INSTRUMENTS FOR THE NEUROPSYCHOLOGICAL ASSESSMENT OF THE ELDERLY: AN INTEGRATIVE REVIEW

Considerations about sexual affective interpersonal relationships in a confinement regime due to
Instrumentos para avaliação neuropsicológica de idosos: uma revisão integrativa
Instrumentos para la evaluación neuropsicológica del adulto mayor: una revisión integradora

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Abstract: Considering the aging of the world population, it is essential to understand which neuropsychological instruments have been used in the context of the neuropsychological assessment of this population. The objective of this study was to investigate which neuropsychological instruments are most frequently used to assess the elderly. An Integrative Literature Review was carried out, being the search conducted on Scopus, PubMed, and Scielo databases for open-access articles published since 2016. Out of the 978 studies found, 37 were selected based on inclusion and exclusion criteria. Over 80 different instruments used for the neuropsychological assessment of the elderly were found. The most frequently used instruments measured executive functions, global mental state, and memory, being the most frequently applied the TMT, the MMSE, the digits span and the verbal fluency task. The existence of normative studies recommended by the Brazilian organ SATEPSI was additionally assessed, being 5 out of the 15 most frequently used instruments recommended for clinical use. We consider that it is necessary to improve the instruments according to the public's needs, taking into consideration the demands generated by the patients' age and varied educational levels.

Keywords: neuropsychological assessment; aging; psychological tests.

Resumo: *Considerando o crescente envelhecimento da população mundial, torna-se essencial compreender quais instrumentos vêm sendo utilizados para a realização de avaliações neuropsicológicas voltadas a esta população. O objetivo deste estudo, portanto, foi investigar quais instrumentos neuropsicológicos são mais frequentemente utilizados para avaliar esta população, e para isso, foi realizada uma Revisão Integrativa da literatura, que buscou trabalhos acadêmicos de acesso livre contidos nas bases Scopus, PubMed e Scielo publicados desde 2016. Dos 978 trabalhos encontrados, 37 artigos foram selecionados com base nos critérios de inclusão e exclusão. Foram encontrados, ao todo, mais de 80 instrumentos diferentes para avaliação neuropsicológica de idosos. Os instrumentos mais usados mediram funções executivas, estado mental global e memória, sendo os mais frequentemente aplicados o TMT, MEEM, dígitos e tarefa de fluência verbal. A existência de estudos normativos recomendados pelo órgão brasileiro SATEPSI foi adicionalmente avaliada, sendo que, entre os 15 instrumentos mais frequentemente observados, cinco possuem recomendação de uso. Considera--se necessário aperfeiçoar os instrumentos conforme as necessidades do público em questão, levando em consideração as demandas advindas da idade e da variabilidade da escolaridade dos pacientes.*

Palavras chave: *avaliação neuropsicológica; envelhecimento; testes psicológicos.*

Resumen: *Considerando el creciente envejecimiento de la población mundial, es fundamental comprender cuáles instrumentos han sido utilizados para evaluar neuropsicológicamente a esta población. El objetivo de este estudio fue investigar cuáles instrumentos neuropsicológicos son los más utilizados para evaluar esta población y para esto se realizó una Revisión Integradora de la literatura. Las búsquedas se realizaron en Scopus, PubMed y Scielo por artículos de acceso libre publicados desde 2016. De los 978 estudios encontrados, se seleccionaron 37 artículos a partir de los criterios de inclusión y exclusión. Se encontraron más de 80 instrumentos diferentes para evaluar a las personas mayores. Los instrumentos más utilizados miden las funciones ejecutivas, el estado mental global y la memoria, siendo los más frecuentemente empleados el TMT, MEEM, dígitos y tarea de fluencia verbal. La existencia de estudios normativos recomendados*

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por el órgano brasileño SATEPSI fue adicionalmente evaluado, siendo cinco de los 15 instrumentos más frecuentemente empleados recomendados por el órgano. Es necesario mejorar los instrumentos en función de las necesidades del público en cuestión, teniendo en cuenta las demandas que surgen con la edad y la variabilidad de niveles educativos.

Palabras clave: *evaluación neuropsicológica; envejecimiento; testes psicológicos.*

Introduction

Populational aging is a world-scale phenomenon. The elderly is the fastest-growing segment in Brazil, it is estimated by the Brazilian Institute of Statistics and Geography (IBGE) that this segment will reach 41.5 million by 2030 (Campos, & Borges, 2015). It has been projected, according to WHO data, that Brazil's elderly population is going to be the 6th largest worldwide (Felix, 2007). According to the World Health Organization (OMS, n.d.), the population over 60 years of age is growing at a rate of about 3% per year and is growing faster than all younger age groups. In addition to the known changes in metabolism due to age, cognition may also change along with aging, with impacts on perception, attention, memory, and reasoning. Such changes may occur due to natural aging and changes in the frontal lobe circuits, which tend to appear precociously in comparison to other regions of the brain (Fuentes *et al.*, 2014). Such changes, thus, are highly related to the executive functions (EF), mainly related to the frontal lobes of the brain, being also implicated in neurodegenerative processes including dementia (Nobrega, 2014). An accurate assessment and differential diagnosis are highly important to promote interventions and preserve the patient's quality of life. Neuropsychological assessment (NA), the process that aims to investigate the relationship between cognitive functions and the central nervous system, promotes a better understanding of the cognitive changes possibly resulting from brain injuries and dysfunctions (Hamdan *et al.*, 2011). As an efficient method to assist the diagnostic process and monitor the progression of numerous clinical conditions, particularly dementia, NA is known to contribute to a higher quality of life (Hamdan & Ramos, 2016). It is necessary to note that the term "dementia" encompasses different clinical conditions that are characterized by intellectual impairment that directly interferes with the patient's routine (Hamdan & Ramos, 2016). It is more prevalent among older adults, with some estimates indicating that the incidence of dementia may triple in the next 40 years (Hebert *et al.*,

2013). An increase from 4.7 million people affected in the United States in 2010 to 13.8 million in 2050 is projected (Hebert *et al.*, 2013). Thus, it is urgently necessary to understand the demands and peculiarities of this population in order to meet their needs in a coherent and adapted way, which is also important for NA. According to the Psychological Test Assessment System (SATEPSI – Brazil, 159 tests are approved for application in the country (as of April 18th, 2021), which evaluate multiple psychological and neuropsychological aspects, and also vary in application and correction norms. However, out of the 159 approved tests, only six are recovered when the target population ("Público-alvo") criteria of the searching mechanism are set for the elderly ("idosos"; as of April 18th, 2021), although it is known that others also have normative data of this population, such as WASI (Wechsler's Brief Intelligence Scale). The tests in question are Online Alternating Attention Test (AOL), Beck's Depression Inventory-II (BDI-II), d2 Test-Revised (d2-R), Rey Auditory Verbal Learning Test (RAVLT), Benton Visual Retention Test (BVRT), Wisconsin Card Sorting Test (WCST). Out of these tests, RAVLT is used to assess verbal memory, WCST is used to assess executive functioning, two are used to assess attention (AOL and d2-R), BDI-II is used to assess the level of depression symptoms and BVRT is used to assess visual memory, visual perception, and visuoconstructives praxis. Considering the worldwide population aging and the assessment resources available for NA, it is necessary to understand how NA is carried out internationally to improve it in an ecological and suitable manner, especially regarding the elderly. The present study, thus, aims to provide a list of the most oftenly used psychological and neuropsychological instruments internationally and the most important cognitive aspects in the context of the NA of elderly populations.

Methodology

An Integrative Literature Review was carried out to identify the knowledge gaps about the theme of NA in the elderly. This method consists of gathering

and systematizing results on a given topic, which systematically allows the synthesis of multiple published studies and general conclusions on the subject (Souza *et al.*, 2010). The following filters were used: articles published in scientific journals in the field of research "Psychology"; published from 2016 up to the day the search was done (May 23rd, 2020). No language filters were added. PubMed, Scopus, and Scielo databases were chosen, with the following keywords: "Neuropsychological Assessment" AND "elderly" AND "test". The inclusion criteria demandad articles to: be published in scientific journals; to include data collection in a clinical context; to employ neuropsychological instruments; to specifically focus the elderly (60+ years of age); to focus on NA. The criteria excluded articles that: did not collect data; did not use neuropsychological instruments; did not focus on the elderly; were focused on other fields, such as traffic psychology; sought the standardization of tests in a specific language or specific population; focused neuroimaging exams. The examination of the selected articles was initially focused on the abstracts and titles, being the included articles posteriorly evaluated according to their full texts in order to apply the inclusion and exclusion criteria. Tables of all the employed instruments and their frequency of use were elaborated. The state of the instrument regarding SATEPSI's position was assessed by searching for the instrument's name on two databases (on April 18th, 2021): the complete list of psychological tests ("Lista completa"; <https://satepsi.cfp.org.br/lista_teste_completa.cfm>) and the complementary list of instruments that are not of exclusive to psychologists ("Instrumentos Não Privativos"; <https://satepsi.cfp.org.br/testesNaoPrivativos.cfm>). The search was conducted using fragments of the instrument's name, its initials, and the full name, both in English and in Portuguese, when possible. Qualitative searching was employed for subtests, since a subtest might be approved as part of a collection of subtests, such as cases listed in Table 2. This study did not intend to include standardizations and normative samples that were not yet listed by SATEPSI.

Results

Initially, 978 studies were retrieved from the three databases using the overcited keywords. Scopus granted 803 findings, while PubMed granted 147 and Scielo, 28. After applying the first filters (articles published in scientific journals since 2016 in the field of Psychology), 125 articles were retrieved from Scopus, 54 from PubMed, and four from Scielo. The second filter restrained the search for articles that were labeled as "open access", granting 28 articles from Scopus, 23 from PubMed, and four from Scielo, totaling 55 papers. After the examination of titles and abstracts, four duplicates were excluded. With the full reading of the articles, 14 were excluded since the studies involved the standardization of tests in certain languages or specific to certain types of assessment, such as traffic psychology. In addition, some studies covered the adult population lower than 60 years of age or did not use neuropsychological instruments, resulting in the final number of 37 articles that met the inclusion criteria. The selection process is described in Figure 1.

Figure 1 - Literature research flow diagram.
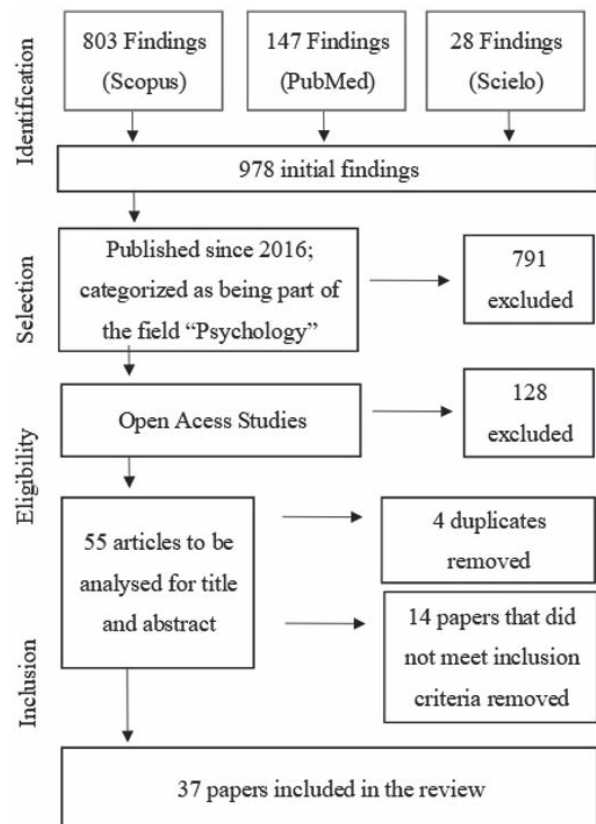
Neuropsychological instruments

The final list displays the articles in descending order of the year of publication, which is described in Figure 2. Fifty-seven instruments were used to assess different cognitive aspects, including batteries,

subtests, scales, and tasks. To facilitate the understanding of the most frequently used instruments, an instrument frequency list, described in Figure 3, was elaborated in ascending order, from the most frequently used to the less frequently used, including, out of parsimony, only instruments used in at least three different studies, which totaled a list of 17 instruments involved in NA. Also listed in Figure 3 is the information regarding SATEPSI's position (or lack of an evaluation) on the instrument.

Figure 2 - List of eligible articles.

Author, year	Used Instruments
Bangen et al., 2019	The Lawton & Brody Activities of Daily Living Scale (ADL), Verbal Fluency (Animals), Benton Naming Test (BNT), Trail Making Test (TMT A-B), Rey Auditory Verbal Learning Test (RAVLT)
Crivelli et al., 2019	MMSE, Verbal Memory, Logical Memory Test (LMT), Delayed, Digit Span Forward and Backward (DS), TMT A-B, Digit Symbol Modalities Test (DSMT), Verbal Fluency (animals and vegetables), BNT
Hessen et al., 2019	CERAD (Word List Delayed verbal recall and Delayed verbal recognition), Visual Object Space Perception (VOSP), TMT A-B, Phonetic Word Fluency (Controlled Oral Word Association Test - COWAT)
Oh et al., 2019	MMSE, Verbal Fluency Test (animals), DS, Seoul Verbal Learning Test-Elderly's version (SVLT-E)
Ashendorf et al., 2018	MMSE, ADL, Neuropsychological Assessment Battery (NAB)
Chen et al., 2018	MMSE, Hamilton Depression Rating Scale (HAMD-17), LMT, RAVLT, BNT, Verbal Fluency, Stroop Test, TMT A-B, Symbol-Digit Modality Test (SDMT), DS, Clock Drawing Test 4 (CDT4), Rey-Osterrieth Complex Figure Test (ROCF).
Choi et al., 2018	MMSE, KLOSCAD-N, DS, FAB, Executive Clock Drawing, CERAD-N, Verbal Fluency, BNT, Word List Memory Test, Contructional Praxis Test (CPT), Word List Recall Test (WLRT), Constructional Recall Test, TMT A e B
Lammers et al., 2018	Comprehensive computerised neuropsychological test battery (CANTAB), Paired Associate Learning (PAL), Verbal Recognition Memory (VRM), Spatial Span Length (SSP) and Simple Reaction Time (SRT), TMT A-B, Grooved Pegboard Task (GPT).
Martinelli et al., 2018	MMSE, Cambridge Cognitive Examination (CAMCOG), CDT, Pentagon Drawing Test (PDT)
Shibata et al., 2018	MMSE, Repeatable Battery for the Assessment of Neuropsychological Status (RBANS)
Tan et al., 2018	DS, Visual Memory, Auditory Detection, FAB, BNT, Verbal Memory, Picture Recall, Wechsler Memory Scale Revised (WMS-R), Visual Reproduction, CDT, Blocks, Symbol Digit Modality Test, Digit Cancellation
Valkanova et al., 2018	MOCA, TMT A-B, Verbal Fluency, DS-forwards, backwards, Digit Symbol substitution Test, ROCF, Hopkins Verbal Learning Test-Revised, BNT
Payton et al., 2018	Episodic and Semantic memory, Verbal Fluency (F, A, animals and professions), perceptual speed, digit cancellation, Pattern Comparison, TMT A-B
Anstey et al., 2017	Stroop Test, DS-backwards, TMT A-B, CVLT, Benton Visual Retention Test, Letter Fluency from the Halstead-Reitan Battery, BNT
Custodio et al., 2017	RAVLT, LMT, TMT A-B, ROCF, BNT, Wisconsin Card Sorting Test, Letter Number, DS
Espinosa et al., 2017	MMSE, Word-List Learning (WMS-III), Free and Cued Selective Reminding Test (FCSRT), vocabulary subtest (WAIS-III), RAVLT, Alzheimer's Disease Assessment Scale-Cognitive Subscale (ADAS-Cog), ROCF, Digit Symbol coding, DS, TMT A-B, Verbal Fluency (animals and P), BNT, Commands (ADAS-Cog), ROCF, Blocks (WAIS-III).
Klaming et al., 2017	RAVLT
Liebel et al., 2017	The Symbol Search (WAIS III), Coding subtest of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) Symbol, Letter Fluency and Category Fluency trials of Delis–Kaplan Executive Function System (D-KEFS), Stroop Test
Renfroe et al., 2017	Judgment of Line Orientation (JOLO), NAB
Schweitzer et al., 2017	Isaacs Set Test, "Colors" or "Towns", Free and Cued Selective Reminding Test (Grober and Buschke), digit-symbol (WAIS IV), Verbal Fluency (animals or vegetables, P or F), 10-word list memory test
Vandemeulebroecke et al., 2017	MMSE, Semantic fluency, BNT, CVLT, Phonemic fluency, TMT A-B
Wadsworth et al., 2017	MMSE, Hopkins Verbal Learning Test-Revised (HVLT-R), Verbal Fluency (F, A, S, Animals), BNT, DS, CDT
Bourscheid et al., 2016	MMSE, Geriatric Depression Scale (GDS-15), NEUPSILIN
Giulioli et al., 2016	MMSE, ADL, Benton Visual Retention Test (BVRT), Isaacs' Set Test, Digit Symbol Substitution Test (WAIS-III), Zazzo's Cancellation Task (short version), Wechsler Paired-Associates Test, Wechsler SimilaritiesTest
Hobson et al., 2016	MMSE, Addenbrooke's Cognitive Examination (ACE III)
Ichihara-Takeda et al., 2016	MMSE, Verbal Fluency (animals), FAB, DS-R (WMS-R), Visuospatial Working Memory Capacity, TMT A-B, Raven's Progressive Matrices
Ozer et al., 2016	ADL, GDS, CVLT, Brixton Spatial Anticipation Test, TMT A-B, Clock Drawing Test
Paula et al., 2016	Raven Progressive Matrices, The Stick Design Test (SDT), RAVLT
Pistono et al., 2016	ROCF, Memory and Semantic Test (WAIS III), DS and Symbol Digit subtests (WAIS-III), TMT A-B, Verbal Fluency (P and animals), Picture-naming task, Benton Facial Recognition Test
Steibel et al., 2016	MMSE, Rivermead Behavioral Memory Test (RBMT)
Vlagsma et al., 2016	Vienna Test System, TMT A-B, Stroop Test, DS-forward, RAVLT, Visual Elevator, Test of Everyday Attention, subtest of Zoo Map
Wadsworth et al., 2016	MMSE, HVLT-R, Verbal Fluency (F,A,S, animals), BNT, DS, CDT, TMT A-B
Zenisek et al., 2016	MoCA, DS (WAIS-IV), HVLT-R, Brief Visuospatial Memory Test Revised (BVMT-R), BNT, Block and Coding (WAIS-IV), D-KEFS, Verbal Fluency, Stroop Test, TMT A-B
Marra et al., 2015	MMSE, BNT, LMT, RAVLT, Letter-number, Sequencing Test, DS, TMT A-B, Verbal Fluency (F, A, S, animals), Stroop Test
Guerriero et al., 2015	MMSE, Free and Cued Reminding Selective (FCRST), TMT A-B
Lee et al., 2015	GDS, MMSE, Verbal Fluency, BNT, Wordlist Memory
Luis et al., 2015	MMSE, GDS, Vocabulary, Comprehension, Similarities, Digits, Information and Letters and Numbers (WAIS III), Stroop Test, Visual Patterns Test (VPT), Verbal Span and Visuospatial Span (subtest and the VPT)

It was observed that the most frequently used instruments, which were employed more than 15 times among the reviewed articles, were the Trail Making Test (TMT A-B), Mini-Mental State Examination (MMSE), Digit Span Forward and Backward (DS), Verbal Fluency (VF) and Boston Naming Test (BNT). Out of the most frequently used, BNT did not present SATEPSI's approval. This factor can make the adequate comparison between the samples a difficult process, since the results could be biased due to socioeconomic characteristics of the population,

although normative samples and testing norms that are not listed by SATEPSI do exist, such as the BNT adaptation published by Miotto *et al.* (2010). This review did not intend to verify standardization studies not listed by SATEPSI. Out of the less frequently used instruments shown in Figure 3 (employed in three different studies), it was observed that (as of April 18th, 2021), BVRT and blocks subtest from WAIS-III were recommended for usage. The search for CAVLT granted no results from SATEPSI. In sum, five out of the 15 most frequently observed instruments are recommended by SATEPSI.

Figure 3 - List and frequency of instruments used.

Use count (number of articles)	Instrument name	State of the instrument regarding SATEPSI
20	Trail Making Test (TMT A-B)	Not listed
18	Mini Mental State Examination (MMSE)	Recommended. Non-exclusive instrument
18	Digit Span Forward and Backward	Recommended. Not listed as an individual instrument, but as a component of Wechsler's Intelligence Scales WAIS-III and WISC-IV (Wechsler, & Nascimento, 2004; Wechsler, Rueda, Noronha, Sisto, Santos, & Castro, 2013)
17	Verbal Fluency (VF)	Recommended. Not listed as an individual instrument, but as a component of Neupsilin (Fonseca, Salles, & Parente, 2009)
15	Boston Naming Test (BNT)	Not listed
9	Symbol-Digit Modality Test (SDMT)	Not listed
8	Rey Auditory Verbal Learning Test (RAVLT)	Recommended
7	Stroop Test	Not listed
7	Clock Drawing Test 4 (CDT4)	Not listed
4	The Lawton & Brody Activities of Daily Living Scale (ADL)	Not listed
4	Rey–Osterrieth complex figure (ROCF)	Recommended
4	Frontal Assessment Batery (FAB)	Not listed
4	Hopkins Verbal Learning Test (HVLT)	Not listed
4	Geriatric Depression Scale (GDS-15)	Not listed
3	California Verbal Learning Test (CVLT)	Not listed
3	Benton Visual Retention Test (BVRT)	Recommended
3	Blocks (WAIS-III)	Recommended

Discussion

Although 57 different instruments have been employed in the reviewed articles, it was observed that the most recurrent ones in the NA of the elderly were related to EF, mental screening or memory. Cognitive screening instruments such as MMSE and MoCA were used in less than half of the studies (18 articles), which can influence the test results since the participant's previous clinical condition has not undergone any previous assessment. In addition, depression markers (such as BDI and GDS) and the subjects' level of independence (ADL) were mentioned in only four studies, which may also interfere with the results (Ferreira *et al.*, 2019; Tastan *et al.*, 2019).

The studies had different foci and objectives, ranging from the relationship of biomarkers and cognitive functions (Espinosa *et al.*, 2017; Hessen *et al.*, 2019; Liebel *et al.*, 2017; Payton *et al.*, 2018) to the effectiveness of administering neuropsychological tests when applied remotely (Wadsworth *et al.*, 2016, 2017). Some studies sought to evaluate patients with some type of dementia (Ashendorf *et al.*, 2018; Martinelli *et al.*, 2018; Pistono *et al.*, 2016; Zenisek *et al.*, 2016) and others assessed the general cognition of the elderly by providing updated data for a specific population (Bourscheid *et al.*, 2016; Giulioli *et al.*, 2016; Ichihara-Takeda *et al.*, 2016). One study sought to identify the cognitive tests that best predict the ability to drive in individuals with dementia (Crivelli *et al.*, 2019) and one sought to adapt an instrument to assess low educational level populations while presenting preliminary evidence of its psychometric properties (Paula *et al.*, 2016). Although it was possible to list the main instruments used in the assessment of the elderly, the foci variability unviabilized the comparison of the findings, being the findings also related to different contexts and populations. Considering the reviewed articles and the lack of specific articles regarding the NA of the elderly, it is necessary to interpret this data with caution, as the clinical practice might differ from the published protocols. It was observed that, although the articles are recent, the majority of the instruments have been developed a long time ago. In addition, in the case of Brazil, most of the instruments found are not recommended by SATEPSI (as of June 16th, 2020), either because the standardization is obsolete or because of the lack of a normative sample for the population (as in the case of BNT). Both in Brazil and internationally, it is necessary to assess whether the tests have been effective in evaluating the desired cognitive aspects, due to the frequent lack of standardization. It is necessary to understand whether the items have fully encompassed the elderly person's context, as well as if the results can provide plausible ecological inference of their cognitive functioning and possible diagnosis. The assessment based on ecological instruments is characterized by the standardized form of application associated with the tasks that simulate daily situations of cognitive demand. In the case of the EF, which was a commonly assessed aspect of cognition, daily complex tasks may involve a high demand (Zimmermann *et al.*, 2014). In this context, the adequate use of instruments can not only contribute to both the assessment and a possible rehabilitation process but can also enhance the interpretation of the results. By incorporating the patient's daily life and characteristics, the possibility of inadequate conclusions following a NA may be decreased. Thus, it is suggested that further research is carried out with the use of instruments that are valid for the elderly. It is also important to highlight that such instruments should be elaborated with ecological aspects in mind, taking into account specific factors such as natural cognitive decline and education levels, especially if low. Such focus was clearly observed in only one of the reviewed studies (Paula *et al.*, 2016).

Conclusion

Bearing in mind that the main objective of this work was to list the most frequently used psychological and neuropsychological tests internationally for the NA of the elderly, as well as the most frequently assessed cognitive aspects, it can be concluded that, in addition to the lack of protocols specialized for this population, the tests mainly evaluate EF, memory and global mental state. The most frequently used instruments, although classic in Neuropsychology, do not always present standardization and normative samples that are recommended by SATEPSI for their employment in Brazil. The lack of standardization and normative samples may impact the adequate inference of daily functioning and, consequently, may compromise the selection of adequate treatments. It is important to note that several instruments present different stages of standardization, some even including normative samples, while not being yet considered by SATEPSI. Although expensive, the standardization of instruments could promote higher access to health services among the elderly, both in public and private institutions, through more adequate assessments, referrals and treatment protocols. In sum, a possible protocol to assess this population could start with an assessment of the patient's general condition, the possibility of mental disorders such as depression, and the possibility of pre-existing comorbidities, while using ecologically coherent tests for each cognitive aspect and taking into account background measures such as education and socioeconomic status.

References

Anstey, K., Eramudugolla, R., Chopra, S., Price, J., Wood, J., & Bondi, M. (2017). Assessment of driving safety in older adults with Mild Cognitive Impairment. **Journal of Alzheimer's Disease**, 57(4), 1197–1205. DOI: 10.3233/JAD-161209.

Ashendorf, L., Alosco, M., Bing-Canar, H., Chapman, K., Martin, B., Chaisson, C., Dixon, D., Steinberg, E., Tripodis, Y., Kowall, N., & Stern, R. (2018). Clinical utility of select neuropsychological assessment battery tests in predicting functional abilities in dementia. **Archives of Clinical Neuropsychology**, 33(5), 530–540. DOI: 10.1093/arclin/acx100.

Bangen, K., Weigand, A., Thomas, K., Delano-Wood, L., Clark, L., Eppig, J., Werhane, M., Edmonds, E., & Bondi, M. (2019). Cognitive dispersion is a sensitive marker for early neurodegenerative changes and functional decline in nondemented older adults. **Neuropsychology**, 33(5), 599–608. DOI: 10.1037/neu0000532.

Bourscheid, F., Mothes, L., & Irigaray, T. (2016). Memória em idoso: Relação entre percepção subjetiva e desempenho em testes objetivos. **Estudos de Psicologia (Campinas)**, 33(1), 151–159. DOI: 10.1590/1982-027520160001000015.

Campos, M., & Borges, G. (2015). Projeção de níveis e padrões de fecundidade no Brasil. *In*: Ervatti, L., Borges, G., & Jardim, A. (org.). **Mudança demográfica no Brasil no início do século XXI**: subsídios para as projeções da população. Rio de Janeiro, Rio de Janeiro, Brasil: Instituto Brasileiro de Geografia e Estatística (IBGE).

Chen, B., Zhong, X., Mai, N., Peng, Q., Wu, Z., Ouyang, C., Zhang, W., Liang, W., Wu, Y., Liu, S., Chen, L., & Ning, Y. (2018). Cognitive Impairment and Structural Abnormalities in Late Life Depression with Olfactory Identification Impairment: An Alzheimer's Disease-Like Pattern. **International Journal of Neuropsychopharmacology**, 21(7), 640–648. DOI: 10.1093/ijnp/pyy016.

Choi, H., Choe, J., Kim, H., Han, J., Chi, Y., Kim, K., Hong, J., Kim, T., Kim., T., Yoon, S., & Kim, K. (2018). Deep learning based low-cost high-accuracy diagnostic framework for dementia using comprehensive neuropsychological assessment profiles. **BMC Geriatrics**, 18(1), 1–12. DOI: 10.1186/s12877-018-0915-z.

Crivelli, L., Russo, M., Farez, M., Bonetto, M., Prado, C., Calandri, I., Campos, J., Cohen, G., Méndez, P., Sabe, L., & Allegri, R. (2019). Driving and Alzheimer's disease: A neuropsychological screening battery for the elderly. **Dementia e Neuropsychologia**, 13(3), 312–320. DOI: 10.1590/1980-57642018dn13-030008.

Custodio, N., Lira, D., Herrera-Perez, E., Montesinos, R., Castro-Suarez, S., Cuenca-Alfaro, J., & Valeriano-Lorenzo, L. (2017). Memory alteration test to detect amnestic mild cognitive impairment and early Alzheimer's dementia in population with low educational level. **Frontiers in Aging Neuroscience**, 9(278). DOI: 10.3389/fnagi.2017.00278.

Espinosa, A., Alegret, M., Pesini, P., Valero, S., Lafuente, A., Buendía, M., José, I., Ibarria, M., Tejero, M., Giménez, J., Ruiz, S., Hernández, I., Pujadas, F. Martínez-Lage, P., Munuera, J., Arbizu, J., Tárraga, L., Hendrix, S., Ruiz, A., Becker, J. . . . Boada, M. (2017). Cognitive composites domain scores related to neuroimaging biomarkers within probable Amnestic Mild Cognitive Impairment-storage subtype. **Journal of Alzheimer's Disease**, 57(2), 447–459. DOI: 10.3233/JAD-161223.

Felix, J. (2007). Economia da Longevidade: uma revisão da bibliografia brasileira sobre o envelhecimento populacional. **Encontro da Associação Brasileira de Economia Da Saúde**, São Paulo, São Paulo, Brasil, VII.

Ferreira, J., Fernandes, J., Barbosa, R., da Silva-Filho, J., & Barbosa, L. (2019). Memory Changes and Executive Functions in Patients with Depression. **Psicologia, Saúde & Doença**, 20(1), 114–121. DOI: 10.15309/19psd200109.

Fonseca, R., Salles, J., & Parente., M. (2009). **Instrumento de avaliação neuropsicológica breve: NEUPSILIN**. São Paulo, São Paulo, Brasil: Vetor.

Fuentes, D., Malloy-Diniz, L., Camargo, C., & Cosenza, R. (2014). **Neuropsicologia**: teoria e prática. Porto Alegre, Rio Grande do Sul, Brasil: Artmed.

Giulioli, C., Meillon, C., Harmand, M., Dartigues, J., & Amieva, H. (2016). Normative scores for standard neuropsychological tests in the oldest old from the French population-based PAQUID study. **Archives of Clinical Neuropsychology**, 31(1), 58–65. DOI: 10.1093/arclin/acv055.

Guerriero, F., Botarelli, E., Mele, G., Polo, L., Zoncu, D., Renati, P., Sgarlata, C., Rollone, M., Ricevuti, G., Maurizi, N., Francis, M., Rondanelli, M., Perna, S., Guido, D., & Mannu, P. (2015). An innovative intervention for the treatment of cognitive impairment: emisymmetric bilateral stimulation improves cognitive functions in Alzheimer's disease and Mild Cognitive Impairment: An open-label study. **Neuropsychiatric Disease and Treatment**, 11, 2391–2404. DOI: 10.2147/ndt.s90966.

Hamdan, A., Pereira, A., & Riechi, T. (2011). Avaliação e Reabilitação Neuropsicológica: desenvolvimento histórico e perspectivas atuais. **Interação em Psicologia**, 15(n. especial), 47–58. DOI: 10.5380/psi.v15i0.25373.

Hamdan, A., & Ramos, A. (2016). Avaliação Neuropsicológica na Doença Alzheimer e Demência Frontotemporal: critérios nosológicos. **Interação Em Psicologia**, 18(3), 391–397. DOI: 10.5380/psi.v18i3.47039.

Hebert, L., Weuve, J., Scherr, P., & Evans, D. (2013). Alzheimer disease in the United States (2010-2050) estimated using the 2010 census. **Neurology**, 80(19), 1778–1783. DOI: 10.1212/WNL.0b013e31828726f5.

Hessen, E., Kirsebom, B., Eriksson, C., Eliassen, C. , Nakling, A., Brathen, G., . . . Fladby, T. (2019). In brief neuropsychological assessment, Amnestic Mild Cognitive Impairment (MCI) is associated with cerebrospinal fluid biomarkers for cognitive decline in contrast to the prevailing NIA-AA MCI criterion. **Journal of Alzheimer's Disease**, 67(2), 715–723. DOI: 10.3233/JAD-180964.

Hobson, P., Rohoma, K., Wong, S., & Kumwenda, M. (2016). The utility of the Mini-Addenbrooke's Cognitive Examination as a screen for cognitive impairment in elderly patients with chronic kidney disease and diabetes. **Dementia and Geriatric Cognitive Disorders Extra**, 6(3), 541–548. DOI: 10.1159/000450784.

Ichihara-Takeda, S., Takeda, K., Ikeda, N., Matsuyama, K., & Funahashi, S. (2016). Neuropsychological assessment of a new computerized cognitive task that was developed to train several cognitive functions simultaneously. **Frontiers in Psychology**, 7, 497. DOI: 10.3389/fpsyg.2016.00497.

Klaming, R., Annese, J., Veltman, D. J., & Comijs, H. C. (2017). Episodic memory function is affected by lifestyle factors: a 14-year follow-up study in an elderly population. **Aging, Neuropsychology, and Cognition**, 24(5), 528–542. DOI: 10.1080/13825585.2016.1226746.

Lammers, F., Borchers, F., Feinkohl, I., Hendrikse, J., Kant, I., Kozma, P., Pischon, T., Slooter, A., Spies, C., van Montfort, S., Zacharias, N., Zaborszky, L., & Winterer, G. (2018). Basal forebrain cholinergic system volume is associated with general cognitive ability in the elderly. **Neuropsychologia**, 119, 145–156. DOI: 10.1016/j.neuropsychologia.2018.08.005.

Lee, K., Lee, J., Lee, D., Youn, J., Kim, J., Moon, S., Kim, B., Ryu, S., Kim, M., Lee, C., Lee, N., Chang, S., Kim, Y., Kim, D., Lee, H., Woo, J., Kim, K., & Jhoo, J. (2015). The effect of choline acetyltransferase genotype on donepezil treatment response in patients with Alzheimer's Disease. **Clinical Psychopharmacology and Neuroscience**, 13(2), 168–173. DOI: 10.9758/cpn.2015.13.2.168.

Liebel, S., Jones, E., Oshri, A., Hallowell, E., Jerskey, B., Gunstad, J., & Sweet, L. (2017). Cognitive processing speed mediates the effects of cardiovascular disease on executive functioning. **Neuropsychology**, 31(1), 44–51. DOI: 10.1037/neu0000324.

Luis, E., Arrondo, G., Vidorreta, M., Martínez, M., Loayza, F., Fernández-Seara, M., & Pastor, M. (2015). Successful working memory processes and cerebellum in an elderly sample: A neuropsychological and fMRI study. **PLOS ONE**, 10(7), 1–17. DOI: 10.1371/journal.pone.0131536.

Marra, H., Myczkowski, M., Memória, C., Arnaut, D., Ribeiro, P., Mansur, C., Alberto, R., Bellini, B., da Silva, A., Tortella, G., de Andrade, D., Teixeira, M., Forlenza, O., & Marcolin, M. (2015). Transcranial Magnetic Stimulation to address Mild Cognitive Impairment in the elderly: a randomized controlled study. **Behavioural Neurology**, 287843. DOI: 10.1155/2015/287843.

Martinelli, J., Cecato, J., Martinelli, M., Melo, B., & Aprahamian, I. (2018). Desempenho do teste do desenho do pentágono para rastreio de idosos com demência de Alzheimer. **Dementia e Neuropsychologia**, 12(1), 54–60. DOI: 10.1590/1980-57642018dn12-010008.

Miotto, E., Sato, J., Lucia, M., Camargo, C., & Scaff, M. (2010). Development of an adapted version of the Boston Naming Test for Portuguese speakers. **Revista Brasileira de Psiquiatria**, 32(3), 279–282. DOI: 10.1590/S1516-44462010005000006.

Nobrega, O.. (2014). Instrumentos para Avaliação Neuropsicológica do Paciente Idoso. **Revista Brasileira de Pesquisa Em Ciência Da Saúde,** 1(2), 29–30. DOI: 10.1590/1413-81232018247.20862017.

Oh, S., Sung, J., Choi, S., & Jeong, J. (2019). Clustering and switching patterns in semantic fluency and their relationship to working memory in Mild Cognitive Impairment. **Dementia and Neurocognitive Disorders**, 18(2), 47–61. DOI: 10.12779/dnd.2019.18.2.47.

Organização Mundial da Saúde (OMS). (2021). **A ONU e as pessoas idosas**. Recuperado de https://nacoesunidas.org/acao/pessoas-idosas/.

Ozer, S., Noonan, K., Burke, M., Young, J., Barber, S., Forster, A., & Jones, R. (2016). The validity of the Memory Alteration Test and the Test Your Memory test for community-based identification of amnestic Mild Cognitive Impairment. **Alzheimer's and Dementia**, 12(9), 987–995. DOI: 10.1016/j.jalz.2016.03.014.

Paula, J., Costa, M., Andrade, G., Ávila, R., & Malloy-Diniz, L. (2016). Validity and reliability of a "simplified" version of the Taylor Complex Figure Test for the assessment of older adults with low formal education. **Dementia & Neuropsychologia**, 10(1), 52–57. DOI: 10.1590/s1980-57642016dn10100010.

Payton, N., Kalpouzos, G., Rizzuto, D., Fratiglioni, L., Kivipelto, M., Bäckman, L., & Laukka, E. (2018). Combining Cognitive, Genetic, and Structural Neuroimaging Markers to Identify Individuals with Increased Dementia Risk. **Journal of Alzheimer's Disease,** 64(2), 533–542. DOI: 10.3233/JAD-180199.

Pistono, A., Jucla, M., Barbeau, E., Saint-Aubert, L., Lemesle, B., Calvet, B., Köpke, B., Puel, M., & Pariente, J. (2016). Pauses during Autobiographical Discourse Reflect Episodic Memory Processes in Early Alzheimer's Disease. **Journal of Alzheimer's Disease,** 50(3), 687–698. DOI: 10.3233/JAD-150408.

Renfroe, J., Turner, T., & Hinson, V. (2017). Assessing visuospatial skills in Parkinson's: comparison of neuropsychological assessment battery visual discrimination to the judgment of line orientation. **Archives of Clinical Neuropsychology**, 32(1), 123–127. DOI: 10.1093/arclin/acw102.

Schweitzer, P., Husky, M., Allard, M., Amieva, H., Pérès, K., Foubert-Samier, A., . . . Swendsen, J. (2017). Feasibility and validity of mobile cognitive testing in the investigation of age-related cognitive decline. **International Journal of Methods in Psychiatric Research**, 26(3), 1–8. DOI: 10.1002/mpr.1521.

Shibata, T., Musha, T., Kosugi, Y., Kubo, M., Horie, Y., Tanaka, M., Matsuraki, H., Kobayashi, Y., & Kuroda, S. (2018). Boundary EEG asymmetry is associated to linguistic competence in vascular cognitive impairments. **Frontiers in Human Neuroscience**, 12, 170. DOI: 10.3389/fnhum.2018.00170.

Souza, M., Silva, M., & Carvalho, R. (2010). Integrative review: what is it? How to do it? **Einstein (São Paulo)**, 8(1), 102–106. DOI: 10.1590/s1679-45082010rw1134.

Steibel, N., Olchik, M., Yassuda, M., Finger, G., & Gomes, I. (2016). Influence of age and education on the Rivermead Behavioral Memory Test (RBMT) among healthy elderly. **Dementia & Neuropsychologia**, 10(1), 26–30. DOI: 10.1590/s1980-57642016dn10100005.

Tan, B., Venketasubramanian, N., Vrooman, H., Cheng, C., Wong, T., Chen, C., & Hilal, S. (2018). Haemoglobin, magnetic resonance imaging markers and cognition: a subsample of population-based study. **Alzheimer's Research & Therapy**, 10(1), 1–12. DOI: 10.1186/s13195-018-0440-5.

Tastan, S., Ayhan, H., Kose, G., Iyigun, E., & Gokcul, S. (2019). Analysis of the relationship between the autonomy of Turkish elderly people and their happiness and anxiety-depression status: A cross-sectional study. **International Psychogeriatrics**, 31(12), 1841–1842. DOI: 10.1017/S1041610219000164.

Valkanova, V., Esser, P., Demnitz, N., Sexton, C., Zsoldos, E., Mahmood, A., . . . Ebmeier, K. (2018). Association between gait and cognition in an elderly population based sample. **Gait and Posture**, 65, 240–245. DOI: 10.1016/j.gaitpost.2018.07.178.

Vandemeulebroecke, M., Bornkamp, B., Krahnke, T., Mielke, J., Monsch, A., & Quarg, P. (2017). A longitudinal item response theory model to characterize cognition over time in elderly subjects. **CPT: Pharmacometrics & Systems Pharmacology**, 6(9), 635–641. DOI: 10.1002/psp4.12219.

Vlagsma, T., Koerts, J., Tucha, O., Dijkstra, H., Duits, A., van Laar, T., & Spikman, J. (2016). Mental slowness in patients with Parkinson's disease: Associations with cognitive functions? **Journal of Clinical and Experimental Neuropsychology**, 38(8), 844–852. DOI: 10.1080/13803395.2016.1167840.

Wadsworth, H., Dhima, K., Womack, K., Hart, J., Weiner, M., Hynan, L., & Cullum, C. (2017). Validity of Teleneuropsychological Assessment in Older Patients with Cognitive Disorders. **Archives of Clinical Neuropsychology**, 33(8), 1040–1045. DOI: 10.1093/arclin/acx140.

Wadsworth, H., Galusha-Glasscock, J., Womack, K., Quiceno, M., Weiner, M., Hynan, L., Shore, J., & Cullum, C. (2016). Remote Neuropsychological Assessment in Rural American Indians with and without Cognitive Impairment. **Archives of Clinical Neuropsychology,** 31(5), 420–425. DOI: 10.1093/arclin/acw030.

Wechsler, D., & Nascimento, E. (2004). **WAIS III: escala de inteligência Wechsler para adultos.** São Paulo, São Paulo, Brasil: Casa do Psicólogo.

Wechsler, D., Rueda, F., Noronha, A., Sisto, F., Santos, A., & Castro, N. (2013). **WISC IV: escala Wechsler de inteligência para crianças.** São Paulo, São Paulo, Brasil: Casa do Psicólogo.

Zenisek, R., Millis, S., Banks, S., & Miller, J. (2016). Prevalence of below-criterion reliable Digit Span scores in a clinical sample of older adults. **Archives of Clinical Neuropsychology**, 31(5), 426–433. DOI: 10.1093/arclin/acw025.

Zimmermann, N., Cardoso, C., Kochhann, R., Jacobsen, G., & Fonseca, R. (2014). Contributions of the ecological approach to the neuropsychology of executive functions. **Temas Em Psicologia**, 22(3), 639–654. DOI: 10.9788/TP2014.3-09.