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Normative data stratified by age and education for a Spanish neuropsychological test battery: Results from the Colombian Alzheimer's Prevention Initiative Registry

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Abstract

Objective: Neuropsychologists continue to face challenges when assessing Spanish-speaking individuals due to limited availability of normative data. We developed comprehensive normative data stratified by age and education for a Spanish neuropsychological test battery used by the Grupo de Neurociencias de Antioquia (Colombia) and the Colombian Alzheimer's Prevention Initiative Registry, which have followed large families at risk for autosomal-dominant Alzheimer's disease (ADAD) since the 1990s. Approximately 75% of these individuals are cognitively-unimpaired and are not genetically predisposed to develop ADAD.

Methods: We conducted a retrospective study on neuropsychological evaluations from 2,673 cognitively unimpaired individuals (56% female), with ages ranging from 18 to 86 years and education from 1 to 25 years. Neuropsychological measures included the Consortium to Establish

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a Registry for Alzheimer's Disease-Colombia, and other multi-domain Spanish tests. We examined associations between age, education, and sex with cognitive performance.

Results: Norms stratified by age and education are presented. Cognitive performance showed small associations with age and education and was unrelated to sex.

Conclusions: We provided population-based norms for Spanish tests targeting multiple cognitive domains using a large Colombian sample. These normative data may be helpful for the neuropsychological characterization of Spanish speakers from Latin America in clinical and research settings.

Keywords

Normative data; Spanish; Assessment; Neuropsychological battery; Cognition

Introduction

Previous work, such as that conducted by Ardila, Rosselli, and Puente (1994), represent some of the pioneering efforts to highlight the need to develop normative data for Spanish-speaking individuals (including older adults and illiterate individuals), as well as improving the translation and validation of available measures. The field of neuropsychology, in recent years, has broadened our understanding of how cultural factors impact neuropsychological performance (Ardila, 2005; Brickman, Cabo, & Manly, 2006). As such, neuropsychologists have emphasized the need to develop sensitive and specific normative data to better assess individuals from diverse cultural and linguistic backgrounds (Rivera-Mindt, Byrd, Saez, & Manly, 2010), which has helped advance the field of cross-cultural neuropsychology.

As a result, several normative studies with Spanish-speaking individuals from different regions have been developed, including combined Latin American countries (Guàrdia-Olmos, Peró-Cebollero, Rivera, & Arango-Lasprilla, 2015; Arango-Lasprilla, 2015; Alegret et al., 2012), Mexico (Ostrosky-Solís, Ardila, & Rosselli, 1999; Ostrosky-Solís et al., 2007; Ostrosky-Solís, Gutierrez, Flores, & Ardila, 2007), the United States (including Puerto Rico) (Stricks, Pittman, Jacobs, Sano, & Stern, 1998; Pontón et al., 1996; Hall et al., 2018) and Spain (Peña-Casanova et al., 2012; Muntal et al., 2017). Despite these tremendous advances, there is a continued need for culturally and linguistically-appropriate norms in order to serve the needs of heterogeneous Spanish-speaking populations.

As part of ongoing efforts from the Neuroscience Group of Antioquia (Grupo de Neurociencias de Antioquia, GNA) in Medellín, Colombia and in collaboration with the Banner Alzheimer's Institute of Arizona, US, the Colombian Alzheimer's Prevention Initiative (API) Registry has evaluated over 5,000 individuals that belong to families at risk for autosomal dominant Alzheimer's disease (ADAD). These individuals have undergone clinical and cognitive assessments since the 1990s. Approximately 75% of these individuals are cognitively unimpaired and are not genetically predisposed to develop ADAD (Cornejo, Lopera, Uribe, & Salinas, 1987).

The CERAD is a neuropsychological screening battery originally developed in English (Morris et al., 1988) that includes 7 subtests: Mini-Mental State Examination (MMSE),

Semantic Fluency (Animals), Word List Learning, Word List Recall, Word List Recognition, modified Boston Naming (15 items), and Constructional Praxis. This battery has been validated to distinguish between AD and normal aging (Morris et al., 1989; Welsh et al., 1994). The Spanish CERAD has been standardized in the United States (O'Bryant et al., 2018), Costa Rica (Guerrero-Berroa et al. 2016), Puerto Rico (Carrión-Baralt et al., 2009), and Colombia (Aguirre-Acevedo et al., 2007).

Previous work by this group validated the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) in Spanish (CERAD-Col), using data from 150 cognitively unimpaired and 151 impaired individuals (50-95 years of age) who belong to the extended families followed by the GNA (Aguirre-Acevedo et al., 2007). Henao-Arboleda and colleagues (2010) developed norms stratified by age and education for the CERAD-Col using 848 cognitively unimpaired older adults with a mean age of 64, 36 individuals with mild cognitive impairment with a mean age of 69, and 151 participants with AD with a mean age of 72. These efforts resulted in a set of normative data for this extensive battery that can be used to evaluate cognitive functioning in healthy and cognitively impaired Spanish-speaking individuals.

Since the original normative works in Colombia, we have been able to obtain cross-sectional cognitive data from 2,673 individuals between the ages of 18 to 86. Our aims for the present paper were twofold: 1) expand existing standardized norms for the CERAD-Col and additional cognitive measures routinely used at the GNA by examining a larger sample with wider range of ages and with more heterogeneous educational backgrounds; and 2) develop norms for Spanish speaking populations of tests frequently used in clinical assessment (Rey-Osterrieth Complex Figure [RCFT], Raven's Progressive Matrices, Part A, Trail Making Test-A [TMT-A] WAIS-III Digit Symbol, Phonemic Fluency [FAS] and the Wisconsin Card Sorting Task [WCST]) and of other tests that currently lack normative data (i.e., Memory Impairment Screening and Memory Capacity Test). In sum, this is a large normative study that provides comprehensive norms for a broad set of Spanish-speaking neuropsychological measures targeting multiple cognitive domains.

Method

Participants

Participants were recruited from the Colombian API Registry, an effort led by the Grupo de Neurociencias (GNA) in Antioquia, Colombia, to recruit and conduct clinical and cognitive evaluations on individuals at risk for autosomal dominant AD (ADAD) due to a Presenilin-1 (PSEN1) E280A mutation who were at least 8 years of age. Detailed description of the inclusion and exclusion criteria for the registry can be found in Rios-Romenets et al. (2017) and Tariot et al. (2018). Briefly, for this retrospective study, we included clinically normal men and women PSEN1 E280A noncarriers who were at least 18 years old with a MMSE score ≥ 26. Individuals were excluded if they met criteria for Mild Cognitive Impairment due to AD as defined by cutoff scores greater than 2 on the Global Deterioration Scale (GDS; Reisberg, Ferris, de Leon, & Crook, 1988). Individuals with a significant medical, psychiatric or neurological condition or disorder; history of stroke, seizures, substance abuse, or other disorders that affect motor, visuospatial or cognitive abilities; clinically

significant screening blood laboratory abnormalities; use of any other medications with the potential to significantly affect cognition were excluded. Illiterate individuals or with zero years of formal education were also excluded.

A total of 2,673 cognitively unimpaired individuals were included in the development of these normative data (Figure 1). Participants' ages ranged from 18 to 86 years (M = 32.94, SD = 12.10), and their years of education ranged from 1 to 25 years (M = 8.89, SD = 4.34). Approximately half of the sample consisted of women (56.2 %).

Procedure

Participants provided written informed consent before enrollment into the registry. Participants were studied under guidelines approved by local institutional review boards. Ethics approval was obtained from the University of Antioquia Ethics Committee. Consenting and administration of the neuropsychological examination was conducted in Spanish, the participants' native language, by psychometricians and neuropsychologists. All tests were administered during one session at the GNA in Medellín, Antioquia, Colombia.

Measures

CERAD Total: We calculated a CERAD Total score as previously reported by Aguirre-Acevedo et al. (2016) following the Chandler method (Chandler et al., 2005), which includes six subtests from the original CERAD (Morris, 1988). This included Semantic Fluency (Animals), Boston Naming Test (15 items), Word List Learning, World List Learning Recall, Word List Learning Recognition, and Constructional Praxis Copy.

Mini-mental State Examination (MMSE).—The *MMSE* is a cognitive screening test (Folstein, Folstein, & McHugh, 1975) consisting of 30 items that measure orientation, attention, calculation, memory, visuospatial functioning, and language. This adapted version used the recall words "mesa", "silla" and "lapiz", and excluded the backward spelling of the word "world" (Aguirre-Acevedo et al., 2007).

Semantic Fluency (Animals).—On this language test, participants are asked to name as many animals as possible in sixty seconds. The score is the total number of correctly named animals (Newcombe, 1969).

Boston Naming Test (BNT-15).—The *BNT* is a measure of naming. On this version of the *BNT* (Kaplan, Goodglass, & Weintraub, 1983), participants are asked to name 15 drawings (i.e., 5 high frequency, 5 medium frequency, and 5 low frequency). Each drawing is shown for a maximum of 10 seconds, and semantic and phonemic cues are not given. A point is awarded for each word that is named correctly for a maximum score of 15.

CERAD Word List Memory Task.—The Word List Memory task is divided into learning, free recall, and recognition. First, participants are shown 10 cards with a word each over three trials and are instructed to read them aloud and memorize them. Each card was presented for two seconds. The score is calculated as the sum of words recalled correctly

over three trials, for a total of 30 points (*Word List Learning*). Intrusions are recorded and scored separately.

After a 7-minute delay, participants are asked to recall the 10 words that were previously shown (*Word List Delayed Recall*). The total score is calculated as the total number of correct words for a maximum score of 10. Finally, participants are shown a list of 20 words (10 target words and 10 distractors) and are asked to indicate whether they recognized the target words. The total score is calculated as the sum of correct "yes" or 'no" answers minus 10 (*Word List Recognition*). Negative totals are given a score of zero (Aguirre-Acevedo et al., 2007).

CERAD Constructional Praxis (CP).—This visuospatial construction and memory task is divided into a learning and a recall phase. During the learning phase, participants are asked to copy four simple drawings (i.e., circle, rhombus, cube, and superimposed rectangles) on paper (*CP Copy*). After a two-minute delay, participants are asked to recall and draw the previously learned figures, which are scored following previously established criteria for a total of 11 points (*CP Delayed Recall*: Aguirre-Acevedo et al., 2007).

Memory Impairment Screening (MIS).—The *MIS* (Buschke et al., 1999) is a screen for memory impairment. This test was adapted for Spanish-speaking individuals by Romero-Vanegas, Valencia-Marin, Aguirre-Acevedo, Buschke, and Lopera (2010). Participants are asked to read four words paired to a semantic category. A delayed free recall and delayed cued recall are administered after an interference task. The total score is the sum of the total correct words recalled in the free and cued conditions, for a maximum score of 8 (*MIS Free Recall and MIS Cued Recall*, respectively).

Memory Capacity Test (MCT).—The *MCT* is a measure of associative memory (Buschke, 1984) that was adapted for Spanish-speaking individuals (Romero-Vanegas et al., 2010). This test consists of two list of 16 items each. Words in each list belong to a different semantic category; the semantic categories are the same on both lists. First, participants read the words and the examiner pairs the word with the category. Participants are given the semantic cue and asked to recall the words (*MCT List 1 Cued Recall).* This procedure is repeated for the second list *(MCT List 2 Cued Recall*). Then, a cued recall phase for both lists is administered (*MCT List 1 Cued Recall 2 & MCT List 2 Cued Recall 2*). Finally, participants are asked to freely recall all words (List 1 & 2: *MCT Total Free Recall*).

Rey-Osterrieth Complex Figure (RCFT).—The *RCFT* (Osterrieth, 1944) is a visual test that measures planning, attention, and memory. During the learning phase of the task (*RCFT Copy*), participants are asked to copy a complex figure. The figures are scored based on previously established criteria for a total of 36 points for each. After a 3-minute delay, they are asked to reproduce the figure from memory (*RCFT Delayed Recall*).

Raven's Progressive Matrices, Part A.—On this task of non-verbal reasoning, participants are asked to identify the missing component from a set of five figures that increase in difficulty, for a total score of 12 (*Raven's Progressive Matrices:* Raven, 1996).

Trail Making Test-A (TMT-A).—The TMT-A is task of psychomotor speed in which participants are instructed to draw lines connecting circles with numbers from one to 25 on numerical order, as quickly as possible (Reitan & Wolfson, 1985). The score is calculated as the total time, in seconds, taken to complete the task.

WAIS-III Digit Symbol.—On this task of psychomotor speed, participants are shown a series of symbols that correspond to a distinct number from one to nine. They are then asked to draw the symbol that corresponds to the number, as quickly as possible. Participants are allowed 120 seconds. One point is given for each correct response (Wechsler, 1997).

"A" Cancellation Test.—This is a test of sustained attention (Ardila, Rosselli, & Puente, 1994) wherein participants are presented with a series of scattered letters on a paper and asked to cross out the 'A's as quickly as possible. Participants are timed, and the score is the number of correctly identified A's.

Phonemic Fluency (FAS).—Participants are instructed to name as many words as possible beginning with the letters F, A, and S that are not proper names, or words sharing similar roots, in 60 seconds each (Benton, 1976).. The total score is the number of correct words given for the three letters.

Wisconsin Card Sorting Task (WCST).—The *WCST* (Nelson, 1976) is a test of cognitive flexibility in which participants are presented with four fixed cards, each with a different shape, color, and number of shapes. Participants are instructed to correctly match 48 cards to one of the four fixed cards, one at a time. Participants are asked to determine the correct way to match the cards by using the feedback that is provided (i.e., right or wrong). The rule changes after the participants correctly match 6 consecutive cards, which forces participants to shift categories.

Normative Procedure

A retrospective study was conducted on neuropsychological data from the GNA and the Colombian API registry, acquired between 1993 and 2017. To obtain normative data, we divided the age ranges into eleven subgroups: 18-20, 21-25, 26-30, 31-35, 36-40, 41-45, 46-50, 51-55, 56-60, 61-65, and 65 and over; and divided years of education based on educational attainment: elementary, high school, or college, which correspond to 1-5, 6-11, or 12 or more years of education, respectively. Given the smaller sample of older individuals with higher levels of education, we used median years of education to stratify the groups in high and low education levels for all groups over the age of 41. We also provided additional normative data grouping all individuals above age 60 for clinical use when indicated (Please see Supplemental Table 1). Means and standard deviations for all subgroups were calculated for each cognitive measure, as described above.

Statistical Analyses

All analyses were conducted with IBM SPSS 25 (Armonk, NY). Normative data for each neuropsychological test can be found on tables 1–11 and includes the mean and standard deviation by age group and educational level. Preliminary analyses revealed that data were

not normally distributed (See Supplemental Table 2 for average, standard deviation, median, interquartile range, expected range, observed range, floor and ceiling effects, skewness and kurtosis coefficients). We examined the associations between age and education with cognitive measures assumed to be normally distributed (kurtosis coefficient < 7 and skewness coefficient < 2) using Pearson correlation coefficients (as described in Curran, West, & Finch, 1996). For the remaining variables, non-parametric Spearman's rho (r_s) was calculated. Cognitive performance among males and females was examined for clinical relevance using t-test analyses. Effect sizes for each test were calculated and are presented on Table 13 (Fritz, Morris, & Richler, 2012). The Bonferroni method was used to correct for multiple comparisons ($p \leq .002$, $\alpha = .05$, 24 comparisons).

Results

Norms

Tables 1 through 11 report the mean and standard deviation of the neuropsychological tests for each age group divided by level of education (Age ranges: 18-20, 21-25, 26-30, 31-35, 36-40, 41-45, 46-50, 51-55, 56-60, 61-65, and > 65; Education (years): 1-5, 6-11, ≥ 12).

Effect of Age, Education and Sex

After the Bonferroni correction was applied, age was negatively correlated with Constructional Praxis Delayed Recall ($r = -.080$, $p < .001$), RCFT Delayed Recall ($r = -.081$, $p < .001$), RCFT Copy ($r = -.052$, $p < .001$), WAIS-III Digit Symbol ($r = -0.67$, $p < .001$), and Phonemic Fluency (FAS) ($r = -0.53$, $p < .001$), while it was positively correlated to TMT- A ($r_s = .063$, $p < .001$). None of the other cognitive measures showed an association with age (see Table 12).

Most cognitive measures, including Semantic Fluency, BNT-15, Word List Learning, Raven's Progressive Matrices, and WAIS-III Digit Symbol had significant positive correlations with education (e.g., Semantic Fluency [Animals], $r = .063$, $p < .001$; BNT-15, $r = .103$, $p < .001$; Word List Learning, $r = .086$, $p < .001$; Raven's Progressive Matrices, $r = .074$, $p < .001$; and WAIS-III Digit Symbol, $r = .081$, $p < .001$). Processing speed, as measured by TMT-A completion time was negatively correlated with education ($r_s = -.126$, $p < .001$), as well as WCST Total Errors ($r = -.06$, $p < .001$) and WCST Perseverations ($r = -.06$, $p < .001$). T-test analyses revealed sex differences in performance on a few cognitive measures. Nevertheless, only the sex difference on the subtest of Word List Learning survived correction for multiple comparisons ($p \leq .002$), and all effect size were small (see Table 13).

Discussion

Norms for neuropsychological tests have been traditionally obtained from English-speaking individuals posing a challenge when evaluating individuals from diverse cultural and linguistic backgrounds, such as Spanish-speaking individuals. Further, Hispanic populations are culturally heterogeneous, which poses a greater challenge since cultural backgrounds are known to impact neuropsychological performance (Ardila, 2005; Brickman et al., 2006). Recognizing these limitations, the neuropsychology field in Latin America and other

Spanish-speaking regions has made great strides validating appropriate measures and developing norms, but there is still a need to develop more comprehensive normative data that accounts for different sociodemographic characteristics such as age, gender, level of education, and linguistic background to improve diagnostic accuracy and assessment of cognitive function (Ardila, Rosselli, & Puente, 1994).

We provided norms from a well-characterized Colombian population, which has been followed by the GNA since the 1990s. We extended previous normative studies for the CERAD-Col using an extraordinarily large sample that included 2,673 cognitively normal Spanish-speaking individuals. Our sample also broadened the age and educational attainment range (18 to 86 years old; 1-25 years of education). Large sample sizes are uncommon in normative studies with Spanish-speaking individuals, highlighting the contribution of this project to the existing literature. Moreover, past efforts to establish normative information for Spanish speakers using the CERAD have been conducted primarily with older or oldest old adults (Carrión-Baralt et al., 2009; Guerrero-Berroa et al., 2016; Fillenbaum, Kuchibhatla, Henderson, Clark, & Taussig, 2007). Lastly, to our knowledge, we provided the first comprehensive normative data for commonly used measures including the Memory Impairment Screening and Memory Capacity Test (Pérez-Martinez, Baztán, González-Becerra, & Socorro, 2005; Kuslansky, Buschke, Katz, Sliwinski, & Lipton, 2002; O'Connell & Tuokko, 2002).

Effect of Age, Education, and Sex

The results from the correlation analyses did not reveal strong associations between age and education and performance on the neuropsychological tests. With this caveat in mind, age was negatively associated with several cognitive measures as previously shown by Tombaugh (2004), wherein as age increased, performance on Constructional Praxis Delayed Recall, RCFT Delayed Recall, RCFT Copy, WAIS-III Digit Symbol, and Phonemic Fluency (FAS) worsened. Similarly, as age increased, performance on a measure of processing speed slowed down (i.e., TMT-A: Salthouse, 1985). No significant correlations were obtained for age and the WCST, Semantic Fluency (Animals), Word List Learning and the MMSE, perhaps because changes in these tests are typically observed in older populations (Butler, Ashford, & Snowdon, 1996; Mungas, Reed, Farias, & DeCarli, 2009). Regarding the associations between education level and neuropsychological test performance, while several correlations remained significant after correcting for multiple comparisons, their strength was very small. Nevertheless, as previously shown, higher levels of education related to higher scores (Ardila, Rosselli, & Rosas, 1989; Manly et al., 1999) in both verbal and nonverbal tests (Rosselli & Ardila, 2003). Finally, while males performed significantly better on Word List Learning than females, the effect size was very small. Thus, we decided not to stratify the norms per sex. In sum, the effects of age, education, and sex were small, suggesting the robustness of these norms.

Limitations

There are important limitations to this work. While the sample size was appropriate for this normative procedure, the age distribution was skewed, with approximately half of the sample falling under the age of 30. This may result from the recruitment efforts of the API

registry targeting non-carriers from families at risk for early-onset AD. This age distribution may also explain the weak correlations of some test scores with age. Furthermore, given that individuals over the age of 40 were less likely to have 12 or more years of education, we stratified the norms in high and low education for those age groups using the median years of education. This arrangement resulted in larger sample sizes for those age groups and better representation of the sample. Notably, differences in access to education and its quality vary greatly in rural as opposed to urban zones in developing countries, such as Colombia (Pulido, Heredia, & Angel, 2010). Thus, differences in quality of education may restrict the validity of utilizing years of education as a measure. Future research may investigate how factors related to education such as quality of education can impact cognitive test performance (Sisco et al., 2015).

Furthermore, the sample was restricted geographically as all participants were recruited from the same area of Colombia (Antioquia region), and thus generalization to other Spanish-speaking individuals may not be appropriate. These limitations are not uncommon in retrospective studies with Latin American older adults, and do not hamper the importance and utility of this study. In addition, these normative data are an important resource for clinicians and researchers working with Colombian populations, or those with similar characteristics. Future research should strive to address these limitations by recruiting individuals from larger representative sample from diverse regions and backgrounds.

Additionally, the sample size is not equal among all tests because not all participants received the same battery of tests across the years, an inherent limitation of a retrospective study that nonetheless does not reduce the clinical utility of the normative data. Notably, the “A” Cancellation test was removed from the protocol due to psychometric limitations, resulting in smaller number of participants over the age of 33 with scores for this test.

Lastly, some of the norms obtained from this sample may differ from previous norms published with Spanish-speaking individuals from other regions. For instance, our norms varied from those published by Ostrosky-Solís et al. (2007) across ages and education levels. Several factors may account for these differences, including sociodemographic, cultural, or educational characteristics of our sample. Future research should explore differences among available norms directly and identify contributing factors to such differences so that we expand our understanding on how social and cultural factors impact neuropsychological performance. These limitations are not uncommon in retrospective studies with Latin American older adults, and do not hamper the importance and utility of this study. Future research should strive to address these limitations by recruiting individuals from larger representative sample from diverse regions and backgrounds.

Conclusion & Future Directions

In sum, we provide normative data stratified by age and level of education for frequently used neuropsychological measures. Our work expands previous efforts by increasing the sample size, widening the age range and educational backgrounds, and providing normative data for tests that currently lack norms for Spanish-speaking individuals. These norms may be useful to clinicians and researchers to improve the diagnostic utility of neuropsychological evaluations and reduce misdiagnosis across the lifespan. Future research

will benefit from including individuals from diverse regions, across the lifespan, including older adults with higher education. These data may also inform research studies, including ongoing biomarker studies and clinical trials that are being conducted with individuals with autosomal-dominant AD (Tariot et al., 2018: API Clinical Trial [NCT01998841]).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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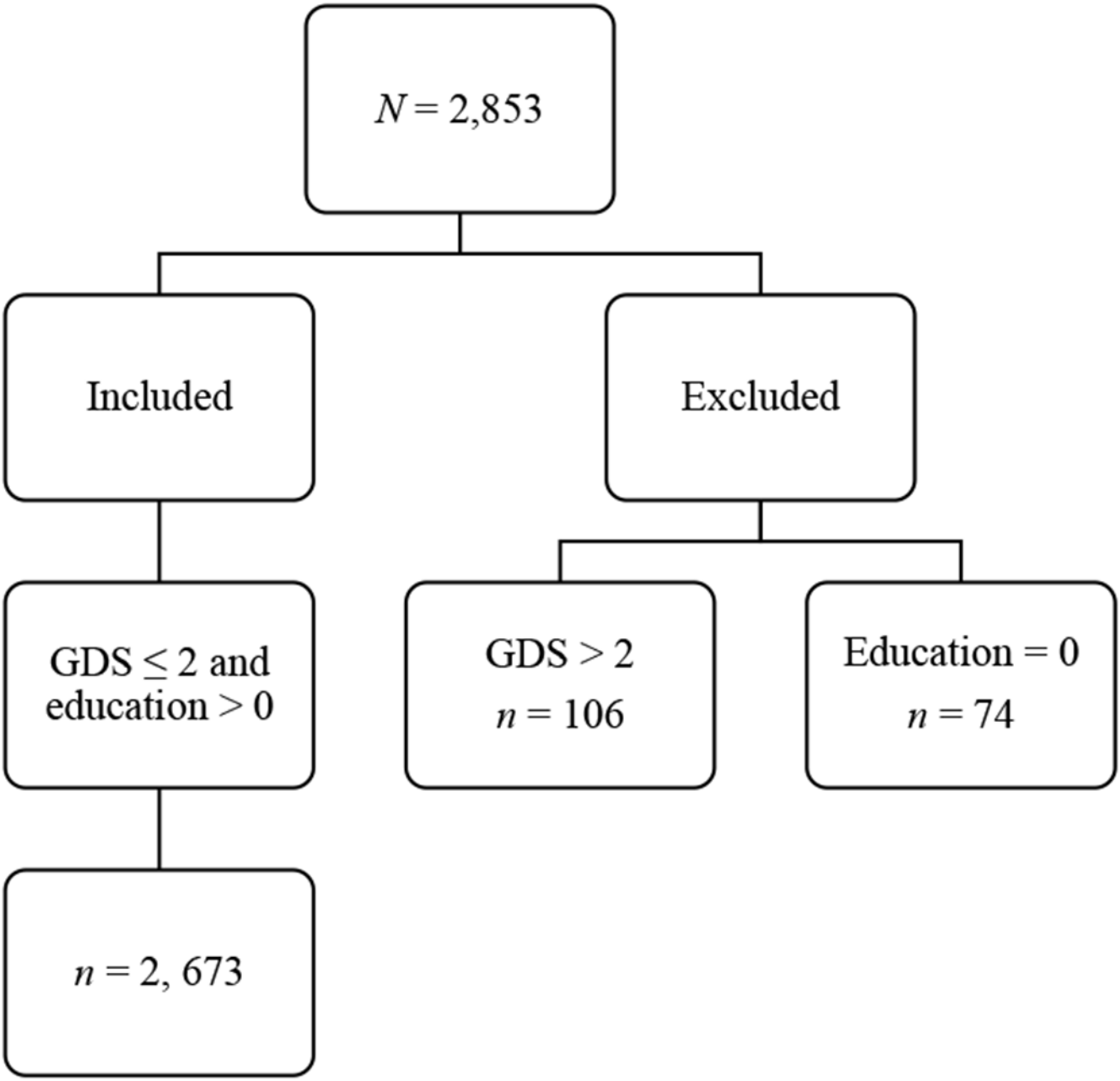

Figure 1.
Recruitment Process
Recruitment process for normative sample; GDS = Global Deterioration Scale

Table 1

Means and standard deviation for ages 18-20

		Education (years)		
		1-5 (*n* = 48)	6-11 (*n* = 210)	≥ 12 (*n* = 106)
Test	***n***	***M* (SD)**	***M* (SD)**	***M* (SD)**
Cognitive Screen				
CERAD Total	364	69.81 (13.2)	71.07 (11.82)	71.96 (11.75)
MMSE /30	364	28.37 (2.46)	28.74 (1.8)	28.71 (1.8)
Language				
Semantic Fluency (Animals)	364	18.17 (4.9)	17.36 (4.81)	18.11 (4.96)
BNT-15 /15	364	12.06 (2.41)	12.3 (2.03)	12.73 (1.85)
Memory				
Word List Learning /30	364	16.47 (4.18)	17 (3.97)	16.83 (4.13)
Word List Delayed Recall /10	364	6.15 (1.81)	6.23 (1.91)	6.27 (1.79)
Word List Recognition /10	364	9.19 (1.55)	9.39 (1.35)	9.49 (1.16)
MIS Free Recall /8	364	6.1 (2.34)	6.38 (1.8)	6.22 (1.91)
MIS Cued Recall /8	364	1.1 (0.77)	0.91 (0.73)	1.1 (0.73)
MCT List 1 Cued Recall	364	14.32 (2.13)	14.64 (2.01)	14.84 (1.62)
MCT List 2 Cued Recall	364	11.05 (3.28)	11.63 (3.6)	12.1 (3.28)
MCT List 1 Cued Recall 2	364	14.03 (2.51)	14.14 (2.52)	14.28 (1.95)
MCT List 2 Cued Recall 2	364	11.89 (3.42)	11.96 (3.56)	12.55 (3.08)
MCT Total Free Recall	364	19.16 (6.48)	18.94 (6.19)	19.91 (5.66)
CP Delayed Recall /11	364	8 (3.2)	8.43 (2.6)	8.42 (2.73)
RCFT Delayed Recall /16	364	14.56 (6.91)	15.71 (6.87)	15.83 (6.81)
Visuospatial				
CP Copy /11	364	9.4 (1.95)	9.74 (1.54)	9.6 (1.65)
RCFT Copy /36	364	26.01 (7.84)	27.62 (5.9)	27.62 (6.27)
Raven's Progressive Matrices /12	364	8.64 (2.21)	8.72 (2.13)	8.81 (1.73)
Processing Speed				
TMT-A (seconds)	364	69.67 (44.46)	68.32 (40.47)	69.52 (44.12)
WAIS-III Digit Symbol	364	42.63 (20.99)	45.96 (19.96)	47.1 (21.14)
A Cancellation Correct /16	364	14.86 (0.38)	14.41 (1.18)	14.47 (0.99)
Executive Functioning				
Phonemic Fluency (FAS)	364	25.75 (13.2)	26.12 (11.54)	25.73 (11.83)
WAIS-III Arithmetic	364	8.17 (2.79)	7.75 (1.92)	6.87 (3.11)
WCST Total Correct	364	19.58 (8.57)	20.51 (8.53)	22.16 (8.51)
WCST Total Errors	364	28.38 (8.61)	27.25 (8.73)	25.84 (8.51)
WCST Total Categories /6	364	2.42 (1.31)	2.52 (1.43)	2.9 (1.49)
WCST Perseverations	364	21.02 (8.84)	19.14 (8.5)	18.24 (7.76)
WCST Failure Maintain Set	364	0.53 (0.68)	0.62 (1.04)	0.45 (0.88)

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 2

Means and standard deviation for ages 21-25

		Education (years)		
		1-5 (*n* = 89)	6-11 (*n* = 251)	≥ 12 (*n* = 191)
Test	*n*	*M* (SD)	*M* (SD)	*M* (SD)
Cognitive Screen				
CERAD Total	531	69.6 (11.83)	72.24 (11.11)	72.31 (10.6)
MMSE /30	531	28.47 (2.48)	28.9 (1.5)	28.86 (1.72)
Language				
Semantic Fluency (Animals)	531	16.87 (4.71)	17.95 (4.65)	17.92 (4.48)
BNT-15 /15	531	11.91 (2.26)	12.22 (1.92)	12.57 (1.74)
Memory				
Word List Learning /30	531	16.78 (3.9)	17.06 (3.97)	17.25 (3.89)
Word List Delayed Recall /10	531	6.28 (1.62)	6.31 (1.8)	6.38 (1.83)
Word List Recognition /10	531	9.7 (0.78)	9.54 (0.96)	9.54 (0.95)
MIS Free Recall /8	531	6.57 (1.86)	6.63 (1.77)	6.59 (1.85)
MIS Cued Recall /8	531	0.8 (0.68)	0.93 (0.73)	1.03 (0.64)
MCT List 1 Cued Recall	531	14.78 (1.62)	14.85 (1.89)	14.94 (1.73)
MCT List 2 Cued Recall	531	12.01 (3.51)	12.37 (3.27)	12.12 (3.07)
MCT List 1 Cued Recall 2	531	13.83 (2.43)	14.42 (2.17)	14.28 (2.28)
MCT List 2 Cued Recall 2	531	12.18 (3.28)	12.78 (3.23)	12.52 (2.98)
MCT Total Free Recall	531	18.58 (5.58)	20.06 (5.61)	19.43 (5.51)
CP Delayed Recall /11	531	7.81 (3.02)	8.63 (2.5)	8.49 (2.46)
RCFT Delayed Recall /16	531	14.29 (6.64)	15.74 (7.22)	15.17 (6.65)
Visuospatial				
CP Copy /11	531	9.48 (1.79)	9.73 (1.53)	9.81 (1.42)
RCFT Copy /36	531	26.81 (5.99)	27.52 (6)	28.41 (5.17)
Raven's Progressive Matrices /12	531	8.93 (1.99)	8.65 (2.08)	8.55 (1.84)
Processing Speed				
TMT-A (seconds)	531	73.74 (42.58)	65.63 (50.75)	63.93 (38.85)
WAIS-III Digit Symbol	531	42.82 (17.4)	46.19 (18.29)	43.56 (17.55)
A Cancellation Correct /16	531	14.53 (0.83)	14.48 (1.08)	14.5 (0.92)
Executive Functioning				
Phonemic Fluency (FAS)	531	24.92 (12.17)	27.19 (11.18)	26.43 (11.81)
WAIS-III Arithmetic	531	7.36 (2.62)	7.52 (2.2)	7.86 (1.98)
WCST Total Correct	531	20.88 (8.91)	21.56 (7.96)	20.94 (7.83)
WCST Total Errors	531	27.12 (8.91)	26.41 (8.01)	27 (7.84)
WCST Total Categories /6	531	2.62 (1.56)	2.8 (1.35)	2.73 (1.31)
WCST Perseverations	531	19.67 (9.23)	18.46 (7.59)	19.13 (7.82)
WCST Failure Maintain Set	531	0.49 (0.82)	0.46 (0.78)	0.45 (0.85)

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 3

Means and standard deviation for ages 26-30

		Education (years)		
		1-5 (*n* = 114)	6-11 (*n* = 214)	≥ 12 (*n* = 140)
Test	*n*	*M* (SD)	*M* (SD)	*M* (SD)
Cognitive Screen				
CERAD Total	468	69.46 (12.49)	72.62 (11)	73.92 (11.59)
MMSE /30	468	28.57 (1.67)	28.76 (1.63)	28.97 (1.67)
Language				
Semantic Fluency (Animals)	468	17.43 (4.98)	18.17 (4.76)	18.66 (4.89)
BNT-15 /15	468	11.96 (1.93)	12.56 (1.81)	12.83 (1.84)
Memory				
Word List Learning /30	468	16.19 (4.01)	17.45 (3.82)	17.54 (4.21)
Word List Delayed Recall /10	468	5.95 (1.99)	6.35 (1.85)	6.5 (1.85)
Word List Recognition /10	468	9.34 (1.38)	9.41 (1.19)	9.39 (1.32)
MIS Free Recall /8	468	6.19 (1.94)	6.63 (1.77)	6.74 (1.61)
MIS Cued Recall /8	468	0.96 (0.64)	0.9 (0.61)	0.89 (0.69)
MCT List 1 Cued Recall	468	14.14 (2.76)	14.86 (1.52)	15.06 (1.65)
MCT List 2 Cued Recall	468	11.35 (3.92)	11.91 (2.98)	12.64 (3.05)
MCT List 1 Cued Recall 2	468	13.31 (3.14)	14.21 (2.11)	14.49 (2.32)
MCT List 2 Cued Recall 2	468	11.52 (3.86)	12.11 (3.06)	12.9 (3.14)
MCT Total Free Recall	468	18.08 (6.15)	19.17 (5.56)	20.95 (5.59)
CP Delayed Recall /11	468	8.03 (2.77)	8.41 (2.63)	8.73 (2.5)
RCFT Delayed Recall /16	468	14.75 (7.14)	15.34 (7.46)	16.72 (7.14)
Visuospatial				
CP Copy /11	468	9.65 (1.71)	9.69 (1.51)	9.88 (1.38)
RCFT Copy /36	468	26.03 (6.48)	27.68 (6.49)	28.07 (5.82)
Raven's Progressive Matrices /12	468	8.43 (2.1)	8.8 (1.95)	9.2 (2.09)
Processing Speed				
TMT-A (seconds)	468	77.64 (47.36)	68.78 (40.94)	71.44 (75.5)
WAIS-III Digit Symbol	468	41.29 (18.57)	45.48 (18.15)	48.58 (18.24)
A Cancellation Correct /16	468	14.71 (0.77)	14.31 (1.12)	14.11 (1.28)
Executive Functioning				
Phonemic Fluency (FAS)	468	24.89 (11.71)	25.32 (10.97)	26.1 (11.77)
WAIS-III Arithmetic	468	7.38 (2.25)	7.73 (1.93)	8.17 (5.66)
WCST Total Correct	468	18.83 (8.48)	20.83 (8.75)	21.55 (8.76)
WCST Total Errors	468	29.17 (8.48)	26.99 (8.96)	26.41 (8.82)
WCST Total Categories /6	468	2.41 (1.33)	2.71 (1.53)	2.71 (1.5)
WCST Perseverations	468	20.92 (9.08)	19.33 (8.47)	19.12 (9.09)
WCST Failure Maintain Set	468	0.34 (0.76)	0.5 (0.8)	0.66 (1.3)

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 4

Means and standard deviation for ages 31-35

		Education (years)		
		1-5 (*n* = 134)	6-11 (*n* = 182)	≥ 12 (*n* = 87)
Test	*n*	*M* (SD)	*M* (SD)	*M* (SD)
Cognitive Screen				
CERAD Total	403	70.56 (10.27)	71.62 (11.67)	74.2 (9.63)
MMSE /30	403	28.84 (1.72)	28.99 (1.63)	28.89 (1.42)
Language				
Semantic Fluency (Animals)	403	17.66 (5.15)	17.83 (5.22)	18.56 (4.4)
BNT-15 /15	403	11.97 (2.19)	12.36 (2.18)	12.66 (1.86)
Memory				
Word List Learning /30	403	16.67 (3.32)	16.9 (3.85)	17.77 (3.66)
Word List Delayed Recall /10	403	6.37 (1.61)	6.21 (1.9)	6.35 (1.73)
Word List Recognition /10	403	9.56 (0.94)	9.74 (0.69)	9.64 (0.71)
MIS Free Recall /8	403	6.52 (1.57)	6.73 (1.78)	6.56 (1.66)
MIS Cued Recall /8	403	0.82 (0.59)	0.9 (0.8)	1.05 (0.63)
MCT List 1 Cued Recall	403	14.66 (1.9)	14.66 (1.96)	14.92 (2)
MCT List 2 Cued Recall	403	11.59 (3.24)	11.79 (3.57)	12.19 (3.24)
MCT List 1 Cued Recall 2	403	14.06 (2.36)	14.18 (2.43)	14.67 (2.01)
MCT List 2 Cued Recall 2	403	11.97 (3.21)	12.03 (3.65)	12.59 (3.03)
MCT Total Free Recall	403	19.03 (5.94)	19.56 (6.16)	19.67 (5.12)
CP Delayed Recall /11	403	7.99 (2.81)	8.43 (2.79)	8.67 (2.45)
RCFT Delayed Recall /16	403	13.91 (6.42)	15.62 (7.02)	15.95 (7.34)
Visuospatial				
CP Copy /11	403	9.6 (1.67)	9.81 (1.45)	9.74 (1.47)
RCFT Copy /36	403	26.84 (5.81)	27.99 (6.4)	28.63 (5.87)
Raven's Progressive Matrices /12	403	8.59 (1.93)	8.87 (1.94)	9.12 (1.64)
Processing Speed				
TMT-A (seconds)	403	77.89 (48.04)	67.86 (45.16)	60.52 (38.46)
WAIS-III Digit Symbol	403	40.52 (18.19)	47.63 (20.09)	48.09 (18.11)
A Cancellation Correct /16	403	14.74 (0.54)	14.41 (0.93)	15 (0)
Executive Functioning				
Phonemic Fluency (FAS)	403	23.92 (11.95)	24.43 (11.21)	27.17 (10.53)
WAIS-III Arithmetic	403	8.33 (1.32)	7.96 (2.16)	8.37 (1.6)
WCST Total Correct	403	21.11 (9.14)	22.85 (8.44)	19 (8.33)
WCST Total Errors	403	26.86 (9.17)	25.14 (8.45)	29 (8.33)
WCST Total Categories /6	403	2.83 (1.55)	3.12 (1.53)	2.6 (1.48)
WCST Perseverations	403	19.66 (8.84)	17.65 (8.3)	20.33 (8.72)
WCST Failure Maintain Set	403	0.42 (0.89)	0.38 (0.65)	0.35 (0.77)

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 5

Means and standard deviation for ages 36-40

		Education (years)		
		1-5 (*n* = 111)	6-11 (*n* = 99)	≥ 12 (*n* = 67)
Test	*n*	*M* (SD)	*M* (SD)	*M* (SD)
Cognitive Screen				
CERAD Total	277	68.89 (12.95)	71.92 (11.25)	71.25 (10.24)
MMSE /30	277	28.24 (2.45)	28.72 (1.89)	28.75 (1.65)
Language				
Semantic Fluency (Animals)	277	17.77 (4.77)	17.76 (4.64)	18.09 (4.67)
BNT-15 /15	277	11.79 (2.22)	12.46 (1.9)	12.42 (1.96)
Memory				
Word List Learning /30	277	16.48 (4.19)	17.28 (4.27)	17.06 (3.32)
Word List Delayed Recall /10	277	5.9 (2.04)	6.51 (2.09)	6.22 (1.81)
Word List Recognition /10	277	9.41 (1.37)	9.34 (1.22)	9.47 (1.03)
MIS Free Recall /8	277	6.14 (1.94)	6.45 (1.71)	6.15 (2.24)
MIS Cued Recall /8	277	0.83 (0.7)	1.04 (0.74)	1.1 (0.72)
MCT List 1 Cued Recall	277	14.41 (2.22)	14.86 (1.99)	14.62 (1.97)
MCT List 2 Cued Recall	277	11.2 (3.58)	12.13 (3.38)	11.38 (3.71)
MCT List 1 Cued Recall 2	277	13.55 (2.79)	14.08 (2.6)	14.21 (2.18)
MCT List 2 Cued Recall 2	277	11.56 (3.47)	12.35 (3.26)	11.73 (3.64)
MCT Total Free Recall	277	18.45 (5.97)	18.89 (5.97)	18.56 (6.07)
CP Delayed Recall /11	277	7.54 (2.7)	8.3 (2.58)	8.58 (2.37)
RCFT Delayed Recall /16	277	14.49 (6.78)	15.08 (6.39)	15.64 (6.8)
Visuospatial				
CP Copy /11	277	9.38 (1.57)	9.7 (1.51)	9.97 (1.28)
RCFT Copy /36	277	25.77 (7.49)	26.85 (6.47)	27.7 (6.34)
Raven's Progressive Matrices /12	277	8.45 (1.94)	8.75 (1.99)	8.98 (1.93)
Processing Speed				
TMT-A (seconds)	277	84.21 (53.93)	65.93 (33.71)	66.57 (43.82)
WAIS-III Digit Symbol	277	42.74 (19.73)	43.94 (18.02)	44.63 (20.9)
A Cancellation Correct /16	277	14.4 (1.08)	14.67 (0.62)	14.53 (0.74)
Executive Functioning				
Phonemic Fluency (FAS)	277	23.95 (14.62)	24.97 (11.69)	25.55 (13.09)
WAIS-III Arithmetic	277	7.12 (2.47)	8.43 (1.6)	7.8 (1.9)
WCST Total Correct	277	20.1 (7.91)	22.22 (8.2)	22.65 (7.68)
WCST Total Errors	277	27.85 (7.92)	25.74 (8.24)	25.35 (7.68)
WCST Total Categories /6	277	2.55 (1.32)	2.84 (1.48)	2.97 (1.45)
WCST Perseverations	277	20.38 (8.88)	18.24 (7.88)	18.23 (7.55)
WCST Failure Maintain Set	277	0.44 (0.67)	0.6 (1.16)	0.57 (0.72)

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 6

Means and standard deviation for ages 41-45

		Education (years)	
		0-4 (*n* = 38)	≥5 (*n* = 145)
Test	*n*	*M (SD)*	*M (SD)*
Cognitive Screen			
CERAD Total	183	72.26 (12.75)	73.23 (11.34)
MMSE /30	183	28.32 (2.29)	28.88 (1.51)
Language			
Semantic Fluency (Animals)	183	17.95 (4.76)	18.53 (4.98)
BNT-15 /15	183	11.76 (2.14)	12.17 (1.95)
Memory			
Word List Learning /30	183	16.58 (5.1)	16.81 (3.9)
Word List Delayed Recall /10	183	6.18 (2.15)	6.27 (1.8)
Word List Recognition /10	183	9.59 (0.89)	9.5 (0.91)
MIS Free Recall /8	183	6.71 (1.51)	6.36 (1.84)
MIS Cued Recall /8	183	0.67 (0.49)	0.95 (0.69)
MCT List 1 Cued Recall	183	14.55 (2.43)	14.84 (1.68)
MCT List 2 Cued Recall	183	11.68 (3.28)	11.61 (3.41)
MCT List 1 Cued Recall 2	183	13.58 (2.73)	14.22 (2.29)
MCT List 2 Cued Recall 2	183	12.29 (3.2)	12.21 (3.14)
MCT Total Free Recall	183	18.32 (5.88)	18.99 (6.16)
CP Delayed Recall /11	183	7.53 (3.45)	8.1 (2.62)
RCFT Delayed Recall /16	183	14.61 (7.69)	14.07 (7.35)
Visuospatial			
CP Copy /11	183	9.63 (1.55)	9.66 (1.47)
RCFT Copy /36	183	27.37 (6.8)	27.2 (5.87)
Raven's Progressive Matrices /12	183	8.59 (2.2)	8.54 (1.97)
Processing Speed			
TMT-A (seconds)	183	76.03 (50.38)	69.41 (35.89)
WAIS-III Digit Symbol	183	42.32 (20.41)	43.5 (17.81)
A Cancellation Correct /16	183	13.5 (1.52)	14.44 (1.34)
Executive Functioning			
Phonemic Fluency (FAS)	183	22.62 (11.78)	24.09 (11.38)
WAIS-III Arithmetic	183	8 (2.35)	7.7 (1.92)
WCST Total Correct	183	21.61 (7.2)	21.48 (8.95)
WCST Total Errors	183	26.39 (7.2)	26.52 (8.95)
WCST Total Categories /6	183	2.69 (1.31)	2.75 (1.45)
WCST Perseverations	183	19.47 (7.04)	18.45 (8.62)
WCST Failure Maintain Set	183	0.69 (1.31)	0.61 (0.91)

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 7

Means and standard deviation for ages 46-50

		Education (years)	
		0-4 (*n* = 50)	**≥ 5 (*n* = 120)**
Test	***n***	***M(SD)***	***M (SD)***
Cognitive Screen			
CERAD Total	170	73.27 (10.92)	73 (11.6)
MMSE /30	170	28.88 (2.04)	28.85 (1.87)
Language			
Semantic Fluency (Animals)	170	17.6 (4.46)	17.74 (5.32)
BNT-15 /15	170	12.66 (1.81)	12.41 (1.89)
Memory			
Word List Learning /30	170	16.46 (4.98)	17.37 (4.11)
Word List Delayed Recall /10	170	6.1 (2.35)	6.25 (1.76)
Word List Recognition /10	170	9.39 (1.07)	9.49 (0.98)
MIS Free Recall /8	170	6.83 (1.38)	6.2 (1.81)
MIS Cued Recall /8	170	0.76 (0.44)	0.95 (0.63)
MCT List 1 Cued Recall	170	14.81 (1.65)	14.81 (1.75)
MCT List 2 Cued Recall	170	11.75 (3.88)	11.74 (3.45)
MCT List 1 Cued Recall 2	170	14.31 (2.21)	14.44 (1.93)
MCT List 2 Cued Recall 2	170	12.53 (3.64)	12.34 (3.38)
MCT Total Free Recall	170	18.81 (6.35)	19.56 (5.66)
CP Delayed Recall /11	170	7.88 (3.03)	8.13 (2.72)
RCFT Delayed Recall /16	170	14.74 (8.19)	15.12 (7.28)
Visuospatial			
CP Copy /11	170	9.62 (1.52)	9.77 (1.63)
RCFT Copy /36	170	26.82 (6.91)	27.9 (6.77)
Raven's Progressive Matrices /12	170	8.19 (2.11)	8.79 (1.94)
Processing Speed			
TMT-A (seconds)	170	68.15 (38.51)	69.43 (34.76)
WAIS-III Digit Symbol	170	45.03 (19.26)	42.19 (16.3)
A Cancellation Correct /16	170	14 (1.24)	14.38 (0.81)
Executive Functioning			
Phonemic Fluency (FAS)	170	23.8 (13.57)	24.38 (10.81)
WAIS-III Arithmetic	170	7.91 (2.39)	8.07 (1.54)
WCST Total Correct	170	19.53 (7.9)	20.5 (8.95)
WCST Total Errors	170	28.47 (7.9)	27.47 (9)
WCST Total Categories /6	170	2.38 (1.36)	2.72 (1.46)
WCST Perseverations	170	20.13 (7.65)	20.58 (9.78)
WCST Failure Maintain Set	170	0.45 (0.65)	0.44 (0.76)

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 8

Means and standard deviation for ages 51-55

		Education (years)	
		0-4 (*n* = 40)	≥ 5 (*n* = 80)
Test	*n*	*M (SD)*	*M (SD)*
Cognitive Screen			
CERAD Total	120	70.41 (10.71)	72.76 (11.69)
MMSE /30	120	28.6 (1.88)	28.83 (1.44)
Language			
Semantic Fluency (Animals)	120	16.38 (3.71)	17.69 (5.38)
BNT-15 /15	120	12.18 (2.07)	12.57 (1.97)
Memory			
Word List Learning /30	120	16 (4.19)	17.34 (3.98)
Word List Delayed Recall /10	120	6.08 (1.65)	6.32 (1.84)
Word List Recognition /10	120	9.59 (0.82)	9.45 (1.14)
MIS Free Recall /8	120	6.24 (1.95)	6.3 (1.82)
MIS Cued Recall /8	120	1.05 (0.78)	0.92 (0.66)
MCT List 1 Cued Recall	120	14.44 (1.93)	14.79 (1.56)
MCT List 2 Cued Recall	120	11.35 (3.89)	12.12 (3.15)
MCT List 1 Cued Recall 2	120	13.41 (2.79)	14.33 (2.04)
MCT List 2 Cued Recall 2	120	11.85 (3.47)	12.77 (2.74)
MCT Total Free Recall	120	17.74 (6.32)	20.2 (5.48)
CP Delayed Recall /11	120	7.58 (2.74)	8.12 (2.59)
RCFT Delayed Recall /16	120	13.91 (6.49)	13.96 (6.4)
Visuospatial			
CP Copy /11	120	9.83 (1.48)	9.6 (1.63)
RCFT Copy /36	120	26.87 (6.33)	28.01 (5.04)
Raven's Progressive Matrices /12	120	8.41 (1.91)	8.66 (1.57)
Processing Speed			
TMT-A (seconds)	120	69.89 (39.12)	76.49 (110.08)
WAIS-III Digit Symbol	120	41.18 (19.28)	42.76 (18.12)
A Cancellation Correct /16	120	13.6 (1.52)	14.69 (0.63)
Executive Functioning			
Phonemic Fluency (FAS)	120	24.17 (10.9)	24.5 (11.92)
WAIS-III Arithmetic	120	6.75 (1.26)	7.92 (1.88)
WCST Total Correct	120	18.37 (7.63)	19.96 (8.24)
WCST Total Errors	120	29.63 (7.63)	28.04 (8.24)
WCST Total Categories /6	120	2.45 (1.31)	2.56 (1.28)
WCST Perseverations	120	22.24 (7.73)	19.38 (7.97)
WCST Failure Maintain Set	120	0.35 (0.65)	0.33 (0.75)

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 9

Means and standard deviation for ages 56-60

		Education (years)	
		0-4 (*n* = 29)	≥ 5 (*n* = 38)
Test	***n***	***M (SD)***	***M (SD)***
Cognitive Screen			
CERAD Total	67	74.22 (12.57)	72.19 (9.49)
MMSE /30	67	28.52 (2.43)	28.32 (1.92)
Language			
Semantic Fluency (Animals)	67	17.71 (4.66)	17.13 (4.06)
BNT-15 /15	67	12.68 (2.2)	12.61 (1.84)
Memory			
Word List Learning /30	67	17.54 (3.95)	16 (3.68)
Word List Delayed Recall /10	67	6.46 (1.9)	5.78 (2.11)
Word List Recognition /10	67	9.52 (1.12)	9.55 (0.68)
MIS Free Recall /8	67	6.52 (2.11)	6.39 (2.28)
MIS Cued Recall /8	67	1.3 (0.48)	1.31 (0.85)
MCT List 1 Cued Recall	67	14.78 (2.26)	14.52 (1.84)
MCT List 2 Cued Recall	67	11.57 (4.09)	11.26 (3.45)
MCT List 1 Cued Recall 2	67	14.61 (2.33)	14.23 (2.26)
MCT List 2 Cued Recall 2	67	12.43 (3.68)	11.94 (3.18)
MCT Total Free Recall	67	19.65 (6.29)	18.23 (6.06)
CP Delayed Recall /11	67	8.46 (2.47)	7.58 (2.93)
RCFT Delayed Recall /16	67	16.07 (6.44)	13.32 (6.8)
Visuospatial			
CP Copy /11	67	9.82 (1.25)	9.61 (1.46)
RCFT Copy /36	67	27.46 (5.16)	25.11 (8.01)
Raven's Progressive Matrices /12	67	8.55 (2.11)	8.42 (1.79)
Processing Speed			
TMT-A (seconds)	67	72.86 (54.75)	86.53 (70.13)
WAIS-III Digit Symbol	67	46 (18.11)	41.57 (18.56)
A Cancellation Correct /16	67	14.83 (0.41)	12.83 (2.64)
Executive Functioning			
Phonemic Fluency (FAS)	67	24.21 (12.43)	26.08 (12.31)
WAIS-III Arithmetic	67	8.2 (1.92)	7.6 (2.61)
WCST Total Correct	67	20.82 (8.05)	20.97 (7.89)
WCST Total Errors	67	27.18 (8.05)	27.03 (7.89)
WCST Total Categories /6	67	2.57 (1.17)	2.47 (1.4)
WCST Perseverations	67	19.14 (7.99)	18.06 (6.66)
WCST Failure Maintain Set	67	0.39 (0.58)	0.68 (1.3)

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 10

Means and standard deviation for ages 61-65

		Education (years)	
		0-4 (*n* = 22)	≥ 5 (*n* = 32)
Test	***n***	***M (SD)***	***M (SD)***
Cognitive Screen			
CERAD Total	54	68.62 (7.1)	72.28 (10.76)
MMSE /30	54	28.91 (1.06)	28.25 (2.24)
Language			
Semantic Fluency (Animals)	54	16.09 (3.16)	17.91 (4.69)
BNT-15 /15	54	11.77 (2.22)	12.47 (1.8)
Memory			
Word List Learning /30	54	15.45 (2.52)	16.38 (3.54)
Word List Delayed Recall /10	54	6.14 (1.64)	6.34 (1.54)
Word List Recognition /10	54	9.76 (0.54)	9.45 (1.09)
MIS Free Recall /8	54	6.6 (1.31)	5.86 (2)
MIS Cued Recall /8	54	0.67 (0.65)	1.16 (0.9)
MCT List 1 Cued Recall	54	14.3 (1.72)	14.29 (1.98)
MCT List 2 Cued Recall	54	11.05 (3.41)	11.71 (2.73)
MCT List 1 Cued Recall 2	54	13.95 (1.88)	14.21 (2.5)
MCT List 2 Cued Recall 2	54	11.4 (3.44)	12.21 (2.7)
MCT Total Free Recall	54	17.35 (6.71)	18.18 (6.3)
CP Delayed Recall /11	54	7.55 (2.96)	7.34 (2.68)
RCFT Delayed Recall /16	54	13.39 (7.11)	11.75 (6.1)
Visuospatial			
CP Copy /11	54	9.32 (1.39)	8.97 (2.06)
RCFT Copy /36	54	26.14 (5.98)	24.39 (7.55)
Raven's Progressive Matrices /12	54	8.43 (1.94)	8.16 (2)
Processing Speed			
TMT-A (seconds)	54	87.27 (54.51)	76.31 (48.02)
WAIS-III Digit Symbol	54	33.5 (10.58)	41.04 (15.53)
A Cancellation Correct /16	54	12 (2.83)	13.67 (2.31)
Executive Functioning			
Phonemic Fluency (FAS)	54	24.5 (10.92)	27.47 (10)
WAIS-III Arithmetic	54	4.5 (0.71)	5.5 (0.71)
WCST Total Correct	54	19.73 (6.13)	20.06 (8.72)
WCST Total Errors	54	28.27 (6.13)	27.87 (8.73)
WCST Total Categories /6	54	2.55 (1.18)	2.48 (1.36)
WCST Perseverations	54	19.27 (6.21)	20.26 (9.04)
WCST Failure Maintain Set	54	0.48 (0.68)	0.63 (0.81)

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 11

Means and standard deviation for ages 65 and above

		Education (years)	
		0-4 (*n* = 17)	≥ 5 (*n* = 24)
Test	***n***	***M (SD)***	***M (SD)***
Cognitive Screen			
CERAD Total	41	69.12 (11.22)	68.74 (11.87)
MMSE /30	41	28.41 (3.16)	28.33 (2.24)
Language			
Semantic Fluency (Animals)	41	17 (4.85)	16.79 (4.17)
BNT-15 /15	41	11.76 (2.31)	12 (1.89)
Memory			
Word List Learning /30	41	16.12 (3.6)	15.58 (3.62)
Word List Delayed Recall /10	41	5.29 (1.79)	5.46 (2.13)
Word List Recognition /10	41	9.35 (1.17)	9.37 (1.3)
MIS Free Recall /8	41	6.75 (1.44)	6.11 (2)
MIS Cued Recall /8	41	0.89 (0.33)	1.18 (0.87)
MCT List 1 Cued Recall	41	13.71 (2.92)	14.22 (2.29)
MCT List 2 Cued Recall	41	11.64 (3.08)	10.89 (4.19)
MCT List 1 Cued Recall 2	41	13.43 (2.77)	13.61 (3.11)
MCT List 2 Cued Recall 2	41	11.71 (3.29)	11.11 (4.01)
MCT Total Free Recall	41	18.29 (6.06)	16.67 (8.03)
CP Delayed Recall /11	41	7.24 (2.41)	6.92 (3.36)
RCFT Delayed Recall /16	41	13.65 (6.74)	11.54 (7.12)
Visuospatial			
CP Copy /11	41	9.59 (1.42)	9.29 (1.78)
RCFT Copy /36	41	26.76 (4.18)	24.73 (6.67)
Raven's Progressive Matrices /12	41	8.06 (2.11)	7.71 (2.26)
Processing Speed			
TMT-A (seconds)	41	83.31 (44.68)	85.46 (54.81)
WAIS-III Digit Symbol	41	41.56 (19.9)	41.76 (21.76)
A Cancellation Correct /16	41	. (.)	13.83 (1.94)
Executive Functioning			
Phonemic Fluency (FAS)	41	26.13 (12.99)	20.39 (12)
WAIS-III Arithmetic	41	. (.)	6.17 (2.32)
WCST Total Correct	41	18.76 (9.84)	21.78 (7.89)
WCST Total Errors	41	29.24 (9.84)	26.17 (7.84)
WCST Total Categories /6	41	2.47 (1.46)	2.57 (1.27)
WCST Perseverations	41	22.18 (10.55)	19.22 (7.17)
WCST Failure Maintain Set	41	0.41 (0.71)	0.85 (1.04)

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 12

Correlations between tests with age and years of education

Test	Age	Education
Cognitive Screen		
CERAD Total	−0.028	0.097**
MMSE [a]	−0.012	0.049*
Language		
Semantic Fluency (Animals)	−0.023	0.063**
BNT-15	−0.011	0.103**
Memory		
Word List Learning	−0.035	0.086**
Word List Delayed Recall	−0.034	0.055**
Word List Recognition [a]	−0.008	0.006
MIS Free Recall	−0.028	0.021
MIS Cued Recall	0.016	0.048
MCT List 1 Cued Recall [a]	−0.032	0.078**
MCT List 2 Cued Recall	−0.042*	0.065**
MCT List 1 Cued Recall 2	−0.012	0.089**
MCT List 2 Cued Recall 2	−0.021	0.052*
MCT Total Free Recall	−0.043*	0.075**
CP Delayed Recall	−0.080**	0.106**
RCFT Delayed Recall	−0.081**	0.070**
Visuospatial		
CP Copy	−0.023	0.065**
RCFT Copy	−0.052**	0.087**
Raven's Progressive Matrices	−0.052*	0.074**
Processing Speed		
TMT-A [a]	0.063**	−0.126**
WAIS-III Digit Symbol	−0.067**	0.081**
A Cancellation Correct [a]	−0.096	0.044
Executive Functioning		
Phonemic Fluency (FAS)	−0.053**	0.044*
WAIS-III Arithmetic	−0.037	0.043
WCST Total Correct	−0.026	0.059**
WCST Total Errors	0.029	−0.060**
WCST Total Categories	−0.022	0.059**
WCST Perseverations	0.031	−0.061**

Test	Age	Education
WCST Failure Maintain Set [a]	−0.006	0.017

[a] = Spearman's rho was used in these tests due to lack of normality.

**. Correlation is significant after Bonferroni correction ($p \leq .002$, $\alpha = .05$, 24 models)

*. Correlation is significant at the 0.05 level (2-tailed).

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).

Table 13

Test performance by sex

Test	Males M (SD)	Females M (SD)	t	p	d
Cognitive Screen					
CERAD Total	73.38 (10.76)	72.19 (11.17)	−2.63	.009	−.15
MMSE	28.80 (1.84)	28.72 (1.78)	−1.10	.269	−.13
Language					
Semantic Fluency (Animals)	18.03 (4.78)	17.68 (4.82)	−1.89	.059	−.11
BNT-15	12.35 (1.95)	12.33 (2.02)	−.26	.796	−.06
Memory					
Word List Learning	17.24 (3.83)	16.74 (4.04)	−3.27	.001**	−.04
Word List Delayed Recall	6.37 (1.80)	6.16 (1.89)	−2.87	.004*	−.09
Word List Recognition	9.52 (1.07)	9.46 (1.10)	−1.37	.172	−.04
MIS Free Recall	6.51 (1.80)	6.44 (1.83)	−.97	.330	−.08
MIS Cued Recall	0.94 (0.67)	0.95 (0.70)	.22	.823	.01
MCT List 1 Cued Recall	14.82 (1.81)	14.65 (1.98)	−2.18	.029*	−.09
MCT List 2 Cued Recall	11.94 (3.23)	11.79 (3.50)	−1.07	.280	−.04
MCT List 1 Cued Recall 2	14.27 (2.22)	14.08 (2.47)	−1.95	.051	−.08
MCT List 2 Cued Recall 2	12.39 (3.10)	12.12 (3.46)	−1.92	.055	−.08
MCT Total Free Recall	19.52 (5.65)	19.03 (6.06)	−1.99	.047*	−.08
CP Delayed Recall	8.36 (2.66)	8.16 (2.71)	−1.91	.056	−.07
RCFT Delayed Recall	15.23 (6.92)	14.93 (7.09)	−1.09	.274	−.04
Visuospatial					
CP Copy	9.70 (1.53)	9.67 (1.56)	−.48	.633	−.02
RCFT Copy	27.42 (6.13)	27.29 (6.35)	−.52	.600	−.02
Raven's Progressive Matrices	8.74 (1.99)	8.66 (1.95)	−1.08	.280	−.04
Processing Speed					
TMT-A (seconds)	69.09 (50.30)	71.72 (49.16)	1.35	.176	.05
WAIS-III Digit Symbol	45.42 (18.58)	43.71 (18.80)	−2.16	.031*	−.09
A Cancellation Correct	14.41 (1.06)	14.39 (1.13)	−.20	.841	−.03
Executive Functioning					
Phonemic Fluency (FAS)	26.07 (11.41)	24.72 (11.97)	−2.95	.003*	−.12
WCST Total Correct	20.94 (8.55)	20.96 (8.34)	.05	.961	.00
WCST Total Errors	27.03 (8.57)	26.98 (8.41)	−.15	.879	−.01
WCST Total Categories	2.71 (1.45)	2.70 (1.42)	−.08	.937	−.01
WCST Perseverations	19.40 (8.64)	19.15 (8.22)	−.74	.458	−.03
WCST Failure Maintain Set	0.49 (0.82)	0.49 (0.93)	−.06	.953	.00

**t-test is significant after Bonferroni correction (p ≤ .002)

*t-test is significant at the 0.05 level (2-tailed).

Note. Mini-Mental State Examination (MMSE); Boston Naming Test (BNT); Memory Impairment Screening (MIS); Memory Capacity Test (MCT); CERAD Constructional Praxis (CP); Rey-Osterrieth Complex Figure (RCFT); Trail Making Test-A (TMT-A); Wechsler Adult Intelligence Scale-III (WAIS-III); Wisconsin Card Sorting Test (WCST); Mean (M); Standard Deviation (SD).