

## Cognitive assessment instruments used in elderly Brazilians in the last five years

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**Abstract** *Detecting and monitoring cognitive deficits in elderly populations are necessary, as they can impact individuals' functionality. This integrative review aims to analyze the scientific production on the use of cognitive assessment instruments in Brazilian elderly individuals through articles published in the last five years, indexed in the Web of Science, Pubmed, Scopus and Bireme databases. Inclusion criteria were original articles published in English and Portuguese from 2012 to 2016, the age criterion to define elderly individuals and scores higher than 6 in the adapted CASP. The exclusion criterion was conference abstracts submitted for publication. The final sample consisted of 100 articles. Sixty-one cognitive assessment instruments were used in the studies, especially the Mini-Mental State Examination. This review features the use of cognitive instruments in the Brazilian literature, their different versions and domains evaluated. The literature includes a large number of instruments. The most used tests were the MMSE (version proposed by Brucki et al.), the Verbal Fluency Test ("animal" category) and the Digit Span Memory Test (forward span and backward span). The findings presented in this review are relevant not only for observational and experimental research but also for clinical practice.*

**Key words** *Elderly, Geriatric assessment, Cognition*

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## Introduction

Increasing life expectancy and aging of the Brazilian population, associated with their impacts, have been the focus of studies for years. According to the Brazilian Institute of Geography and Statistics (IBGE) census in 2010, older adults accounted for 11% of the Brazilian population and it is estimated that they will reach 13.4% by 2030<sup>1</sup>.

Elderly people are exposed to functional losses due to aging (senescence) and/or age-related diseases (senility). In addition, some diseases have a higher prevalence in this age group, such as dementia. Alzheimer's disease is the most common type of dementia, which is coupled with severe debilitating cognitive deficits<sup>2</sup>.

In order ensure reliable detection and monitoring of cognitive deficit, information from family members/caregivers should be provided, and patients' follow up, identification of clinical history and standardized tests<sup>3</sup> should also be performed. These tests may include imaging tests, biochemical exams and/or assessment instruments. The selection of a cognitive assessment instrument should be based on its reliability and whether its score results reflect the actual status of the patient without the influence of other factors, such as depressive symptoms, delirium, low level education or hearing impairment<sup>3</sup>.

With the objective of analyzing the recent scientific production on the use of cognitive assessment instruments in the Brazilian elderly population, the following question was addressed in this integrative review: Which instruments are currently used for cognitive assessment in the Brazilian elderly population? Based on the findings, the characteristics of the most used instruments were analyzed.

## Method

After defining the guiding question, the instruments were assessed for eligibility according to the following steps: 1) specification of inclusion criteria (original articles published in English and Portuguese from 2012 to 2016, the age criterion to define elderly individuals and scores higher than 6 in the adapted CASP) and exclusion criteria (conference abstracts submitted for publication); 2) searches using the following Health Science Descriptors (DeCS) and Boolean operators: ["cognition" OR "dementia" AND "geriatric assessment"], in the Scopus, Bireme, Pub-

med and Web of Science databases in November 2016; 3) pre-selection of articles by reading the titles and abstracts and excluding duplicates; 4) critical assessment of the articles after reading them in full; and 5) presentation and discussion of results. The screening process was conducted by two reviewers independently, and disagreements were resolved by a third reviewer.

Two instruments were used for the critical assessment of the articles: the adapted Critical Appraisal Skill Program (CASP), which classifies the quality of the article from 0 to 10, with a score 6 indicating good methodological quality and reduced bias; and the Agency for Healthcare and Research and Quality (AHRQ), which hierarchically ranks the level of evidence of the study in (I) systematic review or meta-analysis, (II) randomized clinical trials, (III) clinical trials without randomization, (IV) cohort and case-control studies, (V) systematic review of descriptive and qualitative studies and (VI) descriptive or qualitative study<sup>4,5</sup>.

## Results

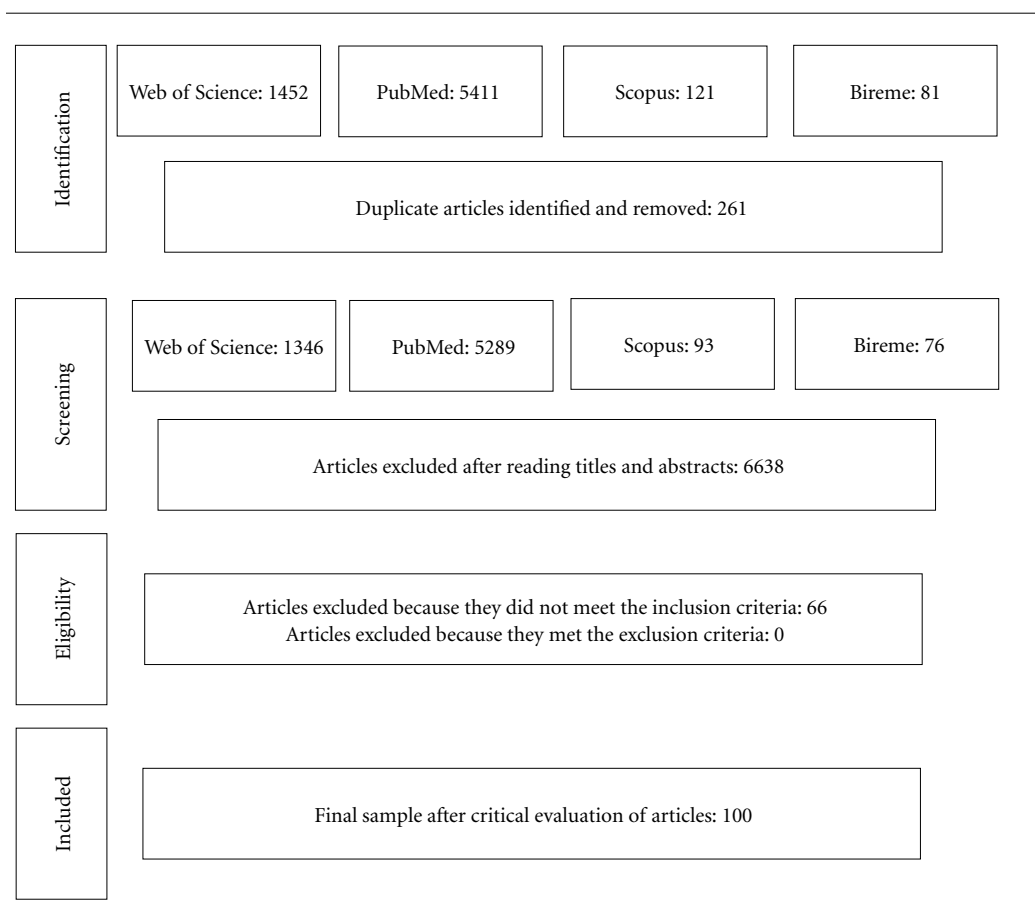
The screening process of articles from the Web of Science, Pubmed, Scopus and Bireme databases is summarized in Figure 1. The final sample consisted of 100 articles<sup>6-105</sup>, 80% of which are in English and 20% in Portuguese, selected according to the established criteria and after critical assessment.

Most studies were conducted in the Southeast (72%) and the South (12%) of Brazil, with the highest publication frequency in 2014 (30%) and 2012 (23%). The predominant age criterion to define elderly individuals was  $\geq 60$  (64%). According to the AHRQ instrument, the level of evidence VI (68%) stood out, followed by level IV (16%).

Regarding the study design, the majority of the articles (84%) were observational, 68% of which were transversal, 14% were cohort and 2% were case-control. Of the clinical trials, 9% were non-randomized and 7% were randomized.

Sixty-one instruments were used for cognitive assessment of Brazilian elderly individuals in the last five years (Chart 1). Most tests were short, with application time of less than 20 minutes.

Most studies (90%) used at least the Mini-Mental State Examination (MMSE) for data collection. The most administered version was that proposed by Brucki *et al.* (2003) (34.4%), but twelve versions could also be observed during the



**Figure 1.** Flowchart summarizing the article screening process.

analysis of the articles. The MMSE was followed by the Verbal Fluency Test (VFT) (24%), the Digit Span Memory Test (15%), the Cambridge Cognitive Examination- Revised (CAMCOG-R) (13%), the Clinical Dementia Rating (CDR) and the Clock-Drawing Test (CDT) (10%).

Chart 2 presents a summary of the cognitive domains evaluated and which tests evaluated them.

Of the 100 articles, 39 mentioned only the use of the MMSE with three objectives in the Method section: screening, sample selection and evaluation of associations. The cut-off points for the MMSE varied mainly according to the individual's level of education. The most commonly used cut-off points are listed as follows:

Brucki et al. (2003): < 20 points for illiterates; 25 points for individuals with 1 to 4 years of schooling; 26.5 for 5 to 8 years of schooling; 28

for 9 to 11 years of schooling; and 29 for more than 11 years of schooling;

Bertolucci et al. (1994): < 13 for illiterates (sensitivity: 82.4%, specificity: 97.5%); 18 for 1 to 8 years of schooling (sensitivity: 75.6%, specificity: 96.6%); and 26 for 9 or more years of schooling (sensitivity: 80%, specificity: 95.6%);

Lourenço & Veras (2006): < 18/19 for illiterates (sensitivity: 73.5%, specificity: 73.9%) and < 23/24 for individuals with one or more years of schooling (sensitivity: 75%, specificity: 69.7%).

Some authors conducted further analysis and adapted these cut-off points according to the design, studied population, objective, among others, which allowed differentiation of the studies and an increasing number of versions. The VFT and the Digit Span Memory Test were the second and third most used tests, respectively. The VFT was administered with several catego-

**Chart 1.** Cognitive assessment instruments used in studies with Brazilian elderly individuals between 2012 and 2016.

<b>Instrument</b>	<b>N (%)</b>	<b>Use</b>	<b>Domains assessed</b>	<b>Versions</b>	<b>n</b>	<b>%</b>
MMSE	90 (90%)	Sample selection Screening Correlation with scores of other tests To evaluate effects of intervention To evaluate association and risk To aid in diagnostic procedures To compare means between groups To follow-up on the evolution of the disease	Temporal orientation Spatial orientation Immediate and delayed memory Attention Calculation Language Constructive praxis	Brucki <i>et al.</i> , 2003	31	34,4
				Bertolucci <i>et al.</i> , 1994	15	16,7
				Lourenço e Veras, 2006 <sup>a</sup>	10	11,1
				Folstein <i>et al.</i> , 1975	8	8,9
				Almeida, 1998	6	6,7
				Icaza e Albala, 1999	5	5,6
				Herrera <i>et al.</i> , 2002	3	3,3
				Castro-Costa <i>et al.</i> , 2008	2	2,2
				Bottino <i>et al.</i> , 2001	2	2,2
				Kochhann <i>et al.</i>	1	1,1
				Nitrini <i>et al.</i> , 2007	1	1,1
				Nitrini <i>et al.</i> , 1994	1	1,1
				Seabra <i>et al.</i> , 1990	1	1,1
				Not mentioned	4	4,4
Verbal Fluency Test	24 (24%)	Sample selection Screening Correlation with scores of other tests To evaluate effects of intervention To evaluate association and risk To aid in diagnostic procedures To compare means between groups To follow-up on the evolution of the disease To evaluate executive functions	Language Semantic memory Executive functions	Semantic (animals)	16	66,7
				Semantic(animalsb and fruitsa)	2	8,3
				Semantic (animals and supermarket)	1	4,2
				Semantic (no category)	3	12,5
				Phonemic(F,A,Sa)	4	16,7
				Phonemic (A,F)	2	8,3
				Phonemic (no categories)	1	4,2
				Free choice	1	4,2
				Not mentioned	1	4,2
				-	-	-
Digit Span Memory Test <sup>a</sup>	15 (15%)	Correlation with scores of other tests To evaluate effects of intervention To aid in diagnostic procedures To evaluate association To compare means between groups	Attention Concentration Learning Working memory Executive functions	-	-	-
				-	-	-
				-	-	-
				-	-	-

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**Chart 1.** Cognitive assessment instruments used in studies with Brazilian elderly individuals between 2012 and 2016.

Instrument	N (%)	Use	Domains assessed			
			Domains assessed	Versions	n %	
CAMCOG-R <sup>b</sup>	13 (13%)	Screening Correlation with scores of other tests To evaluate effects of intervention To aid in diagnostic procedures To evaluate association To compare means between groups	Temporal orientation Spatial orientation Immediate and delayed memory Attention Calculation Language Executive functions Constructive praxis Praxis	-	-	
CDR <sup>c</sup>	10 (10%)	Sample selection Screening To aid in diagnostic procedures To classify severity of dementia	Memory Orientation Executive function (problem solving)	-	-	
CDT	10 (10%)	Sample selection Screening Correlation with scores of other tests To compare means between groups To aid in diagnostic procedures To evaluate association	Visuospatial skills Constructive praxis Executive functions Attention	Sunderland <i>et al.</i> , 1989 <sup>a</sup>	5	50,0
				Shulman <i>et al.</i> , 1993 <sup>a</sup>	3	30,0
				Mendez <i>et al.</i> , 1992 <sup>b</sup>	2	20,0
				Freedman <i>et al.</i> , 1994	1	10,0
				Shulman e Silver, 1986 Shulman, 2000	1	10,0
TMT <sup>b</sup>	9 (9%)	Sample selection Screening To compare means between groups To aid in diagnostic procedures To evaluate association To evaluate effects of intervention	Attention Executive functions	TMT A e B	8	
				TMT A	1	
RAVLT <sup>a</sup>	8 (8%)	To compare means between groups To aid in diagnostic procedures To evaluate effects of intervention To evaluate association Correlation with scores of other tests	Recent memory Episodic memory Learning	-		

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<b>Instrument</b>	<b>N (%)</b>	<b>Use</b>	<b>Domains assessed</b>	<b>Versions</b>	<b>n</b>	<b>%</b>
MoCA <sup>a</sup>	8 (8%)	Screening To evaluate association To evaluate effects of intervention Correlation with scores of other tests	Constructive praxis Attention Executive functions Immediate and delayed memory Language Orientation		-	
IQCODE <sup>a</sup>	8 (8%)	Sample selection Screening To aid in diagnostic procedures To evaluate association To evaluate effects of intervention Correlation with scores of other tests	Not applicable as it evaluates the cognitive decline through an interview with caregiver		-	
BCSB <sup>a</sup>	5 (5%)	Screening To evaluate association To aid in diagnostic procedures	Language Immediate and delayed memory Calculation Executive functions Constructive praxis		-	
RBMT <sup>b</sup>	4 (4%)	Screening To evaluate association To evaluate effects of intervention	Memory		-	
BNT <sup>b</sup>	4 (4%)	To evaluate association To evaluate effects of intervention	Language		-	
FOME <sup>a</sup>	3 (3%)	Screening To evaluate association	Learning Episodic memory Language Executive functions		-	
WCST <sup>b</sup>	3 (3%)	To evaluate effects of intervention	Executive functions		-	
List of words	3 (3%)	To evaluate effects of intervention To evaluate association	Immediate and delayed memory Learning		-	
LCT <sup>b</sup>	3 (3%)	Sample selection Screening To evaluate association	Orientation Language Immediate and delayed memory		-	

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**Chart 1.** Cognitive assessment instruments used in studies with Brazilian elderly individuals between 2012 and 2016.

Instrument	N (%)	Use	Domains assessed		
			Language	Attention	Executive functions
Vocabulary Subtest of the WAIS-III test <sup>a</sup>	3 (3%)	To evaluate effects of intervention To evaluate association To aid in diagnostic procedures	Language Semantic memory	-	-
Digit Symbol-Coding subtest of WAIS-III test <sup>a</sup>	3 (3%)	To evaluate effects of intervention Correlation with scores of other tests To aid in diagnostic procedures	Attention Visuospatial skills Memory	-	-
Corsi block-tapping test	2 (2%)	To compare means between groups To evaluate effects of intervention	Working memory Executive functions	-	-
SKT <sup>b</sup>	2 (2%)	Screening To evaluate association To evaluate effects of intervention	Attention Concentration Executive functions Immediate and delayed memory Recognition	-	-
FAB <sup>a</sup>	2 (2%)	Correlation with scores of other tests	Executive functions	-	-
MAC-Q <sup>b</sup>	2 (2%)	To evaluate association To evaluate effects of intervention	Prospective memory	-	-
MDRS <sup>b</sup>	2 (2%)	To aid in diagnostic procedures	Working memory Executive functions Attention Praxis	-	-
SMMSE <sup>b</sup>	2 (2%)	To evaluate association	Constructive praxis Language Attention Memory Verbal fluency	-	-
TN-LIN <sup>a</sup>	2 (2%)	To compare means between groups Correlation with scores of other tests	Semantic memory Language	-	-
Verbal Paired Associates of the WMS-R <sup>b</sup>	2 (2%)	To evaluate effects of intervention To evaluate association	Immediate and delayed memory	-	-
PDMT	2 (2%)	To evaluate association and risk	Immediate and delayed memory	-	-

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<b>Instrument</b>	<b>N (%)</b>	<b>Use</b>	<b>Domains assessed</b>	<b>Versions</b>	<b>n</b>	<b>%</b>
Stick Design Test <sup>b</sup>	2 (2%)	To compare means between groups Correlation with scores of other tests	Visuospatial skills		-	
Symbol search subtest of WAIS-III <sup>e</sup>	2 (2%)	To evaluate effects of intervention	Attention Executive functions		-	
Cookie Theft picture test of the Boston Diagnostic Aphasia Examination	2 (2%)	To evaluate effects of intervention	Language		-	
CANSMCI-BR <sup>a</sup>	1 (1%)	Screening	Memory Language Executive function		-	
ADAS-Cog <sup>b</sup>	1 (1%)	Screening To evaluate association	Immediate and delayed memory Language Visuospatial skills Ideomotor and constructive praxis		-	
CERAD <sup>b</sup>	1 (1%)	To evaluate association	*Includes Verbal Fluency Tests; MMSE; Boston Naming Test; Word List; Visuoconstructive Skills		-	
The Arizona Battery for Communication Disorders of Dementia	1 (1%)	To evaluate association	Language Episodic memory Visuospatial skills Constructive praxis		-	
TROG-2	1 (1%)	To evaluate association	Language		-	
Community Screening Instrument for Dementia	1 (1%)	Screening To evaluate association	Language Memory Praxis Orientation		-	
Metamemory Adulthood Questionnaire <sup>a</sup>	1 (1%)	To evaluate effects of intervention	Metamemory		-	
MSEQ <sup>a</sup>	1 (1%)	To evaluate effects of intervention	Memory		-	

it continues



**Chart 1.** Cognitive assessment instruments used in studies with Brazilian elderly individuals between 2012 and 2016.

Instrument	N (%)	Use		Domains assessed		Versions	n	%
		To evaluate association	To compare means between groups	Executive functions	Language Executive functions			
Raven's Progressive Matrices Test <sup>b</sup>	1 (1%)	To evaluate association		Executive functions		-		
Stroop test <sup>a</sup>	1 (1%)	To compare means between groups		Executive functions		-		
Similarities subtest of WAIS-III <sup>a</sup>	1 (1%)	To compare means between groups		Language Executive functions		-		
Information subtest of WAIS-III <sup>a</sup>	1 (1%)	To evaluate effects of intervention		Immediate memory		-		
Cube design subtest of WAIS-III <sup>a</sup>	1 (1%)	To evaluate association		Visuospatial skills Executive functions		-		
Matrix reasoning subtest of WAIS-III <sup>a</sup>	1 (1%)	To aid in diagnostic procedures		Executive functions		-		
Comprehension subtest of WAIS-III <sup>a</sup>	1 (1%)	To aid in diagnostic procedures		Executive functions		-		
Arithmetic subtest of WAIS-III <sup>a</sup>	1 (1%)	To evaluate effects of intervention		Attention Calculation		-		
Letter-number sequencing subtest of WAIS-III <sup>a</sup>	1 (1%)	To evaluate effects of intervention		Working memory		-		
Logical memory subtest I and II of WMS-R <sup>b</sup>	1 (1%)	To evaluate effects of intervention		Episodic memory Ability to recall		-		
Delay Visual Memory task	1 (1%)	To evaluate association		Episodic memory		-		
Short form of WAIS-III <sup>a</sup>	1 (1%)	To evaluate association		Attention Executive functions Working memory Episodic memory Calculation Language		-		

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**Chart 1.** Cognitive assessment instruments used in studies with Brazilian elderly individuals between 2012 and 2016.

Instrument	N (%)	Use	Domains assessed	Versions	n	%
NEUPSILIN test <sup>a</sup>	1 (1%)	To evaluate effects of intervention	Attention Orientation Working memory Episodic, semantic and prospective memory Calculation Language Praxis Executive functions		-	
Groton Maze Learning Test; Set-Shifting test, One-back and Two-back tests	1 (1%)	To evaluate effects of intervention	Attention Working memory Executive functions		-	
Five-digit test <sup>a</sup>	1 (1%)	To compare means between groups	Executive functions		-	
Concentrated Attention Test (Toulouse-Piéron) <sup>b</sup>	1 (1%)	To evaluate effects of intervention	Attention		-	
Buschke Selective Reminding Test <sup>b</sup>	1 (1%)	To evaluate association	Episodic memory		-	
Token Test –short version <sup>a</sup>	1 (1%)	To compare means between groups	Semantic memory Language		-	
Delayed recall of simple pictures	1 (1%)	To aid in diagnostic procedures	Delayed memory		-	
Labyrinth Test	1 (1%)	To aid in diagnostic procedures	-		-	
Tower of Hanoi <sup>b</sup>	1 (1%)	To evaluate association	Executive functions		-	
Test of Variables of Visual Attention <sup>1</sup>	1 (1%)	To evaluate association	Attention		-	

<sup>a</sup>: There are studies showing the accuracy of the instrument for the Brazilian elderly population; <sup>b</sup>: There are studies showing the accuracy of the instrument for the Brazilian population; MMSE: Mini-Mental State Examination; CAMCOG: Cambridge Cognitive Examination-Revised; CDR: Clinical Dementia Rating; CDT: Clock-Drawing Test; TMT: Trail Making Test; RAVLT: Rey Auditory Verbal Learning Test; MoCA: Montreal Cognitive Assessment; IQCODE: Informant Questionnaire on Cognitive Decline in the Elderly; BCSB: Brief Cognitive Screening Battery; RBMT: Rivermead Behavioral Memory Test; BNT: Boston Naming Test; FOME: Full Object Memory Evaluation; WCST: Wisconsin Card Sorting Test; LCT: Leganés cognitive test; WAIS\_III: Wechsler Adult Intelligence Scale; SKT: Syndrom-Kurztest (Short Cognitive Performance Test); FAB: Frontal Assessment Battery; MAC-Q: Memory Complaint Questionnaire; MDRS: Mattis Dementia Rating Scale; SMMS: Severe Mini-Mental State Examination; TN-LIN: Naming Test of the Laboratory of Neuropsychological Investigations; WMS-III: Wechsler Memory Scale; PDMT: Picture drawings memory test; CANS/MCI-BR: Computer-Administered Neuropsychological Screen For Mild Cognitive Impairment for Brazilian Portuguese; ADAS-Cog: The Alzheimer's Disease Assessment Scale-Cognitive Subscale; CERAD: Consortium to Establish a Registry for Alzheimer's Disease; TROG-2: Test for Reception of Grammar; MSEQ: Memory Self-Efficacy Questionnaire.

**Chart 2.** Cognitive domains and respective instruments that evaluate these domains.

Attention	MMSE; Digit Span Memory Test; CAMCOG-R; CDT: TMT; MoCA; Digit Symbol-Coding Subtest, Symbol search and Arithmetic Subtest of WAIS-III; SKT; MDRS; SMMSE; CERAD; Short form of WAIS-III; NEUPSILIN test; Concentrated Attention Test of Toulouse-Piéron; Groton Maze Learning Test; Set-Shifting test, One-back and Two-back tests; Test of variables of Visual Attention
Orientation	MMSE; CAMCOG-R; CDR: MoCA; LCT; CERAD; NEUPSILIN test; Community Screening Instrument for Dementia
Language	MMSE; Verbal fluency Test; CAMCOG-R; MoCA; BCSB; BNT; FOME; LCT; SMMSE; TN-LIN; CANSMCI-BR; ADAS-Cog; CERAD; Cookie Theft picture test of the Boston Diagnostic Aphasia Examination; The Arizona Battery for Communication Disorders of Dementia; TROG-2; Community Screening Instrument for Dementia; Similarities subtest of WAIS-III; NEUPSILIN test; Short Form of WAIS-III; Token Test
Memory	MMSE; Verbal fluency Test; Digit Span Memory Test; CAMCOG-R; CDR; RAVLT; MoCA; BCSB; RBMT; FOME- list of words; LCT; Vocabulary, Digit Symbol-Coding Subtest, Information, Number and Letter Sequencing subtests of WAIS-III; Corsi block-tapping test; SKT; MAC-Q; MDRS; SMMSE; TN-LIN; Verbal Paired Associates I and II and Logical Memory I and II of WMS-III; PDMT; CANSMCI-BR; CERAD; ADAS-Cog; The Arizona Battery for Communication Disorders of Dementia; Community Screening Instrument for Dementia; MSEQ; Metamemory in Adulthood Questionnaire; Delayed Visual Memory task; Short form of WAIS-III; NEUPSILIN test; Groton Maze Learning Test; Set-Shifting test, One-back and Two-back tests; Buschke Selective Reminding Test; Token Test; Delayed recall of simple pictures
Executive functions	Verbal fluency Test; Digit Span Memory Test; CAMCOG-R; CDR; CDT; TMT; MoCA; BCSB; FOME; WCST; Corsi block-tapping test; SKT; FAB; MDRS; Symbol Search, Cube Design, Comprehension, Matrix reasoning subtests of WAIS-III; CANSMCI-BR; CERAD; Short term of WAIS-III; NEUPSILIN test; Groton Maze Learning Test; Set-Shifting test, One-back and Two-back tests; Five-digit test; Tower of Hanoi
Praxis	MMSE; CDT; CAMCOG-R; MoCA; BCSB; MDRS; SMMSE; ADAS-Cog; CERAD; The Arizona Battery for Communication Disorders of Dementia; Community Screening Instrument for Dementia; NEUPSILIN test
Visuospatial skills	CDT; Digit Symbol-Coding and Cube Design subtests of WAIS-III; Stick Design Test; ADAS-Cog; CERAD;
Calculation	MMSE; CAMCOG-R; CERAD; Arithmetic subtest of WAIS-III; Short form of WAIS-III; NEUPSILIN test

MMSE: Mini-Mental State Examination; CAMCOG: Cambridge Cognitive Examination-Revised; CDR: Clinical Dementia Rating; CDT: Clock-Drawing Test; TMT: Trail Making Test; RAVLT: Rey Auditory Verbal Learning Test; MoCA: Montreal Cognitive Assessment; IQCODE: Informant Questionnaire on Cognitive Decline in the Elderly; BCSB: Brief Cognitive Screening Battery; RBMT: Rivermead Behavioral Memory Test; BNT: Boston Naming Test; FOME: Fuld Object Memory Evaluation; WCST: Wisconsin Card Sorting Test; LCT: Leganés cognitive test; WAIS\_III: Wechsler Adult Intelligence Scale; SKT: Syndrom-Kurztest (Short Cognitive Performance Test); FAB: Frontal Assessment Battery; MAC-Q: Memory Complaint Questionnaire; MDRS: Mattis Dementia Rating Scale; SMMSE: Severe Mini-Mental State Examination; TN-LIN: Naming Test of the Laboratory of Neuropsychological Investigations; WMS-III: Weschler Memory Scale; PDMT: Picture drawings memory test; CANSMCI-BR: Neuropsychological Screen For Mild Cognitive Impairment for Brazilian Portuguese; ADAS-Cog: The Alzheimer's Disease Assessment Scale-Cognitive Subscale; CERAD: Consortium to Establish a Registry for Alzheimer's Disease; TROG-2: Test for reception of grammar; MSEQ: Memory Self-Efficacy Questionnaire.

ries, and in this review, the semantic category of animals stood out. The Digit Span Memory Test has only one version and can be applied in forward span and backward span. The CDT was also addressed in six forms, and the versions proposed by Sunderland et al. (1989) and Shulman et al. (1993) were most commonly used.

The Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE), used in eight articles, does not directly assess the patient - it is completed by the caregiver or someone close

to the patient. The Leganés Cognitive Test (LCT) can be pointed out, as it was used in the assessment of cognitive function only in one Brazilian state (Rio Grande do Norte).

Two studies mentioned the use of the Comprehensive Geriatric Assessment (CGA), one in hospitalized elderly patients, and the other with elderly patients attending a geriatric outpatient clinic. When administering the CGA, both studies used the MMSE, but one of them associated it with the IQCODE.

## Discussion

A considerable number of studies were included in this review, which indicates that cognition in the elderly population has been extensively addressed in the Brazilian literature. Most of the articles (72%) were published in the Southeast region. The distribution of *stricto sensu* post-graduate courses in Brazil in 2015 showed that the Southeast region accounted for 45.6% of the courses, followed by the South, Northeast, Midwest and North with 21.4%, 19.9%, 8.1% and 5% respectively<sup>106</sup>. This shows how the existing regional inequality impacts the Brazilian scientific production.

Regarding the numerical criterion used for a definition of elderly individuals, the World Health Organization (WHO) has accepted the chronological age of  $\geq 60$  years to refer to the older population in developing countries or 65 years in developed countries<sup>107</sup>. Most studies used the criterion  $\geq 60$  and the studies conducted in the Southeast, North and Northeast of the country used an older age for eligibility. Additionally, a pattern of use by region could not be observed.

A wide range of instruments could be identified, including brief tests and test batteries. The use of these instruments also ranged from screening to aid in diagnostic procedures. The administration of the instruments to monitor types of intervention (e.g., cognitive, motor, drug) provides data on the possible benefits of a specific physical stimulation for the cognition of elderly individuals.

In clinical practice, it is proposed that elderly individuals should be first evaluated with an instrument that provides a basic measure for cognitive function monitoring and/or an alert to the need for further investigation<sup>108</sup>. Through a systematic review, the authors identified diagnostic errors rates of over 10% in 16 diseases prevalent in elderly patients, mainly in dementias. Underdiagnosis of dementia appears more prevalent in older patients with poor access to health care, lower socioeconomic status and lower levels of education<sup>109</sup>. A Brazilian study found that only one third of the elderly individuals diagnosed with dementia by specialists had previous diagnosis of moderate to severe dementia<sup>110</sup>. The causes of low case detection were not indicated.

In relation to the area of research, choosing an adequate instrument and establishing a cut-off point are necessary to avoid mistakes due to false-positive and false-negative test results. Researchers are able to find a cut-off point that best

suits their sample<sup>111</sup> by retrieving published studies with samples containing related profiles, also taking into account the specificity and sensitivity of the test.

The analysis of the most used test in the Brazilian studies with elderly individuals - the MMSE - still shows no standardized administration of the test. The different versions and cut-off points support this statement. These issues display the cultural, educational and age biases that influence the test score. Although these different cut-off points are created to minimize bias and establish criteria for normality for the Brazilian population, the level of education is a variable that influences the MMSE score, and may generate false-negative results in individuals with higher levels of education<sup>94,112</sup>.

It should be noted that, although the MMSE does not evaluate all cognitive domains, it is quick to administer and it is the most widely studied instrument for cognitive screening not only in Brazil but worldwide. The MMSE is also used as a gold standard and reference for validation of other assessment instruments. In Brazil, the first version was proposed almost 23 years ago<sup>108</sup>.

The Consortium to Establish a Registry for Alzheimer's Disease (CERAD) includes batteries of test covering all cognitive domains, but it was used in only one study. It requires longer administration time, which may be a negative factor for its use in research. Also, it does not have criteria for normality for the individuals' level of education.

As for the other instruments more commonly used, the Verbal Fluency Test and Digit Span Memory Test do not assess global cognition and are more specific for certain functions. The VFT focuses on the evaluation of executive functions and consists in recalling the greatest number of words during a pre-established time - usually one minute. The score is calculated by counting the total of produced words. In the phonemic fluency test, the individuals are requested to produce words beginning with a certain letter, for example, "F", "A", "S". The semantic fluency consists of naming words within a category, such as animals. Studies show that it is an instrument with good accuracy in the detection of cognitive deficits in the elderly population<sup>113-115</sup>.

In the articles here, the semantic verbal fluency test of animal category was the most common test in association with other instruments. The semantic task, in addition to evaluating executive functions and language, has the advantage of accessing declarative semantic memory. The

cut-offs points for the Brazilian versions varied according to levels of education and age<sup>116,117</sup>.

The Digit Span Subtest of the Wechsler Adult Intelligence Scale (WAIS-III) consists of two tasks of repeating a sequence of numbers in forward span and backward span, especially used in the evaluation of attention. Although both tasks can be administered independently, the studies included in this review used both tasks. The backward version is also widely used to evaluate working memory. The cut-off point was not cited. The VFT and the Digit Span Memory Test can be used in association with the MMSE for an enhanced cognitive assessment, provided that it is the goal of the professional and/or researcher. The combined use of instruments may be beneficial to avoid false diagnosis in the elderly population<sup>118</sup>.

The CDT is a cognitive screening instrument used to evaluate executive function, praxis and visuospatial skills. It also presents several versions with different scores. In the most used version, the patient is asked to draw the face of a clock and place the hands to designate a specific time, e.g., 1h10min<sup>119</sup>. Combined with the MMSE, the CDT has a sensitivity of 84.9% and specificity of 90.4% in the screening for cognitive impairment in elderly populations<sup>120</sup>. But, individuals with symptoms such as tremor and motor coordination deficits may show lower scores, or even fail to perform a task due to these motor impairments.

As for the instrument administration time, frail or multimorbid elderly individuals may

need more time to complete the evaluation. Individuals who require hearing aids, glasses and dental prostheses should be using them during the evaluation<sup>121</sup>.

A limitation of the study lies in the fact that after the application of the eligibility criteria, the whole Brazilian literature was not evaluated, given that dissertations and theses were not included. This could have increased the variation of the instruments used.

## Conclusion

The variability of cognitive deficits due to aging or associated pathological process points to the need to address the issue of how to identify these deficits earlier and whether this early identification influences the course of the disease and the quality of life of the individuals and their relatives.

This integrative review addresses the use of cognitive assessment instruments in the Brazilian literature, their different versions and domains evaluated. The recent literature includes a large number of instruments. The most used tests were the MMSE (version proposed by Brucki et al.), the Verbal Fluency Test (animal category) and the Digit Span Memory Test (forward span or backward span). The findings presented in this review are relevant not only for observational and experimental research but also for clinical practice.

## Collaborations

NIM Martins designed, outlined, analyzed and interpreted the data and drafted the article. PR Caldas conducted data analysis. ED Cabral performed the critical review of the article. CCSA Lins contributed to the article design and critical review. MGWS Coriolano contributed to the concept, design, interpretation of data and critical review of the article.

## References

- Ervatti LG, Borges GM, Jardim AP. *Mudança Demográfica no Brasil no início do século XXI: Subsídios para as projeções da população*. Rio de Janeiro: IBGE; 2015.
- Freitas EV, Py L, Cançado FAX, Doll J, Gorzoni ML. *Tratado de geriatria e gerontologia*. Rio de Janeiro: Guanabara Koogan; 2013.
- Young J, Meagher D, MacLulich A. Cognitive assessment of older people. *BMJ* 2011; 343:d5042.
- Toledo MM. *Vulnerabilidade de adolescentes ao HIV/AIDS: Revisão Integrativa* [dissertação]. São Paulo: Universidade de São Paulo; 2008.
- Stillwell SB, Fineout-Overholt E, Melnyk BM, Williamson KM. Evidence-based practice: step by step. *Am J Nurs* 2010; 110(5):41-47.
- Alencar MA, Dias JMD, Figueiredo LC, Dias RC. Frailty and cognitive impairment among community-dwelling elderly. *Arq Neuropsiquiatr* 2013; 71(6):362-367.
- Alexandre TS, Corona LP, Nunes DP, Santos JLF, Duarte YAO, Lebrão ML. Disability in instrumental activities of daily living among older adults: gender differences. *Rev Saude Publica* 2014; 48(3):378-389.
- Alexandre TS, Corona LP, Nunes DP, Santos JLF, Duarte YAO, Lebrão ML. Gender differences in incidence and determinants of disability in activities of daily living among elderly individuals: SABE study. *Arch Gerontol Geriatr* 2012; 55(2):431-437.
- Alexandre TS, Duarte YAO, Santos JLF, Wong R, Lebrão ML. Prevalence and Associated Factors of Sarcopenia Among Elderly in Brazil: Findings from The Sabe Study. *J Nutr Health Aging* 2014; 18(3):284-290.
- Alexandre TS, Duarte YAO, Santos JLF, Wong R, Lebrão ML. Sarcopenia according to the European Working Group Sarcopenia in older people (EWGSOP) versus dynapenia as a risk factor for disability in the elderly. *J Nutr Health Aging* 2014; 18(5):547-553.
- Andrade FCD, Corona LP, Lebrão ML, Duarte YAO. Life expectancy with and without cognitive impairment among Brazilian older adults. *Arch Gerontol Geriatr* 2014; 58(2):219-225.
- Ansai JH, Aurichio TR, Rebelatto JR. Relationship between dual task walking, cognition, and depression in oldest old people. *Int Psycho Geriatr* 2016; 28(1):31-38.
- Ansai JH, Rebelatto JR. Effect of two physical exercise protocols on cognition and depressive symptoms in oldest-old people: A randomized controlled trial. *Geriatr Gerontol Int* 2015; 15(9):1127-1134.
- Aprahamian I, Ladeira RB, Diniz BS, Forlenza OV, Nunes PV. Cognitive impairment in euthymic older adults with bipolar disorder: a controlled study using cognitive screening tests. *Am J Geriatr Psychiatry* 2014; 22(4):389-397.
- Aprahamian I, Radanovic M, Nunes PV, Ladeira RB, Forlenza OV. The use of the Clock Drawing Test in bipolar disorder with or without dementia of Alzheimer's type. *Arq Neuropsiquiatr* 2014; 72(12):913-918.
- Araujo NB, Moraes HS, Silveira H, Arcoverde C, Vasques PE, Barca ML, Knapskog A, Engedal K, Coutinho ESF, Deslandes AC, Laks J. Impaired cognition in depression and Alzheimer (AD): a gradient from depression to depression in AD. *Arq Neuropsiquiatr* 2014; 72(9):671-679.
- Argimon IL, Irigaray TQ, Stein LM. Cognitive Development across Different Age Ranges in Late Adulthood. *Universitas Psychologica* 2013; 13(1):253-264.
- Avellar M, Scoriels L, Madeira C, Vargas-Lopes C, Marques P, Dantas C, Manhães AC, Leite H, Panizzutti R. The effect of D-serine administration on cognition and mood in older adults. *Oncotarget* 2016; 7(11):11881-11888.
- Avelino-Silva TJ, Farfel JM, Curiati JAE, Amaral JRG, Campora F, Jacob-Filho W. Comprehensive geriatric assessment predicts mortality and adverse outcomes in hospitalized older adults. *BMC Geriatrics* 2014; 14(129):1-8.
- Avila R, Lopes MA, Nakano EY, Bottino CMC. Normative data of Fuld Object Memory Evaluation test for Brazilian elderly population. *Arq Neuropsiquiatr* 2016; 74(2):138-144.
- Baierle M, Vencato PH, Oldenburg L, Bordignon S, Zibetti M, Clarissa MT, Duarte MMMF, Veit JC, Somacal S, Emanuelli T, Grune T, Breusing N, Garcia SC. Fatty Acid Status and Its Relationship to Cognitive Decline and Homocysteine Levels in the Elderly. *Nutrients* 2014; 6(9):3624-3640.
- Banhato EFC, Leite ICG, Guedes DV, Chaoubah A. Cognition in Elderly People: Study of the Short Form 8 (SF8) of the Wechsler-III Scale. *Psicologia: Reflexão e Crítica* 2012; 25(1):96-104.
- Barcelos-Ferreira R, Nakano EY, Steffens DC, Bottino CMC. Quality of life and physical activity associated to lower prevalence of depression in community-dwelling elderly subjects from Sao Paulo. *J Affect Disord* 2013; 150(2):616-622.
- Bez JPO, Neri AL. Gait speed, grip strength and self-rated health among the elderly: data from the FIBRA Campinas network, São Paulo, Brazil. *Cien Saude Colet* 2014; 19(8):3343-3353.
- Boscatto EC, Duarte MFS, Coqueiro RS, Barbosa AR. Nutritional status in the oldest elderly and associated factors. *Rev Assoc Med Bras*. 2013; 59(1):40-47.
- Brito TRP, Pavarini SCI. Relação entre apoio social e capacidade funcional de idosos com alterações cognitivas. *Rev. Latino-Am. Enfermagem* 2012; 20(4):677-684.
- Caixeta GCS, Doná F, Gazzola JM. Cognitive processing and body balance in elderly subjects with vestibular dysfunction. *Braz J Otorhinolaryngol* 2012; 78(2):87-95.
- Caldas VVA, Zunzunegui MV, Freire ANF, Guerra RO. Translation, cultural adaptation and psychometric evaluation of the Leganés cognitive test in a low educated elderly Brazilian population. *Arq Neuropsiquiatr* 2012; 70(1):22-27.

29. Camargos EF, Louzada LL, Quintas JL, Naves JOS, Louzada FM, Nóbrega OT. Trazodone Improves Sleep Parameters in Alzheimer Disease Patients: A Randomized, Double-Blind, and Placebo-Controlled Study. *Am J Geriatr Psychiatry* 2014; 22(12):1565-1574.
30. Castro-Costa E, Dewey ME, Uchôa E, Firmo JOA, Lima-Costa ME, Stewart R. Construct validity of the mini mental state examination across time in a sample with low-education levels: 10-year follow-up of the Bambuí Cohort Study of Ageing. *Int J Geriatr Psychiatry* 2014; 29(12):1294-1303.
31. Cecato JF, Fiorese B, Montiel JM, Bartholomeu D, Martinelli JE. Clock Drawing Test in Elderly Individuals with Different Education Levels: Correlation with Clinical Dementia Rating. *Am J Alzheimers Dis Other Demen* 2012; 27(8):620-624.
32. Cerutti-Kopplin D, Emami E, Hilgert JB, Hugo FN, Padilha DMP. Cognitive status of edentate elders wearing complete denture: Does quality of denture matter? *J Dent* 2015; 43(9):1071-1075.
33. Costa DS, Paula JJ, Rezende NA, Rodrigues LOC, Malloy-Diniz LF, Romano-Silva MA, Miranda DM. Neuropsychological impairments in elderly Neurofibromatosis type 1 patients. *Eur J Med Genet* 2014; 57(5):216-219.
34. Curcio C, Alvarado BE, Gomez F, Guerra F, Guralnik J, Zunzunegui MV. Life-Space Assessment scale to assess mobility: validation in Latin American older women and men. *Aging Clin Exp Res* 2013; 25(5):553-560.
35. Danielewicz AL, Wagner KJB, d'Orsi E, Boing AF. Is cognitive decline in the elderly associated with contextual income? Results of a population-based study in southern Brazil. *Cad Saude Publica* 2016; 32(5):1-11.
36. Diniz BS, Teixeira AL, Machado-Vieira R, Talib LL, Radanovic M, Gattaz WF, Forlenza OV. Reduced cerebrospinal fluid levels of brain-derived neurotrophic factor is associated with cognitive impairment in late-life major depression. *J Gerontol B Psychol Sci. Soc. Sci.* 2014; 69(6):845-851.
37. Fattori A, Oliveira IM, Alves RMA, Guariento ME. Cluster analysis to identify elderly people's profiles: a healthcare strategy based on frailty characteristics. *São Paulo Med J* 2014; 132(4):224-230.
38. Fichman-Charchat H, Miranda CV, Fernandes CS, Mograbi D, Oliveira RM, Novaes R, Aguiar D. Brief Cognitive Screening Battery (BCSB) is a very useful tool for diagnosis of probable mild Alzheimer's disease in a geriatric clinic. *Arq Neuropsiquiatr* 2016; 74(2):149-154.
39. Figueiredo CS, Assis MG, Silva SLA, Dias RC, Mancini MC. Functional and cognitive changes in community-dwelling elderly: Longitudinal study. *Braz J Phys Ther* 2013; 17(3):297-306.
40. Fraga VG, Guimarães HC, Teixeira AL, Barbosa MT, Mateo ECC, Carvalho MG, Caramelli P, Gomes KB. Genetic predisposition to higher production of interleukin-6 through -174 G > C polymorphism predicts global cognitive decline in oldest-old with cognitive impairment no dementia. *Arq Neuropsiquiatr* 2015; 73(11):899-902.
41. Fraga VG, Guimarães HC, Lara VP, Teixeira AL, Barbosa MT, Carvalho MG, Caramelli P, Gomes KB. TGF- $\beta$ 1 Codon 10 T>C Polymorphism Influences Short-Term Functional and Cognitive Decline in Healthy Oldest-Old Individuals: The Pietá Study. *J Alzheimers Dis* 2015; 48(4):1077-1081.
42. França VF, Barbosa AR, D'Orsi E. Cognition and Indicators of Dietary Habits in Older Adults from Southern Brazil. *PLoS One* 2016; 11(2):1-12.
43. Faria CA, Lourenço RA, Ribeiro PCC, Lopes CS. Desempenho cognitivo e fragilidade em idosos clientes de operadora de saúde. *Rev Saude Publica* 2013; 47(5):923-930.
44. Ferreira L, Tanaka K, Santos-Galduróz RF, Galduróz JCF. Respiratory training as strategy to prevent cognitive decline in aging: a randomized controlled trial. *Clin Interv Aging* 2015; 20(10):593-603.
45. Gomes MV, Toffoli LV, Arruda DW, Soldera LM, Pelosi GG, Neves-Souza RD, Freitas ER, Castro DT, Marquez AS. Age-Related Changes in the Global DNA Methylation Profile of Leukocytes Are Linked to Nutrition but Are Not Associated with the MTHFR C677T Genotype or to Functional Capacities. *Plos One* 2012; 7(12):1-8.
46. Gomes CS, Maciel ACC, Freire ANF, Moreira MA, Ribeiro MO, Guerra RO. Depressive symptoms and functional decline in an elderly sample of urban center in northeastern Brazil. *Arch Gerontol Geriatr* 2014; 58(2):214-218.
47. Gratao ACM, Talmelli LFS, Haas VJ, Marques S, Kusumota L, Rodrigues RAP. Assessment of caregiver burden with elderly having cognitive deficit. *Acta Paul Enferm* 2012; 25(6):908-913.
48. Horie NC, Serrao VT, Simon SS, Gascon MRP, Santos AX, Zambone MA, Freitas MMB, Cunha-Neto E, Marques EL, Halpern A, Melo ME, Mancini MC, Cercato C. Cognitive effects of intentional weight loss in elderly obese individuals with mild cognitive impairment. *J Clin Endocrinol Metab* 2016; 101(3):1104-1112.
49. Irigaray TQ, Gomes Filho I, Schneider RH. Efeitos de um Treino de Atenção, Memória e Funções Executivas na Cognição de Idosos Saudáveis. *Psicologia: Reflexão e Crítica* 2012; 25(1):188-202.
50. Leite MT, Hildebrandt LM, Kirchner RM, Winck MT, Silva LAA, Franco GP. Estado cognitivo e condições de saúde de idosos que participam de grupos de convivência. *Rev Gaúcha Enferm* 2012; 33(4):64-71.
51. Lempke-Scoralick NN, Barbosa AJG, Mota MMPE. Efeitos de um Processo de Alfabetização em Informática na Cognição de Idosos. *Psicologia: Reflexão e Crítica* 2012; 25(4):774-782.
52. Lima-Silva TB, Yassuda MS. Treino Cognitivo e Intervenção Psicoeducativa para Indivíduos Hipertensos: Efeitos na Cognição. *Psicologia: Reflexão e Crítica* 2012; 25(1):30-40.
53. Lopes MA, Ferrioli E, Nakano EY, Litvoc J, Bottino CMC. 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):307-316.

54. Macedo AML, Cerchiari EAN, Alvarenga MRM, Faccenda O, Oliveira MAC. Avaliação funcional de idosos com déficit cognitivo. *Acta Paul Enferm* 2012; 25(3):358-363.
55. Macedo LDD, Oliveira TCG, Soares FC, Bento-Torres J, Bento-Torres NVO, Anthony DC, Picanço-Diniz CW. Beneficial effects of multisensory and cognitive stimulation in institutionalized elderly: 12-months follow-up. *Clin Interv Aging* 2015; 19(10):1351-1359.
56. Macuco CRM, Batistoni SST, Lopes A, Cachioni M, Falcão DVS, Neri AL, Yassuda MS. Mini-Mental State Examination performance in frail, pre-frail, and non-frail community dwelling older adults in Ermelino Matarazzo, São Paulo, Brazil. *Int Psychogeriatr* 2012; 24(11):1725-1731.
57. Martinez BP, Gomes IB, Oliveira CS, Ramos IR, Rocha MD, Forgiarini Júnior LA, Camelier FW, Camelier AA. Accuracy of the Timed Up and Go test for predicting sarcopenia in elderly hospitalized patients. *Clinics (São Paulo)* 2015; 70(5):369-372.
58. Martinho KO, Dantas EH, Longo GZ, Ribeiro AQ, Pereira ET, Franco FS, Gonçalves MR, Morais KB, Martins MV, Danesio J, Tinôco AL. Comparison of functional autonomy with associated sociodemographic factors, lifestyle, chronic diseases (CD) and neuropsychiatric factors in elderly patients with or without the metabolic syndrome (MS). *Arch Gerontol Geriatr* 2013; 57(2):151-155.
59. Matoso JMD, Santos WB, Moreira IFH, Lourenço RA, Correia MLG. Idosos Hipertensos Apresentam Menor Desempenho Cognitivo do que Idosos Normotensos. *Arq Bras Cardiol* 2013; 100(5):444-451.
60. Mattos IE, do Carmo CN, Santiago LM, Luz LL. Factors associated with functional incapacity in elders living in long stay institutions in Brazil: a cross-sectional study. *BMC Geriatr* 2014; 14(47):1-9.
61. Memória CM, Yassuda MS, Nakano EY, Forlenza OV. Brief screening for mild cognitive impairment: validation of the Brazilian version of the Montreal cognitive assessment. *Int J Geriatr Psychiatry* 2012; 28(1):34-40.
62. Memória CM, Yassuda MS, Nakano EY, Forlenza OV. Contributions of the Computer-Administered Neuropsychological Screen for Mild Cognitive Impairment (CANS-MCI) for the diagnosis of MCI in Brazil. *Int Psychogeriatr* 2014; 26(9):1483-1491.
63. Miranda LP, Silveira MF, Oliveira TL, Alves SF, Júnior HM, Batista AU, Bonan PR. Cognitive impairment, the Mini-Mental State Examination and socio-demographic and dental variables in the elderly in Brazil. *Gerodontology* 2012; 29(2):34-40.
64. Miranda EC, Pinheiro MM, Pereira LD, Iorio MCM. Correlation of the P300 evoked potential in depressive and cognitive aspects of aging. *Braz J Otorhinolaryngol* 2012; 78(5):83-89.
65. Montaña MBM, Andreoni S, Ramos LR. Clinical Dementia Rating independently predicted conversion to dementia in a cohort of urban elderly in Brazil. *Int Psychogeriatr* 2013; 25(2):245-251.
66. Moreira RO, Soldera AL, Cury B, Meireles C, Kupfer R. Is cognitive impairment associated with the presence and severity of peripheral neuropathy in patients with type 2 diabetes mellitus? *Diabetol Metab Syndr* 2015; 7(51):1-4.
67. Moreira BS, Dos Anjos DMC, Pereira DS, Sampaio RF, Pereira LSM, Dias RC, Kirwood RN. The geriatric depression scale and the timed up and go test predict fear of falling in community-dwelling elderly women with type 2 diabetes mellitus: a cross-sectional study. *BMC Geriatr* 2016; 16(56):1-10.
68. Moreira VG, Lourenço RA. Prevalence and factors associated with frailty in an older population from the city of Rio de Janeiro, Brazil: the FIBRA-RJ Study. *Clinics (São Paulo)*. 2013; 68(7):979-985.
69. Nascimento CM, Pereira JR, Andrade LP, Garuffi M, Talib LL, Forlenza OV, Cancela JM, Cominetti MR, Stella F. Physical exercise in MCI elderly promotes reduction of pro-inflammatory cytokines and improvements on cognition and BDNF peripheral levels. *Curr Alzheimer Res* 2014; 11(8):799-805.
70. Nascimento CM, Pereira JR, Andrade LP, Garuffi M, Ayan C, Kerr DS, Talib LL, Cominetti MR, Stella F. Physical Exercise Improves Peripheral BDNF Levels and Cognitive Functions in Elderly Mild Cognitive Impairment Individuals with Different BDNF Val66Met Genotypes. *J Alzheimers Dis* 2015; 43(1):81-91.
71. Neri AL, Yassuda MS, Araújo LF, Eulálio MC, Cabral BE, Siqueira MEC, Santos GA, Moura JGA. Metodologia e perfil sociodemográfico, cognitivo e de fragilidade de idosos comunitários de sete cidades brasileiras: Estudo FIBRA. *Cad Saude Publica* 2013; 29(4):778-792.
72. Neri AL, Ongaratto LL, Yassuda MS. Mini-Mental State Examination sentence writing among community-dwelling elderly adults in Brazil: text fluency and grammar complexity. *Int Psychogeriatr* 2012; 24(11):1732-1737.
73. Olchik MR, Faria J, Steibel N, Teixeira AR, Yassuda MS. Memory training (MT) in mild cognitive impairment (MCI) generates change in cognitive performance. *Arch Gerontol Geriatr* 2013; 56(3):442-447.
74. Silva SO, Chan IT, Lobo Santos MA, Cohen M, de La Roque PMA, Silva AJ, Simões A, Givigi HR, Vaisman M, Paixão Júnior CM, Teixeira PFS. Impact of thyroid status and age on comprehensive geriatric assessment. *Endocrine* 2014; 47(1):255-265.
75. Oliveira TCG, Soares FC, Macedo LDED, Diniz DLWP, Bento-Torres NVO, Picanço-Diniz CW. Beneficial effects of multisensory and cognitive stimulation on age-related cognitive decline in long-term-care institutions. *Clin Interv Aging* 2014; 9:309-321.
76. Oliveira MO, Nitrini R, Yassuda MS, Brucki SMD. Vocabulary Is an Appropriate Measure of Premorbid Intelligence in a Sample with Heterogeneous Educational Level in Brazil. *Behav Neurol* 2014; 2014:1-6.
77. Oliveira FF, Wajman JR, Bertolucci PHF, Chen ES, Smith MC. Correlations among cognitive and behavioural assessments inpatients with dementia due to Alzheimer's disease. *Clin Neurol Neurosurg* 2015; 135:27-33.
78. Oliveira FF, Pivi GAK, Chen ES, Smith MC, Bertolucci PHF. Risk factors for cognitive and functional change in one year in patients with Alzheimer's disease dementia from São Paulo, Brazil. *J Neurol Sci* 2015; 359(1-2):127-132.



79. Oliveira GM, Yokomizo JE, Vinholi e Silva LS, Saran LF, Bottino CMC, Yassuda MS. The applicability of the cognitive abilities screening instrument-short (CASI-S) in primary care in Brazil. *Int Psychogeriatr* 2016; 28(1):93-99.
80. Paradelo EMP, Lourenço RA. Is the Cambridge Cognitive Examination – Revised a good tool for detection of dementia in illiterate Brazilian older adults? *Geriatr Gerontol Int* 2014; 14(4):763-768.
81. Pastor-Valero M, Furlan-Viebig R, Menezes PR, Silva SA, Vallada H, Sczufca M. Education and WHO Recommendations for Fruit and Vegetable Intake Are Associated with Better Cognitive Function in a Disadvantaged Brazilian Elderly Population: A Population-Based Cross-Sectional Study. *PLoS One* 2014; 9(4):1-10.
82. Paula JJ, Miranda DM, Moraes EM, Malloy-Diniz LF. Mapping the clockworks: what does the Clock Drawing Test assess in normal and pathological aging? *Arq Neuropsiquiatr* 2013; 71(10):763-768.
83. Paulo TRS, Tribess S, Sasaki JE, Meneguci J, Martins CA, Freitas Júnior IF, Romo-Perez, Virtuoso Júnior JS. A Cross-Sectional Study of the Relationship of Physical Activity with Depression and Cognitive Deficit in Older Adults. *J Aging Phys Act* 2016; 24(2):311-321.
84. Peres MA, Bastos JL, Watt RG, Xavier AJ, Barbato PR, D'Orsi E. Tooth loss is associated with severe cognitive impairment among older people: findings from a population-based study in Brazil. *Aging & Ment Health* 2015; 19(10):876-884.
85. Perez M, Lourenço RA. Rede FIBRA-RJ: fragilidade e risco de hospitalização em idosos da cidade do Rio de Janeiro, Brasil. *Cad Saude Publica* 2013; 29(7):1381-1391.
86. Petry DM, Nery S, Gonçalves CJS. Avaliação neuropsicológica de idosos praticantes de capoeira. *Rev Bras Med Esporte* 2014; 20(1):51-54
87. Pinto JM, Neri AL. Factors associated with low life life satisfaction in community-dwelling elderly: FIBRA Study. *Cad Saude Publica* 2013; 29(12):2447-2458.
88. Quintas JL, Souza VC, Henriques AD, Machado-Silva W, Toledo JO, Córdova C, Moraes CF, Camargos EF, Nóbrega OT. Lack of association between apolipoprotein E genotypes and cognitive performance in the non-demented elderly. *Psychogeriatrics* 2014; 14(1):11-16.
89. Radanovic M, Nunes PV, Forlenza OV, Ladeira RB, Gattaz WF. Cognitive-linguistic deficits in euthymic elderly patients with bipolar disorder. *J Affect Disord* 2013; 150(2):691-694.
90. Ribeiro PCC, Lopes CS, Lourenço RA. Prevalence of Dementia in Elderly Clients of a Private Health Care Plan: A Study of the FIBRA-RJ, Brazil. *Dement Geriatr Cogn Disord* 2013; 35(1-2):77-86.
91. Sanchez MAS, Lourenço RA. Screening for dementia: Brazilian version of the Informant Questionnaire on Cognitive Decline on the Elderly and its psychometric properties. *Geriatr Gerontol Int* 2013; 13(3):687-693.
92. Santos GD, Nunes PV, Stella F, Brum PS, Yassuda MS, Ueno LM, Gattaz WF, Forlenza OV. Multidisciplinary rehabilitation program: effects of a multimodal intervention for patients with Alzheimer's disease and cognitive impairment without dementia. *Arch Clin Psychiatry* 2015; 42(6):153-156.
93. Silva HS, Duarte YAO, Andrade FB, Cerqueira ATAR, Santos JLF, Lebrão ML. Correlates of above-average cognitive performance among older adults: the SABE study. *Cad Saude Publica* 2014; 30(9):1977-1986.
94. Soares LM, Cachioni M, Falcão DVS, Batistoni SST, Lopes A, Neri AL, Yassuda MS. Determinants of cognitive performance among community dwelling older adults in an impoverished sub-district of Sao Paulo in Brazil. *Arch Gerontol Geriatr* 2012; 54(2):187-192.
95. De Souza DMS, Veiga DF, Santos IDAO, Abla LEF, Juliano Y, Ferreira LM. Health-Related Quality of Life in Elderly Patients With Pressure Ulcers in Different Care Settings. *Wound Ostomy Continence Nurs* 2015; 42(4):352-359.
96. Teixeira CVL, Gobbi S, Pereira JR, Vital TM, Hernández SSS, Shigematsu R, Gobbi LTB. Effects of square-stepping exercise on cognitive functions of older people. *Psychogeriatrics* 2013; 13:148-156.
97. Teixeira-Leite H, Manhães AC. Association between functional alterations of senescence and senility and disorders of gait and balance. *Clinics (Sao Paulo)* 2012; 67(7):719-729.
98. Verdan C, Casarsa D, Perrout MR, Santos M, Souza JA, Nascimento O, Coutinho ESF, Laks J Lower mortality rate in people with dementia is associated with better cognitive and functional performance in an outpatient cohort. *Arq Neuropsiquiatr* 2014; 72(4):278-282
99. Yassuda MS, Lopes A, Cachioni M, Falcão DVS, Batistoni SST, Guimarães VV, Neri AL. Frailty Criteria and Cognitive Performance Are Related: Data from The Fibra Study in Ermelino Matarazzo, Sao Paulo, Brazil. *J Nutr Health Aging* 2012; 16(1):55-61.
100. Ávila RRA, Murphy CFB, Schochat E. Efeitos do Treinamento Auditivo em Idosos com Comprometimento Cognitivo Leve. *Psicologia Reflexão e Crítica* 2014; 27(3):547-555.
101. Reis KMC, Jesus CAC. Coorte de idosos institucionalizados: fatores de risco para queda a partir do diagnóstico de enfermagem. *Rev. Latino-Am. Enfermagem* 2015; 23(5):1130-1138.
102. Ribeiro LHM, Neri AL. Exercícios físicos, força muscular e atividades de vida diária em mulheres idosas. *Cien Saude Colet* 2012; 17(8):2169-2180.
103. Santos AA, Mansano-Schlosser TCS, Ceolim MF, Pavarini SCI. Sono, fragilidade e cognição: estudo multicêntrico com idosos brasileiros. *Rev Bras Enferm* 2013; 66(3): 351-357.
104. Santos CA, Ribeiro AQ, Rosa COB, Ribeiro RCL. Depressão, déficit cognitivo e fatores associados à desnutrição em idosos com câncer. *Cien Saude Colet* 2015; 20(3):751-760.
105. Silva A, Faleiros HH, Shimizu WAL, Nogueira LM, Nhãn LL, Silva BMF, Otuyama PM. Prevalência de quedas e de fatores associados em idosos segundo etnia. *Cien Saude Colet* 2012; 17(8):2181-2190.
106. Coordenação De Aperfeiçoamento De Pessoal De Nível Superior (CAPES). GeoCapes. [acessado em março de 2017] Disponível em: <http://geocapes.capes.gov.br>
107. Organização Mundial da Saúde (OMS). *Relatório Mundial de envelhecimento e saúde*. 2015. Disponível em: [http://apps.who.int/iris/bitstream/10665/186468/6/WHO\\_FWC\\_ALC\\_15.01\\_por.pdf](http://apps.who.int/iris/bitstream/10665/186468/6/WHO_FWC_ALC_15.01_por.pdf)

108. Cordell CB, Borson S, Boustani M, Chodosh J, Reuben D, Verghese J, Thies W, Fried LB. Alzheimer's Association recommendations for operationalizing the detection of cognitive impairment during the Medicare Annual Wellness Visit in a primary care setting. *Alzheimer's & Dementia* 2013; 9:141-150.
109. Skinner TR, Scott IA, Martin JH. Diagnostic errors in older patients: a systematic review of incidence and potential causes in seven prevalent diseases. *Int J Gen Med* 2016; 9:137-146.
110. Jacinto AF, Brucki S, Porto CS, Martins MA, Nitrini R. Detection of cognitive impairment in the elderly by general internists in Brazil. *Clinics (São Paulo)* 2011; 66(8):1379-1384.
111. Melo DM, Barbosa AJG. O uso do Mini-Exame do Estado Mental em pesquisas com idosos no Brasil: uma revisão sistemática. *Cien Saude Colet* 2015; 20(12):3865-3876.
112. Moraes C, Pinto JÁ Jr, Lopes MA, Litvoc J, Bottino CMC. Impact of sociodemographic and health variables on mini-mental state examination in a community-based sample of older people. *Eur Arch Psychiatry Clin Neurosci* 2010; 260:535-542.
113. Lim YY, Snyder PJ, Pietrzak RH, Ukiqi A, Villemagne VL, Ames D, Salvado O, Bourgeat P, Martins RN, Masters CL, Rowe CC, Maruff P. Sensitivity of composite scores to amyloid burden in preclinical Alzheimer's disease: Introducing the Z-scores of Attention, Verbal fluency, and Episodic memory for Nondemented older adults composite score. *Alzheimers Dement (Amst.)* 2016; 2:19-26.
114. Demetriou E, Holtzer R. Mild Cognitive Impairments Moderate the Effect of Time on Verbal Fluency Performance. *J Int Neuropsychol Soc* 2017; 23(1):44-55.
115. Mirandez RM, Aprahamian I, Talib LL, Forlenza OV, Radanovic M. Multiple category verbal fluency in mild cognitive impairment and correlation with CSF biomarkers for Alzheimer's disease. *Int Psychogeriatr* 2017; 29(6):949-958.
116. Caramelli P, Carthery-Goulart MT, Porto CS, Charchat-Fichman H, Nitrini R. Category Fluency as a Screening Test for Alzheimer Disease in Illiterate and Literate Patients. *Alzheimer Dis Assoc Disord* 2007; 21(1):65-67.
117. Machado TL, Charchat-Fichman H, Santos EL, Carvalho VA, Fialho PP, Koenig AM, Fernandes CS, Lourenço RA, Paradelo EMP, Caramelli P. Normative data for healthy elderly on the phonemic verbal fluency task – FAS. *Dement Neuropsychol* 2009; 3(1):55-60.
118. Montiel JM, Cecato JF, Bartholomeu D, Martinelli JE. Testes do desenho do relógio e de fluência verbal: contribuição diagnóstica para o Alzheimer. *Psicologia: teoria e prática* 2014, 16(1):169-180.
119. Shulman KI. Clock-drawing: is it the ideal cognitive screening test? *Int J Geriatr Psychiatry* 2000; 15(6):548-561.
120. Yang L, Yan J, Jin X, Jin Y, Yu W, Xu S, Wu H. Screening for Dementia in Older Adults: Comparison of Mini-Mental State Examination, Mini-Cog, Clock Drawing Test and AD8. *PLoS One* 2016; 11(12):1-5.
121. Oresanya LB, Lyons WL, Finlayson E. Preoperative Assessment of the Older Patient: A Narrative Review. *JAMA* 2014; 311(20):2110-2120.

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