

Normative data of Fuld Object Memory Evaluation test for Brazilian elderly population

Dados normativos do teste Fuld Object Memory Evaluation para a população de idosos brasileiros

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ABSTRACT

Objective: This study aims to present normative data for Fuld Object Memory Evaluation test stratified by sex, gender, age, and education for the Brazilian elderly population. **Method:** We evaluated 2.132 healthy elderly both genders, with a mean age of 70.30 years (\pm 7.28) from two community-based samples in Brazil drawn from different economic areas who were screened with cognitive and functional tests and the memory test. Statistical analyses were performed by independent t-test, one-way analysis of variance and multiple linear regression. **Results:** Statistical analyses showed that memory scores tend to improve significantly with increasing years of education and decrease significantly as age increased. **Conclusion:** We conclude that gender, education and age had effect on the Fuld Object Memory Evaluation performance in this Brazilian community-based sample.

Keywords: cognition, neuropsychological tests, dementia, long term memory, episodic memory, mild cognitive impairment.

RESUMO

Objetivo: Este estudo tem como objetivo apresentar dados normativos para o teste de Fuld Object Memory Evaluation estratificada por sexo, idade e educação para a população idosa brasileira. **Método:** Foram avaliados 2.132 idosos saudáveis de ambos os sexos com idade média de 70,30 anos (\pm 7,28) a partir de duas amostras de base comunitária no Brasil provenientes de diferentes áreas econômicas que foram selecionados com testes cognitivos e funcionais e o teste de memória. **Resultados:** As análises estatísticas mostraram que os escores de memória tendem a melhorar significativamente com o aumento de anos de educação e diminuir significativamente o aumento da idade. **Conclusão:** Conclui-se que gênero, escolaridade e idade tem efeito sobre o desempenho no teste Fuld Object Memory Evaluation nesta amostra da comunidade brasileira.

Palavras-chave: cognição, teste neuropsicológico, demência, memória de longo prazo, memória episódica, comprometimento cognitivo leve.

One of the most frequent and substantial complaints regarding cognition in the older population is related to changes in memory. Deficits in memory tests, especially in episodic long-term memory, have the highest sensibility for the neuropsychological diagnosis of dementia¹ and amnesic mild cognitive impairment (MCI).

The greatest difficulties in assessing the memory of older subjects regarding the clinical diagnosis of dementia or MCI occur when the subjects evaluated are illiterate, have minimal formal education, or already have significant memory deficits. A flexible and beneficial instrument to assess memory would provide a better ability to aid in the early diagnosis of dementia, especially if the instrument is not very long or difficult and has instructions that are easy to understand.

The Fuld Object Memory Evaluation (FOME)^{2,3} is an instrument that assesses learning and memory and incorporates selective-reminding procedures. It has been incorporated in dementia research in different countries in populations with different durations of formal education as a measure of overall recall because it has simple instructions and seems easier to the patients because they touch and see the objects that must be memorised, and the objects are very simple and well known^{4,5,6,7,8}.

In an interesting study, FOME was one of the 4 instruments used in a combination of cognitive tests and informant reports of dementia screening in low educated older people. The combination of these 4 instruments, FOME, Mini-Mental State Examination (MMSE), Informant Questionnaire of

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Cognitive Decline (IQCODE) and Bayer-Activities of Daily Living Scale (B-ADL); with the mixed rule correctly classified 100% and the logistic regression classified 95.7% of a Brazilian sample subjects. This combination proved useful to improve the screening of mild to moderate dementia in low educated older people⁹.

The objective of the present study was to provide normative data on the FOME test for the Brazilian elderly population and to investigate the influence of education, age and sex on episodic memory performance. Our hypothesis was that subjects who had less education would perform worse than those who had more years of education, younger subjects would perform better than older subjects, and sex would have no effect on performance.

METHOD

The normative sample consisted of 2,132 older subjects with normal cognitive performance selected as part of a two-phase epidemiological study to investigate the prevalence of dementia in a community-based sample in Sao Paulo and Ribeirao Preto, Brazil. Data for this study were select between 2002 and 2003¹⁰.

Sample selection

According to the Brazilian Institute of Geography and Statistics (IBGE) in 2000, São Paulo is the largest city in Brazil, and the city's population is 10,426,384, of whom 9.3% are 60 years old or older. Ribeirao Preto is a city in southeastern Brazil with a population of approximately 500,000, and 10.1% of the population is aged sixty years and older.

A clustered random sampling of a population of individuals aged 60 years old and older from three different socioeconomic classes (upper, middle and low) was used, following official census data^{11,12}. This strategy aimed to evaluate a sample containing city districts that represent the area universe context of elderly individuals living in Sao Paulo and Ribeirao Preto. Initially, the 96 city districts were ranked from the wealthiest to the poorest according to data from the 2000 Census, provided by IBGE. The following parameters were applied: income, education, proportion of elderly living in each district and sanitation. Subsequently, the districts were divided into three groups, and a district that was representative of each socioeconomic stratum was chosen to represent the upper, middle and lower group.

In Sao Paulo, those three selected districts (upper, middle and lower class) had 17,186; 17,738 and 14,443 elderly individuals, respectively. Then, blocks of 10 homes were randomly chosen in each of the 90 selected census sectors. Following local media (newspaper, radio, television) and mail advertisement, a trained team started a systematic door-knocking survey, visiting 8,042 homes to find elderly subjects. After the identification of elderly subjects, a sample of 2,233 subjects

older than 60 years of age was approached in the community, and a total of 1,563 subjects who agreed to be visited by a trained interviewer (response rate = 70%) were assessed. The interviewers tried at least three times to evaluate the elderly subjects at home before they were considered to have refused. The socio-demographic characteristics of the sample assessed at home have been presented in greater detail recently¹³, but the mean age was 71.4 years (60 to 102; SD = 8.03), 68.7% were female, 16.6% were illiterate, and 71.0% had up to 8 years of education.

In Ribeirao Preto, a sample of 1,828 subjects were approached, of whom 1,145 agreed to participate (683 subjects refused to participate; rate of attrition: 37.3%). The sample came from three socio-economic levels in the following fashion: upper class: 369 subjects (32.2% of the total sample); middle class: 439 subjects (38.3%); lower class: 332 subjects (29%); data were missing for five subjects.

The sample had a mean age of 70.9 years (60 to 100; SD = 7.7), 63.4% were female, 10.1% were illiterate, and 62.2% had up to 8 years of education¹⁴.

In the first phase of this study, subjects were screened for dementia with a combination of cognitive tests and functional scales: the MMSE¹⁵, the Brazilian version of the FOME and a semantic verbal fluency examination were administered to the patients. The IQCODE¹⁶ and the B-ADL¹⁷ were also administered to the informants. Depressive symptoms were evaluated with a 10-item instrument, the D-10 (scores from 0 to 10), which contains questions related to the presence of depressive symptoms most of the time during the past 2 weeks¹⁸.

The following instruments were also used: socio-demographic questionnaire and socioeconomic classification scale (allowing five levels of classification). Data were obtained directly from the cognitively intact elderly subjects and/or from an informant, who was usually a close relative, when the subject was cognitively impaired. Data were collected at the participants' homes between July, 2002 and August, 2003.

All individuals with positive screenings for dementia and depression and a random sample of negative screenings were invited for the second phase, where clinical evaluation and diagnosis were achieved by the consensus of at least two physicians and consistency with the DSM-IV (American Psychiatric Association, 1994)¹⁹ criteria for psychiatric diagnosis.

All subjects considered negative after screenings in the community phase and all subjects evaluated in the second phase who were considered free of psychiatric diagnoses were considered for the present investigation. Moreover, to guarantee the inclusion of normal cognitive subjects, we excluded subjects with a MMSE ≤ 18 ^{20,21} and IQCODE ≤ 3.37 ²², resulting in a sample of 2,132 elderly subjects. This sample was then stratified for education, age and sex. Education was categorized into four groups: no formal education, 1 to 4 years of formal education, 5 to 8 years, and 9 and above

years of formal education. Age was divided into three groups: 60 to 69, 70 to 79, and above 80 years of age.

The investigation was approved by the local ethics committee, and all of the subjects agreed to participate in the study by signing the informed consent.

Fuld Object Memory Evaluation

The FOME is an instrument used to evaluate several components of learning and memory in elderly people, and it also provides information about tactile recognition, right-left discrimination, and verbal fluency. Ten common objects in a bag (ball, button, matchbox, pacifiers, spoon, toothbrush, pencil, comb, catch, cup) are presented to the subjects to determine whether he can identify objects by touch, alternating systematically right and left hand. The patient name each object and then pulls it out of the bag to see if he was right. After conducting a distracting task by asking the patient to say words rapidly from a semantic category, "things that make people happy" (1 minute), the subject is asked to recall the items from the bag. After each recall, he is slowly and clearly reminded verbally of each item omitted in that trial, for a total of 5 trials. A 30-sec rapid semantic retrieval trail comes after each learning trail as a distractor for the next recall trial. The categories for these distractor trials are respectively, "animals", "fruits", "food", "give name" (same sex as the patient) and "things that make people sad". After a 15 minutes interval filled by other tests, an unexpected final recall is requested. Then, a multiple choice recognition task is elicited only for those items not recalled.

The Brazilian version of the test uses all the same semantic categories of the original version, with the exception of "vegetables", which was changed to "fruits". In the original version the ten objects in the bag are; ball, bottle, button, card, cup, key, matches, nail, ring, scissors, that were changed by the previously listed objects.

The data collected during the test are classified as follows: *Immediate retrieval* is determined by the total sum of items remembered in all trials; the *storage efficiency* is determined by the number of different items recalled over the 5 trials and the *retrieval efficiency* is determined by the total number of items recalled in successive trails without any reminding. *Delayed recall* is the number of items remembered spontaneously after an interval.

Statistical analysis

The statistical analysis was based on the crude means and standard deviations (SD) of the FOME scores and on the frequencies and percentages of socio-demographic variables. The comparisons of FOME performance by sex was carried out by independent t-test and the comparison by age and educational level were carried out by one-way Analysis of Variance (ANOVA) followed by Tukey's post-hoc tests. Normality of distribution was verified using the Kolmogorov-Smirnov test.

The factors associated with memory score were analysed by multiple linear regression models with FOME score as dependent variable and education, age and sex as independent variables. The initial multivariate model included all variables and its interactions. In the final model, only those variables/interactions that maintained an association with FOME score at a level of 0.05 or less were retained. Same significance level of $\alpha = 0.05$ was used for all other comparisons, and the statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) for Windows, version 14.0.

RESULTS

For descriptive purposes, years of education were divided into four groups, and age was divided into three age ranges.

Table 1 shows the socio-demographic characteristics of the sample.

Table 2 shows the mean and standard deviation (SD) of the FOME scores, immediate total recall, delayed recall, recognition and verbal fluency scores between sex. In general, females presented higher scores (except in verbal fluency animal and sad, and recognition).

Table 3 shows the mean and SD of the FOME scores, immediate total recall, delayed recall, recognition and verbal fluency scores in the three different age groups. The FOME score decreased with advancing age with statistical significance (except in recognition).

Table 4 shows mean and SD for the FOME scores, immediate total recall, delayed recall, recognition and verbal fluency scores in the three different education levels. Data show that FOME scores increased with increasing years of education with statistical significance.

Table 5 shows the percentiles of the FOMES's immediate and delayed recall performance by age and by education level.

To identify the simultaneous effect of education, age and sex on the FOME scores, a multiple linear regression analysis was performed and is displayed in Table 6.

The reference groups of women (sex), younger individuals (age) and participants with higher education levels (education) were considered to provide better clinical interpretation and all these three variables presented significant influence on the FOME score.

It was observed that the variables age and education presented significant interaction ($p = 0.03$). However, there were no significant interactions of these variables with sex ($p > 0.05$).

DISCUSSION

We analysed the performance of a Brazilian community-based sample of older subjects drawn from two Brazilian cities on the FOME test. The main finding of the present study is that the FOME test is influenced by education, age and sex.

Table 1. Socio-demographic and clinical characteristics of the sample.

	Frequency (%)	Mean (SD)	Range (min; max)
Education (years)			
Illiteracy	213 (10.0)		
1-4	880 (41.3)		
5-8	260 (12.2)		
≥ 9	779 (36.5)		
Age (years)			
60-69	1,069 (50.1)		
70-79	797 (37.4)		
≥ 80	257 (12.1)		
Sex			
Male	726 (34.1)		
Female	1,406 (65.9)		
MMSE		26.48 (3.26)	(18; 50)
IQCODE		3.03 (0.26)	(1; 3.37)
BADL		1.68 (1.22)	(0.92; 24)
Total	2,132		

SD: Standard Deviation; MMSE: Mini-Mental State Examination; IQCODE: Informant Questionnaire of Cognitive Decline and BADL: Bayer-Activities of Daily Living Scale.

Age and education are variables known to affect cognitive performance, so the influence of these two variables on the FOME score is not surprising. Generally, aging affects fluid intelligence, including episodic memory²³, and the influence of education on cognition is already well documented in the literature²⁴.

Our results regarding memory are in accordance with previous findings from Brazilian studies, which also showed the influence of education and age on episodic memory tests. One study that assessed verbal episodic memory in a sample of older adults documented significant differences between literate and illiterate subjects²⁵. Another study that assessed verbal and visual episodic memory in a sample of the Brazilian population found that age and years of education had a significant influence on the tests results. However, no significant influence of sex was observed²⁶. The same influence was documented in the normative data of the word list test with a health elderly sample, but again, no influence of sex was reported²⁷.

Table 2. Mean, standard deviation (SD) and p-values comparing FOME performance between sex.

	Male Mean (SD)	Female Mean (SD)	Total Mean (SD)	p*
Immediate retrieval	37.43 (6.82)	39.40 (6.50)	38.73 (6.68)	< 0.001
Verbal fluency 1 – happy	4.26 (1.85)	4.53 (1.98)	4.45 (1.94)	0.002
Verbal fluency 2 – animal	11.30 (3.65)	11.09 (3.69)	11.16 (3.68)	0.199
Verbal fluency 3 – fruits	8.40 (1.89)	8.84 (2.00)	8.69 (1.97)	< 0.001
Verbal fluency 4 – names	8.50 (2.40)	8.82 (2.45)	8.70 (2.43)	0.005
Verbal Fluency 5 – sad	3.92 (1.76)	4.08 (1.88)	4.02 (1.84)	0.059
Delayed recall	8.06 (1.66)	8.55 (1.60)	8.38 (1.64)	< 0.001
Recognition	9.86 (0.82)	9.94 (0.41)	9.92 (0.54)	0.013

* independent t-test. FOME: Fuld Object Memory Evaluation.

Table 3. Mean, standard deviation (SD) and p-values comparing FOME performance between age categories.

	60-69 Mean (SD)	70-79 Mean (SD)	≥ 80 Mean (SD)	Total Mean (SD)	p*
Immediate retrieval	40.10 ^a (5.99)	38.13 ^b (6.61)	34.84 ^c (7.79)	38.73(6.68)	< 0.001
Verbal fluency 1 – happy	4.55 ^a (1.99)	4.39 ^{ab} (1.91)	4.20 ^b (1.82)	4.45 (1.94)	0.017
Verbal fluency 2 – animal	11.55 ^a (3.94)	10.87 ^b (3.35)	10.44 ^b (3.28)	11.16 (3.68)	< 0.001
Verbal fluency 3 – fruits	8.84 ^a (1.91)	8.63 ^a (1.93)	8.26 ^b (2.24)	8.69 (1.97)	< 0.001
Verbal fluency 4 – names	8.96 ^a (2.42)	8.59 ^b (2.40)	8.00 ^c (2.43)	8.70 (2.43)	< 0.001
Verbal Fluency 5 – sad	4.08 ^a (1.80)	3.95 ^a (1.92)	4.00 ^a (1.73)	4.02 (1.84)	0.294
Delayed recall	8.66 ^a (1.45)	8.24 ^b (1.68)	7.70 ^c (1.96)	8.38 (1.64)	< 0.001
Recognition	9.93 ^a (0.53)	9.91 ^a (0.63)	9.85 ^a (0.63)	9.92 (0.54)	0.114

* One-way Analysis of Variance with Tukey post-hoc. Groups with same superscript letter are not significantly different (p > 0.05). FOME: Fuld Object Memory Evaluation.

Table 4. Mean, standard deviation (SD) and p-values comparing FOME performance between education categories.

	0 Mean (SD)	1-4 Mean (SD)	5-8 Mean (SD)	≥ 9 Mean (SD)	Total Mean (SD)	p*
Immediate retrieval	36.67 ^a (6.80)	37.83 ^a (6.37)	39.22 ^b (6.84)	40.14 ^a (6.61)	38.73 (6.67)	< 0.001
Verbal fluency 1 – happy	3.59 ^a (1.45)	3.94 ^a (1.63)	4.65 ^b (1.93)	5.17 ^c (2.12)	4.45 (1.94)	< 0.001
Verbal fluency 2 – animal	9.47 ^a (2.82)	9.91 ^a (3.01)	11.73 ^b (3.50)	12.84 ^c (3.88)	11.16 (3.68)	< 0.001
Verbal fluency 3 – fruits	7.56 ^a (1.73)	8.19 ^b (1.78)	9.21 ^c (2.15)	9.39 ^c (1.87)	8.69 (1.97)	< 0.001
Verbal fluency 4 – names	7.50 ^a (2.14)	8.09 ^b (2.21)	9.15 ^c (2.56)	9.58 ^c (2.37)	8.70 (2.43)	< 0.001
Verbal Fluency 5 – sad	3.09 ^a (1.34)	3.51 ^b (1.63)	4.26 ^c (1.67)	4.76 ^d (1.94)	4.02 (1.84)	< 0.001
Delayed recall	7.98 ^a (1.77)	8.18 ^a (1.56)	8.50 ^b (1.66)	8.69 ^b (1.63)	8.38 (1.64)	< 0.001
Recognition	9.91 ^a (0.47)	9.93 ^a (0.51)	9.95 ^a (0.37)	9.89 ^a (0.73)	9.92 (0.54)	0.470

* One-way Analysis of Variance with Tukey post-hoc. Groups with same superscript letter are not significantly different (p > 0.05). FOME: Fuld Object Memory Evaluation.

Table 5. Derived scores for each normative group on the FOME immediate retrieval and delayed retrieval.

Immediate retrieval												
Percentile Scores	Age 60-69				Age 70-79				Age ≥ 80			
	Education (years)				Education (years)				Education (years)			
	illiteracy	1-4	5-8	≥ 9	illiteracy	1-4	5-8	≥ 9	illiteracy	1-4	5-8	≥ 9
	n = 89	n = 445	n = 127	n = 165	n = 96	n = 331	n = 98	n = 118	n = 26	n = 97	n = 34	n = 36
90	45.00	46.00	47.00	47.00	44.00	45.00	46.00	47.00	43.00	43.20	43.00	46.60
75	44.00	43.00	45.00	45.00	41.00	42.00	44.00	44.00	39.25	40.50	40.25	43.75
50	39.00	40.00	42.00	42.00	36.00	38.00	40.50	40.00	35.50	36.00	36.00	41.00
25	35.00	35.00	38.00	38.50	32.00	33.00	36.00	35.00	29.50	29.50	27.75	35.50
10	29.00	31.00	31.80	34.60	27.00	29.00	31.00	29.00	25.40	23.80	22.00	25.70

Delayed retrieval recall												
Percentile Scores	Age 60-69				Age 70-79				Age ≥ 80			
	Education (years)				Education (years)				Education (years)			
	illiteracy	1-4	5-8	≥ 9	illiteracy	1-4	5-8	≥ 9	illiteracy	1-4	5-8	≥ 9
	n = 87	n = 439	n = 123	n = 163	n = 95	n = 333	n = 97	n = 117	n = 24	n = 96	n = 34	n = 36
90	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
75	10.00	10.00	10.00	10.00	9.00	9.00	10.00	10.00	10.00	9.00	9.00	9.75
50	9.00	9.00	9.00	9.00	8.00	8.00	9.00	9.00	8.00	8.00	8.00	8.50
25	7.00	8.00	8.00	8.00	7.00	7.00	7.00	8.00	7.00	7.00	6.00	7.00
10	6.00	6.00	7.00	7.00	5.60	6.00	7.00	6.00	5.50	5.00	4.5.	4.70

FOME: Fuld Object Memory Evaluation.

Table 6. Final results of the multiple linear regression of socio-demographic variables associated to FOME score.

Socio-demographic variables	Beta value	Std. Error	95%CI	p-value
Intercept	9.261	0.101	(9.064; 9.458)	< 0.001
Education (years)				<0.001
No formal education	- 0.753	0.225	(-1.195; -0.311)	0.001
1-4	- 0.625	0.135	(- 0.891; -0.360)	< 0.001
5-8	- 0.485	0.198	(-0.873; -0.096)	0.014
≥ 9	0			
Age (years)				< 0.001
60-69	0			
70-79	- 0.478	0.161	(-0.783; -0.162)	0.003
≥ 80	- 1.473	0.218	(-1.901; -1.045)	< 0.001
Sex				< 0.001
Male	-0.655	0.162	(-0.971; -0.338)	< 0.001
Female	0			
Age * Education				0.030
Age ≥ 80 * education 0	0.840	0.493	(-0.127; 1.807)	0.088
Age ≥ 80 * education 1-4	0.780	0.303	(0.186; 1.374)	0.010
Age ≥ 80 * education 5-8	0.549	0.410	(-0.256; 1.354)	0.181
Age ≥ 80 * education ≥ 9	0			
Age 70-79 * education 0	-0.273	0.319	(-0.899; 0.353)	0.392
Age 70-79 * education 1-4	0.055	0.213	(-0.363; 0.472)	0.797
Age 70-79 * education 5-8	0.378	0.302	(0.215; 0.971)	0.212
Age 70-79 * education ≥ 9	0			
Age 60-69 * education 0	0			
Age 60-69 * education 1-4	0			
Age 60-69 * education 5-8	0			
Age 60-69 * education ≥ 9	0			

In each variable, the category with Beta = 0 indicates the reference category. Sex did not present significant interactions with sex and education. FOME: Fuld Object Memory Evaluation.

Brazilian data indicate that education has no influence on the FOME exit score, and these data might be explained by sample characteristics, such as smaller sizes and less heterogeneity regarding education attainment compared to the present community-based sample^{28,29}. Regarding the influence of sex on the episode memory test, this result was not expected based on results reported in the literature^{26,29}.

Therefore, although the statistical analysis indicated that education influenced FOME scores, the FOME remains suitable for use in older people with lower levels of education. Another reason supporting its use is that it is a memory test during which even very elderly patients with significant memory problems and individuals with very low formal education typically do not complain or show anxiety. On the contrary, they enjoy the test. A different reaction is frequently observed for word list tests, in that patients sometimes refuse to perform them.

Our results corroborate a previous study, which showed that the FOME was a good test for assessing older people

with few years of schooling³⁰. Another study in China found influences of age and education on the FOME performance but less influence of sex in the older population³¹.

The normative data are relevant due to the limited availability of memory tests standardised for the Brazilian population; moreover, the data presented can help clinicians to better interpret immediate and delayed scores on episodic memory tests in older Brazilians with varying degrees of education from community-based or primary care samples. Our results also support the notion that clinicians should carefully analyse the memory test performance in low-education elderly populations with memory complaints.

In conclusion, data presented here can help clinicians to better diagnosis Brazilian elderly with memory problems.

There is a limitation of this study, some classifications that the FOME test can provide, storage and retrieval efficiency, could not be analysed in these study because on the time of the data collect, these classifications were not tabulated.

References

1. Bondi MW, Salmon DP, Galasko D, Thomas RG, Thai LJ. Neuropsychological function and apolipoprotein E genotype in the preclinical detection of Alzheimer's disease. *Psychol Aging*. 1999;14(2):295-303. doi:10.1037/0882-7974.14.2.295
2. Fuld PA. Guaranteed stimulus-processing in the evaluation of the memory and learning. *Cortex*. 1980;16:255-71. doi:10.1016/S0010-9452(80)80061-X
3. Fuld PA, Masur DM, Blau AD, Crystal H, Aronson MK. Object-memory evaluation for prospective detection of dementia in normal functioning elderly: predictive and normative data. *J Clin Exp Neuropsychol*. 1990;12(4):520-28. doi:10.1080/01688639008400998
4. LaRue A, Romero LJ, Ortiz IE, Lang HC, Linderman RD. Neuropsychological performance of Hispanic and non-Hispanic older adults: an epidemiological survey. *Clin Neuropsychol*. 1999;13(4):474-86. doi:10.1076/1385-4046(199911)13:04;1-Y;FT474
5. Loewenstein DA, Duara R, Arguelles T, Arguelles S. Use of Fuld Object Memory Evaluation in the detection of mild dementia among Spanish and English speaking groups. *Am J Geriatr Psychiatry*. 1995;3(4):300-7.
6. Marcopulos BA, Gripshover DL, Broshek DK, McLain CA, Brashear HR. Neuropsychological assessment of psychogeriatric patients with limited education. *Clin Neuropsychol*. 1999;13(2):147-56. doi:10.1076/clin.13.2.147.1968
7. Mast BT, Allaire JC. Verbal learning and everyday functional in dementia: an application of latent variable growth curve modeling. *Gerontol*. 2004;61B(3):P167-73. doi:10.1093/geronb/61.3.P167
8. Masur DM, Sliwinski M, Lipton RB, Blau AD, Crystal HA. Neuropsychological prediction of dementia and the absence of dementia in healthy elderly persons. *Neurology*. 1994;44(8):1427-32. doi:10.1212/WNL.44.8.1427
9. Bottino CMC, Zevallos-Bustamante SE, Lopes MA, Azevedo D, Hototian SR, Jacob-Filho W et al. Combined instruments for the screening of dementia in older people with low education. *Arq. Neuropsiquiatr*. 2009;67(2A):185-90. doi:10.1590/S0004-282X2009000200003
10. Lopes MA, Ferrioli E, Nakano EY, Litvock J, Bottino CM. High prevalence of dementia in a community-based survey of older people from Brazil: association with intellectual activity rather than education. *J Alzheimers Dis*. 2012;32(2):307-16. doi:0.3233/JAD-2012-120847.
11. Instituto Brasileiro de Geografia e Estatística. Censos demográficos 1991. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 1992.
12. Instituto Brasileiro de Geografia e Estatística. Contagem populacional de 1996. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 1997.
13. Hototian SR, Lopes MA, Azevedo JD, Tatsch M, Bazzarella MC, Bustamante SE et al. Prevalence of cognitive and functional impairment in a community sample from São Paulo, Brazil. *Dement Geriatr Cogn Disord*. 2008;25(2):135-43. doi:10.1159/000112554
14. Lopes MA, Hototian SR, Bustamante SE, Azevedo D, Tatsch M, Bazzarella MC et al. Prevalence of cognitive and functional impairment in a community sample in Ribeirão Preto, Brazil. *Int J Geriatr Psychiatry*. 2007;22(8):770-6. doi:10.1002/gps.1737
15. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12(3):189-98. doi:10.1016/0022-3956(75)90026-6
16. Jorm AF, Jacomb PA. The Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE): socio-demographic correlates, reliability, validity and some norms. *Psychol Med*. 1989;19(4):1015-22. doi:10.1017/S0033291700005742
17. Folquitto JC, Bustamante SE, Barros SB, Azevedo D, Lopes MA, Hototian SR et al. The Bayer: activities of daily living scale (B-ADL) in the differentiation between mild to moderate dementia and normal aging. *Rev Bras Psiquiatr*. 2007;29(4):350-3. doi:10.1590/S1516-44462006005000037
18. Barcelos-Ferreira R, Pinto Jr JA, Nakano EY, Steffens DC, Litvock J, Bottino CM. Clinically significant depressive symptoms and associated factors in a community sample of elderly subjects from São Paulo, Brazil. *Am J Geriatr Psychiatry*. 2009;17:582-90. doi:10.1097/JGP.0b013e3181a76ddc

19. American Psychiatry Association. Diagnostic and statistical manual of mental disorders, 4th ed. Washington, DC: American Psychiatry Association; 2000.
20. Bertolucci PHF, Brucki SMD, Campacci SR, Juliano Y. [The Mini-Mental State Examination in a general population: impact of education status]. *Arq Neuropsiquiatr*. 1994;52:1-7. Portuguese. doi:10.1590/S0004-282X1994000100001
21. Laks J, Baptista EMR, Contino ALB, Paula EO, Engelhardt E. Mini-Mental Examination norms in a community-dwelling sample of elderly with low schooling in Brazil. *Cad Saúde Pública*. 2007;23(2):315-9. doi:10.1590/S0102-311X2007000200007
22. Perroco TR, Zevallos SEB, Moreno MPQ, Hototian SR, Lopes MA, Azevedo D et al. Performance of Brazilian long short IQcode on the screening of dementia in elderly people with low education.. *Int Psychogeriatr*. 2009;21(3):531-8. doi:10.1017/S1041610209008849
23. Horn JL, Cattell RB. Age differences in fluid and crystallized intelligence. *Acta Psychol*. 1967;26(2):107-29. doi:10.1016/0001-6918(67)90011-X
24. Katzman R. Education and the prevalence of dementia and Alzheimer's disease. *Neurology*. 1993;43(1):13-20. doi:10.1212/WNL.43.1_Part_1.13
25. Nitrini R, Caramelli P, Herrera E, Porto CS, Charchat-Fichman H, Carthery MT et al. Performance of illiterate and literate nondemented elderly subjects in two tests of long-term memory. *J Int Neuropsychol Soc*. 2004;10(4):634-8. doi:10.1017/S1355617704104062
26. Miotto EC, Campanholo KR, Rodrigues MM, Serrao VT, Lucia MC, Scaff M. Hopkins verbal learning test-revised and brief visuospatial memory test-revised: preliminary normative data for the Brazilian population. *Arq Neuropsiquiatr*. 2012;70(12):962-5. doi:10.1590/S0004-282X2012001200014
27. Fichman HC, Dias LBT, Fernandes CS, Lourenço R, Caramelli P, Nitrini R. Normative data and construct validity of the rey auditory verbal learning test in a Brazilian elderly population. *Psychol Neurosci*. 2010;3(1):79-84. doi:10.3922/j.psns.2010.1.010
28. Avila R, Moscoso MAA, Ribeiz S, Arrais J, Jaluul O, Bottino CM. Influence of education and depression symptoms on cognitive function in the elderly. *Int Psychogeriatr*. 2009;21(3):560-7. doi:10.1017/S1041610209008928
29. Yassuda MS, Diniz BS, Flaks MK, Viola LF, Pereira FS, Nunes PV et al. Neuropsychological profile of Brazilian older adults with heterogeneous educational backgrounds. *Arch Clin Neuropsychol*. 2009;24(1):71-9. doi:10.1093/arclin/acp009
30. Chung JCC, Ho WSK. Validation of Fuld object memory evaluation for the detection of dementia in nursing home residents. *Aging Ment Health*. 2009;13(2):274-9. doi:10.1080/13607860802667649
31. Hsieh SL, Tori CD. Normative data on cross-cultural neuropsychological tests obtained from Mandarin-speaking adults across the life span. *Arch Clin Neuropsychol*. 2007;22(3):283-96. doi:10.1016/j.acn.2007.01.004