhouse PA, et al. Clock drawing in Alzheimer's disease: a novel measure of dementia severity. J Am Geriatr Soc. [Internet]. 1989 [cited in Dec 22, 2017]; 37(8):725-9. doi: http://dx.doi.org/10.1111/j.1532-5415.1989.tb02233.x

15. Atalaia-Silva KC, Lourenço RA. Tradução, adaptação e validação de construto do Teste do Relógio aplicado entre idosos no Brasil. Rev Saúde Pública. [Internet]. 2008 [cited in Dec 22, 2017]; 42(5):930-7. DOI: http://dx.doi.org/10.1590/S0034-89102008000500020

16. Tilbery CP, Mendes MF, Thomaz RB, Oliveira BES, Kelian GL, Busch R, et al. Padronização da multiplesclerosis functional composite measure (MSFC) na população brasileira. Arq Neuropsiquiatr. [Internet]. 2005 [cited in Dec 22, 2017]; 63(1):127-32. DOI: http://dx.doi.org/10.1590/S0004-282X2005000100023

17. Morris JC, Heyman A, Mohs RC, Hughes JP, van Belle G, Fillenbaum G, et al. The consortium to establish a registry for Alzheimer's disease (CERAD). Part I. Clinical and neuropsychological assessment of Alzheimer's disease. Neurology. 1989; 39(9):1159-65.

18. Steibel NM, Olchik MR, Yassuda MS, Finger G, Gomes I. Influence of age and educationon the River mead Behavioral Memory Test (RBMT) among healthy elderly. Dement Neuropsychol. [Internet]. 2016 [cited in Dec 19, 2017]; 10(1):26-30. Available from:

http://www.scielo.br/pdf/dn/v10n1/1980-5764-dn-10-01-00026.pdf

19. Mecca TP, Jana TA, Simões MR, Macedo EC. Relação entre habilidades cognitivas não-verbais e variáveis presentes no contexto educacional. Psicol Esc Educ. [Internet]. 2015 [cited in Dec 22, 2017]; 19(2):329-39. DOI: http://dx.doi.org/10.1590/2175-3539/2015/0192844

20. Bertolucci PHF, Okamoto IH, Brucki SMD, Siviero MO, Toniolo Neto J, Ramos LR. Applicability of the CERAD neuropsychological battery to brazilian elderly. Arq Neuropsiquiatr. [Internet]. 2001 [cited in Dec 22, 2017]; 59(3A):532-6. DOI: http://dx.doi.org/10.1590/S0004-282X2001000400009

21. Studart Neto A, Nitrini R. Subjective cognitive decline: the first clinical manifestation of Alzheimer's disease? Dement neuropsychol. [Internet]. 2016 [cited in Dec 22, 2017]; 10(3):170-7. DOI: http://dx.doi.org/10.1590/S1980-5764-2016DN1003002

22. Mota MMPE, Banhato EFC, Silva KCA, Cupertino APFB. Triagem cognitiva: comparações entre o mini-mental e o teste de trilhas. Estud Psicol. [Internet]. 2008 [cited in Dec 22, 2017]; 25(3):353-9. DOI: http://dx.doi.org/10.1590/S0103-166X2008000300004

23. Coelho CLM, Bastos CL, Camara FP, Landeira-Fernandes J. A influência do gênero e da escolaridade no diagnóstico de demência. Estud Psicol. [Internet]. 2010 [cited in Dec 22, 2017]; 27(4):449-56. DOI: http://dx.doi.org/10.1590/S0103-166X2010000400003

24. Stern Y. Cognitive reserve: implications for assessment and intervention. Folia Phoniatr Logop. [Internet]. 2013 [cited in Dec 22, 2017]; 65(2):49-54. DOI: https://doi.org/10.1159/000353443

CONTRIBUTIONS
Sabrina Martins Barroso contributed to the project design, data analysis and writing. **Raphaela Campos de Sousa** worked in data collection, database design and writing.