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Age, gender, and education are associated with cognitive performance in an Israeli elderly sample with type 2 diabetes

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Abstract

Objectives—To evaluate the relationships of age, education, and gender with performance on neuropsychological tests in a cognitively intact, elderly Israeli sample with type 2 diabetes (T2D).

Methods—We examined 862 participants, 65–84 years old, enrolled in the Israel Diabetes and Cognitive Decline (IDCD) study. Multiple regression assessed associations of performance on 17 neuropsychological tests, including the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) neuropsychological battery, with age, education, and gender.

Results—Higher education and younger age were consistently associated with better performance. Women outperformed men on all memory tasks; men outperformed women on two non-verbal measures. These patterns of demographic associations with cognitive performance were very similar to those of U.S. cohorts.

Conclusions—In a cognitively intact, elderly Israeli sample with T2D, better test performance is associated primarily with higher education, followed by younger age and gender differences. Although T2D is associated with cognitive deficits, it recapitulates the patterns of relationships between cognitive performance and demographic characteristics seen in non-T2D diabetic samples.

Keywords

neuropsychology; CERAD; cognitive functioning; diabetes; demographics; elderly

Introduction

Accurate interpretation of neuropsychological performance in older adults is of importance in the clinical and research settings. Neuropsychological tests are used to differentiate normal from abnormal cognitive functioning due to neurological conditions including the various forms of dementia. Performance on these tests can be influenced by demographic factors such as age, education, and gender, for which adjustment is common (Beeri et al., 2006; Gladsjo et al., 1999; Stricks et al., 1998). For example, a highly educated 90-year old

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man who scores 11 in the Fluency test from the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) neuropsychological battery would be considered impaired if one were to apply the original CERAD norms (Welsh et al., 1994). This same score would be considered unimpaired by other norms (Beeri et al., 2006) that take into account not only gender and education, but also older age (e.g., 90 years-old). The association of gender with test performance has been found to be weaker than that of age and education; some studies have found no association (Carrión-Baralt et al., 2009; Kave, 2005; Tombaugh, 2004; Tombaugh et al., 1999) or an association with a small effect (Hester et al., 2005).

Individuals with type 2 diabetes (T2D) are at higher risk of developing mild cognitive impairment, cognitive decline, and dementia (Luchsinger, 2007; Schnaider Beeri et al., 2004; Ravona-Springer and Schnaider-Beeri, 2011; Yaffe, 2012). T2D participants performed poorly on tests of attention, psychomotor speed, executive function, but not memory, compared with non-diabetics (Nandipati et al., 2012) in a large cross-sectional study (*N* approximately 3,000) of non-demented elderly. Similarly, elderly with T2D had lower scores on all cognitive domains assessed, with the exception of memory, compared to controls in another study (van Harten, 2007). A recent longitudinal study reported that those with T2D had worse performance on attention/executive function and the immediate recall of a visual learning and memory task, than those without T2D after a 3-year follow-up period (van Elderen, 2010). Because the associations of demographic factors with cognitive performance are well-established in the general population, studies of the elderly with T2D—who are at high risk of cognitive compromise—often control for demographic characteristics without describing their associations with cognition (Nandipati et al., 2012; van Elderen, 2010; Schnaider Beeri et al., 2004).

Thus, the goal of this study was to investigate whether the associations of age, education, and gender with the CERAD neuropsychological battery, as well as other “non-CERAD” widely used neuropsychological tests, are maintained among diabetic seniors tested in the Hebrew language. In addition, neuropsychological test scores stratified by these demographic factors are provided. This study was based on the Israel Diabetes and Cognitive Decline (IDCD) study, an investigation of the effects of long-term T2D-related characteristics (e.g., inflammation, glycemic control, and obesity) on cognitive decline.

Methods

Participants

The IDCD recruited community-dwelling diabetic elderly (65+ years old) from the approximately 11,000 clients of the Maccabi Healthcare Services (MHS) Diabetes Registry. MHS is the second largest HMO in Israel, treating a representative cross-section of two million citizens. The inclusion criteria included having T2D; normal cognition at entry; being free of any neurological (e.g., *Parkinson's disease [PD]*, stroke), psychiatric (e.g., schizophrenia) or other diseases (e.g., alcohol or drug abuse) that might affect cognition; fluency in the Hebrew language; residence in Israel for at least 40 years; and having an informant. Participants were assessed by a physician experienced in assessment and diagnosis of dementia and by a neuropsychologist, who administered the broad neuropsychological battery. All participants were discussed in a diagnostic consensus conference including neurologists, psychiatrists, geriatricians, and neuropsychologists with expertise in dementia, with at least two different specialties represented. The consensus conference used the Clinical Dementia Rating (CDR) scale as well as neurological and psychiatric assessments to ensure intact cognition (CDR = 0) at entry. Participants that were deemed as cognitively impaired (CDR > 0) were excluded from the study and referred back to their primary physician.

The IDCD has recruited 1,288 participants, of whom 109 refused to participate and 282 were excluded, primarily *due to* cognitive impairment (86%), PD (2%), *cerebrovascular accident* (CVA, 1%), lack of informant (8%), other reasons (1%). This study included the 862 participants who have complete data on the cognitive tests, and on age, gender, and education. A summary of the IDCD procedure is presented in Figure 1. The study was approved by the Icahn School of Medicine at Mount Sinai, Sheba Medical Center, and MHS IRB committees.

CERAD Neuropsychological Battery

The neuropsychological tests consisted of the CERAD neuropsychological battery (in order of administration): Verbal Fluency (Newcombe, 1969), Boston Naming Test (Kaplan et al., 2005), the Mini Mental State Examination (Folstein et al., 1975), Word List Memory, Constructional Praxis (Mohs et al., 1983), Word List Recall, and Word List Recognition. After its original version, CERAD added Constructional Praxis Recall, which is not included in this study. For this study, Word List Recognition used a different list of 12 target words than the 10 words used for immediate and delayed recall. The CERAD neuropsychological battery has been used with Israeli elderly in the Hebrew language (Fillenbaum et al., 2008; Aharon-Peretz et al., 2003; Aharon-Peretz, 2002).

Verbal Fluency (Fluency)—This task measures verbal production, semantic memory, and language (Newcombe, 1969). Participants provide as many examples of the category “animal” as possible in 60 seconds.

Boston Naming Test (Boston)—This task, from the original 60-item Boston Naming Test (Kaplan et al., 2005), measures visual naming through the identification of 15 line drawings. Scores range from 0-15.

Mini Mental State Examination (MMSE)—The MMSE (Folstein et al., 1975) is a screening instrument for dementia that assesses distinct cognitive domains: orientation, memory, attention/concentration, language, and visual construction. Scores range from 0-30.

Word List Memory (Immediate Recall; Word List-I)—This task assesses learning ability for new verbal information. Participants have to read aloud a list of 10 words, which are randomly presented over three successive trials. After each trial, participants have to recall as many words as possible. Scores range from 0-10 for each trial, for a total score of 0-30.

Constructional Praxis (Praxis)—This task measures visuospatial and constructional abilities. It is part of the Alzheimer’s Disease Assessment Scale (Mohs et al., 1983). Participants are required to copy four line drawings presented in order of increasing complexity (circle, diamond, overlapping rectangles, and cube). Scores range from 0-11.

Word List Recall (Delayed Recall; Word List-D)—This test assesses the ability to recall the 10 words from the Word List Memory task after a 15-minute delay. During this delay, Praxis, and Shape, Similarities, and FAS (described below) were administered. Scores range from 0-10.

Word List Recognition (Word List-Rec)—This test assesses the ability to recognize 12 words presented earlier, when presented also with 12 distractor words. There are 12 correct responses for the target words and 12 for the distractor words. Scores range from 0-24.

Other Measures

Non-CERAD neuropsychological tests that assess different areas of cognitive functioning, which are typically affected in dementia, were included: Logical Memory (Story A) and Digit Span (forward and backward) from the Wechsler Memory Scale-Revised (Wechsler, 1987), the Similarities and Digit Symbol subtests from the Wechsler Adult Intelligence Scale-Revised (Wechsler, 1981), FAS (Spreen and Benton, 1977), Trail Making Test (Reitan, 1958), and Shape Cancellation (Sano et al., 1984). The WAIS-R and the WMS-R subtests, as well as the FAS, and TMT have been used in the Hebrew language (Axelrod et al., 2000; Fillenbaum et al., 2008; Aharon-Peretz et al., 2003; Aharon-Peretz, 2002; Shmotkin and Saposnik, 1986; Kave, 2005). Details of these tests and their assigned designations that will be used throughout the text and tables are provided below:

Trail Making Test—This is a timed task of attention, executive function, and visual scanning (Reitan, 1958). In Part A (Trails A), numbers are randomly ordered in a page, which the participant connects in ascending order by drawing a line from number to number. Trails A relies heavily on motor speed. In Part B (Trails B), numbers and letters are randomly arranged in a page, and the participant connects them by drawing a line while alternating between a number and a letter in ascending order. In addition to motor speed, the switching component of Trails B requires mental flexibility. Although, the number of errors was recorded, only the time in seconds to complete each task was used in these analyses. The maximum time to complete each task was 300 seconds.

Shape Cancellation (Shape)—This task of attention (Sano et al., 1984) consists of a page with target (diamonds) and distractor shapes. The participant crosses out only the target shapes as quickly and accurately as possible until the task is completed or four minutes have elapsed. Although, the number of errors was recorded, only time in seconds was used in these analyses. The maximum time was 240 seconds.

FAS—This test requires the ability to generate as many words as possible that begin with the letters F, A, and S (phonemic fluency) in one minute for each letter (Spreen and Benton, 1977). For this task, the Hebrew letters bet, gimel, and shin were used since they are widely administered in neuropsychological testing in Israel (Kave, 2005).

Logical Memory (Story A)—This subtest from the WMS-R (Wechsler, 1987) assesses immediate (LM-I) and delayed (LM-D) verbal memory. A short story is read to the participant, who recalls the story immediately after it is read (immediate recall) and after a 25-35 minute delay (delayed recall). During this delay, Digit Span forward and backward and Digit Symbol (described below), and Fluency, Trails A and B, and Boston were administered. The possible scores for immediate recall and for delayed recall range from 0-25.

Similarities—This subtest from the WAIS-R (Wechsler, 1981) assesses verbal abstract reasoning. The participant states the similarities or superordinate categories of paired words (concepts or objects). Score range from 0 – 33 points.

Digit Span (forward and backward)—This subtest from the WMS-R (Wechsler, 1987) is a task of attention that requires the oral repetition of number sequences. For digit forward (Digit Span-F), the participant repeats the sequence verbatim. For digit backward (Digit Span-B), the repetition is in reverse. For each task, the scores range from 0-12.

Digit Symbol—This subtest from the WAIS-R (Wechsler, 1981) is a measure of psychomotor speed. The participant enters in an empty box the symbol that corresponds to a

given digit, as quickly as possible. *The* participant is presented with a test key that contains the digits ranging from 1 to 9 paired with *their* corresponding geometrical *symbols*. The task is timed for 90s. Scores range from 0-133 (0-93 in the original version). The highest score in this study was 70.

Statistical Analyses

Multiple regression analyses were performed to examine the association of the neuropsychological measures with the independent variables age, education, and gender. Age and education were used as continuous variables in the regressions. These associations were also evaluated, controlling for duration of T2D (using length of follow-up in the MHS diabetes registry as a surrogate) and lifetime medications for T2D (any medication vs. control by diet, and any insulin vs. no insulin). It must be noted that the diabetes registry was initiated in 1998, limiting the length of follow-up.

Analyses of variance calculated means and standard deviations of the neuropsychological test scores by combinations of categorical age, education, and gender. Education was operationally defined as number of years of formal education and had three categories (0–11, 12, and 13+). These categories were selected in view of the broad educational range of the sample, and their utility in previous studies (Heaton et al., 1992; Shores and Carstairs, 2000). Similarly, in view of the sample sizes and the use of five-year categories in other studies (Beeri et al., 2006; Jacobs et al., 1997), age was subgrouped into three categories (65-69, 70-74, and 75-84) to have sufficiently large samples in the oldest categories.

Of the 17 neuropsychological measures, four had kurtosis above 5.0 (Boston, Trails A, Shape, and MMSE) and none of the others had kurtosis above 1.5. Since Boston and MMSE were negatively skewed, each was subtracted from its maximum value + 1, to create a positively skewed, positive variable suitable for logarithmic transformation. Then the four very kurtotic variables were logarithmically transformed. These transformed *variables* and the untransformed variables were dependent variables in regression analyses. To simplify interpretation of regression coefficients, five of the transformed or untransformed variables were reversed. Trails A and B and Shape were *scored as* times in seconds; large values represented worse cognition. Thus, these three measures had to be reversed so that—like the other variables—larger values represented better cognition. Similarly, since Boston and MMSE were reversed in the transformation process, they had to be reversed again.

Results

Demographic Characteristics

Table 1 presents the demographic characteristics for the entire sample based on age and education categories. Overall, the mean age for the total sample ($n = 862$) was 71.9 ($SD = 4.6$, range = 65-84) and the mean education level was 13.1 ($SD = 3.5$, range = 0-26, two with no formal education and one with 26 years). There were more men (60.2%) than women. The mean duration of T2D was 10.5 years ($SD = 1.4$, range = 2-16).

Multiple Regression Analyses. Table 2 presents the association of each neuropsychological measure with the demographic characteristics. Regardless of the ranges of the original scores, all β coefficients reflect higher values referring to better cognition. More education was consistently very strongly ($p < .001$) associated with better performance. Younger age was also consistently associated with better performance, but *associations for* some measures were not significant despite the large sample size. Several significant differences favored each gender. Among them, women outperformed men on all four memory tests

(Word List-I, Word List-D, LM-I and LM-D); men outperformed women on the two significant non-verbal tests (Praxis and Shape).

Controlling for duration of T2D and lifetime medications for T2D had minimal effects (absolute change in $\beta < 0.01$) on the associations of age, education, and gender with all the neuropsychological tests.

Table 3 presents the means, standard deviations, and the number of participants for each untransformed neuropsychological test for each combination of categories of age, education, and gender.

Discussion

Demographic and neuropsychological data were analyzed on 862 diabetic elderly participating in the IDCD Study. Our findings on the associations of age, education, and gender with the CERAD neuropsychological battery and other cognitive measures are consistent with several studies in the general population (Beeri et al., 2006; Gladsjo et al., 1999; La Rue et al., 1999). Our results extend such findings by showing that, in T2D, education, age, and to a lesser extent gender, significantly impact test performance. A recent study using age, gender, and premorbid IQ as predictors of cognitive performance found that these predictors were associated with all the cognitive measures, with the exception of gender, which was associated with most, but not all (Knight et al., 2006). For FAS, education accounted for more variance than age (18.6% vs. 11.0%, respectively), and gender accounted for less than 1% of the variance (Tombaugh et al., 1999). For Trails A and B, there were age and education effects, but not gender (Tombaugh, 2004). Women outperforming men on memory tasks has been reported in other studies (La Rue et al., 1999; Welsh et al., 1994).

In contrast to most other tests, where most studies find age effects, results for phonemic and category fluency tasks (e.g., FAS and Fluency) are less consistent (Stricks et al., 1998; Welsh et al., 1994; Fillenbaum et al., 2005). We found associations between the fluency tasks and age, consistent with several studies reporting decline in verbal production in older age (Fillenbaum et al., 2005; Wiederholt et al., 1993), but different from other findings (Beeri et al., 2006; Welsh et al., 1994). This discrepancy may reflect differences in sample demographics. The Beeri et al. participants, for instance, were at least 85 years old, but ours were 65-84.

Although all participants in this study had T2D and were assessed in the Hebrew language, we compared these results with other studies, mainly from the U.S., and not limited to individuals with T2D. The difficulties of these comparisons highlight some of the challenges addressed in cross-cultural neuropsychology. Since studies differ in demographic distributions, comparisons by age, education, and gender strata are particularly relevant. For some comparisons, we considered only subsets of the Israeli sample.

Non-demented elderly with diabetes (almost all with T2D implied by their ages) performed poorly on Animal Naming, Digit Span-B, Digit Symbol, and Trails A and B, compared with non-diabetics, after adjustment that included demographics (Nandipati et al., 2012). Compared to a cognitively normal, generally non-diabetic U.S. sample (Weintraub et al., 2009), our T2D sample had lower mean scores on Digit Span-B, Digit Symbol, and Trails A and B. For these tasks, our T2D sample showed significant demographic associations, in line with other studies (Fillenbaum et al., 2001; Weintraub et al., 2009).

Moreover, on all WMS-R and WAIS-R subtests (except Similarities, which was not tested), the Weintraub et al. sample outscored the Israeli sample (Weintraub et al., 2009). In

contrast, the Israeli sample performed better on Similarities than three U.S. samples (Kaufman et al., 1988; López and Taussig, 1991; Stricks et al., 1998).

Israeli mean scores stratified by education and gender were generally comparable to U.S. participants on the CERAD neuropsychological battery (Welsh et al., 1994). Exceptions were Boston and Word List-D, which favored the U.S. Additional exceptions were Word List-I and MMSE for U.S. women with at least 12 years of education—who were both younger and more educated, which may explain their better performance. On the FAS, the Israeli sample also performed more poorly than a U.S. sample (Tombaugh et al., 1999).

The difference in FAS scores may be attributed to several factors. Variability in the number of words generated for different letters of the alphabet (Tombaugh et al., 1999) implies variability between different languages. Khalil (2010) also found that an Arabic-speaking sample generated fewer words (using an Arabic adaptation of the FAS) than English-speaking older adults, a difference that was attributed to cultural and sociolinguistic factors. Fluency in the Hebrew language may have contributed to lower scores. Kave, who included a sample of 71-85 year-old non-diabetic, cognitively intact Israelis with at least 8 years of education found a mean score of 30.8 (8.2) for the Hebrew FAS (Kave, 2005). Applying the same education limits to our sample, the mean score increased to 26.3. Similarly, for Animals (Fluency), the mean score in Kave's study was 17.9 while in our study it was 16.3 with the same limits. Kave's immigrant participants were formally educated in Hebrew, which was their primary language. IDCD immigrant participants resided in Israel at least 40 years and spoke Hebrew fluently, but prior language and cultural experience may have impaired their performance. This interpretation is consistent with Boone's et al. results showing that fully bilingual participants or who were tested in their primary language (English) outperformed those who spoke English as a second language on several neuropsychological tests including FAS (Boone et al., 2007).

Effects of ethnicity/culture on some cognitive measures have been reported, with minority elderly in the U.S. tending to perform more poorly than Whites (Byrd et al., 2004; Stricks et al., 1998). Poorer performance by African American elderly than Whites on the CERAD neuropsychological battery was not statistically significant after controlling for demographic characteristics (Fillenbaum et al., 2001). In AD, there were racial differences on performance on Boston, MMSE, and Praxis, but not Fluency and Word List-I, after controlling for age, education, and duration and severity of AD (Welsh et al., 1995). This study excluded Word List-D and Word List-Rec due to floor/ceiling effects. Cuban American Spanish-speaking women with mild and moderate AD performed more poorly on some WAIS-R subtests than their White non-Hispanic English-speaking counterparts matched for age and level of cognitive impairment, controlling for education (Loewenstein et al., 1993). White adults outperformed Black adults on each of the 11 WAIS-R subtests (Kaufman et al., 1988). Thus, findings from cross-cultural research consistently argue in favor of norms for specific ethnic groups, which can decrease the likelihood of ethnically biased misclassifications.

The analysis of this study was limited to the three most prominent demographic characteristics, and did not include medical factors. Another limitation was that assessment of the memory domain was limited to verbal tasks, not including any visuospatial tasks. The strengths of this study included a large sample size, a comprehensive neuropsychological battery, and a highly reliable diagnosis of T2D.

This study documents that relationships of age, education, and gender with neuropsychological test performance in a diabetic cohort are similar to relationships found in general samples. Higher education and younger age were associated with better

performance. Women performed better than men on verbal memory tasks, and men outperformed women on non-verbal tasks. Although, the study was limited to individuals with T2D tested in Hebrew, and there were some lower mean test scores compared to other studies of non-T2D participants, the relationships of demographic factors with cognitive performance were robustly maintained.

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Key points

1. In a cognitively normal sample of elderly with type 2 diabetes, higher education and younger age are consistently associated with better performance on neuropsychological tests. Women outperform men on verbal memory tasks, and men perform better than women on two non-verbal tasks.
2. The relationships between demographic characteristics and neuropsychological test performance in type 2 diabetes are similar to that observed in non-diabetic samples.

Figure 1.
Selection of Study Participants

Table 1
Demographic characteristics for the entire sample, stratified by age and education ranges and gender

Education Range	Men				Women				Total			
	0-11	12	13+	Total	0-11	12	13+	Total	0-11	12	13+	Total
N	127	148	244	519	86	128	129	343	213	276	373	862
<u>Age, years</u>												
Mean	72.3	71.8	71.8	71.9	72.3	72.3	71.4	72.0	72.3	72.0	71.7	71.9
(SD)	4.7	4.4	4.7	4.6	4.7	4.8	4.2	4.5	4.7	4.6	4.5	4.6
<u>Education, years</u>												
Mean (SD)	9.1	12.0	16.4	13.4	8.9	12.0	15.9	12.7	9.0	12.0	16.3	13.1
(SD)	2.0	.0	2.1	3.5	2.2	.0	2.4	3.3	2.1	.0	2.2	3.5

Age Range	Men				Women				Total			
	65-69	70-74	75-84	Total	65-69	70-74	75-84	Total	65-69	70-74	75-84	Total
N	194	174	151	519	121	127	95	343	315	301	246	862
<u>Age, years</u>												
Mean	67.3	72.0	77.7	71.9	67.3	72.0	77.9	72.0	67.3	72.0	77.8	71.9
(SD)	1.2	1.4	2.6	4.6	1.3	1.4	2.5	4.5	1.3	1.4	2.5	4.6
<u>Education, years</u>												
Mean (SD)	13.4	13.8	13.0	13.4	12.9	12.8	12.4	12.7	13.2	13.4	12.8	13.1
(SD)	3.3	3.4	3.9	3.5	2.9	3.6	3.5	3.3	3.1	3.5	3.8	3.5

Table 2

Multiple regressions predicting neuropsychological test scores from the continuous variables age, education, and gender.

Neuropsychological Tests ^a (range)	R	β for age	β for educ	β for gender ^b
Fluency (0-)	.35***	-.23***	.26***	-.02
Boston (0-15)	.32***	-.20***	.19***	-.12***
MMSE (0-30)	.25***	-.07*	.21***	-.09**
Word List-I (0-30)	.34***	-.23***	.20***	.15***
Praxis (0-11)	.31***	-.07*	.28***	-.08*
Word List-D (0-10)	.31***	-.22***	.10**	.20***
Word List-Rec (0-24)	.16***	-.06	.15***	.04
Trails A (0-300s)	.39***	-.23***	.30***	-.02
Trails B (0-300s)	.40***	-.19***	.34***	-.03
Shape (0-240s)	.23***	-.08*	.18***	-.11**
FAS (0-)	.40***	-.15***	.36***	.08*
LM-I (0-25)	.31***	-.10**	.26***	.16***
LM-D (0-25)	.29***	-.09**	.25***	.15***
Similarities (0-33)	.47***	-.09**	.45***	-.03
Digit Span-F (0-12)	.28***	-.05	.25***	-.10**
Digit Span-B (0-12)	.32***	-.05	.29***	-.07*
Digit Symbol (0-133)	.45***	-.21***	.39***	.02

Note: I = Immediate, D = Delayed, Rec = Recognition, F = Forward, B = Backward, LM = Logical Memory.

^a Logarithmic transformations were applied to Mini-Mental State Examination, (MMSE), Boston Naming Test (Boston), and Trails A. On timed tasks (i.e., Trails A, Trails B, and Shape), scores were reversed so that high scores indicate good performance rather than poor performance.

^b A positive beta for gender indicates that women outperformed men.

p < .0001

**
p < .01

*
p < .05

Table 3

Neuropsychological test scores for the entire sample

Gender	Educ	Age	Fluency	Boston	MMSE	Word List-I	Praxis	Word List-D	Word List-Rec	Trails A	Trails B	Shape	
Male	0 – 11	65-69	M	17.0	13.4	28.0	17.4	9.6	5.1	20.4	62.1	152.9	66.6
			SD	4.7	2.2	1.6	3.3	1.6	2.0	2.1	25.3	75.0	33.5
		70-74	N	45	45	45	45	45	45	45	45	45	42
			M	16.6	13.4	27.8	16.9	9.7	4.6	20.5	71.7	152.6	77.2
	75-84		SD	4.2	2.0	1.7	3.2	1.5	2.1	1.8	29.7	64.3	39.3
			N	41	41	41	41	41	41	41	41	45	37
			M	14.2	13.1	27.9	16.3	9.6	3.8	20.6	87.8	179.7	76.8
			SD	4.8	1.8	1.6	4.0	1.6	2.1	2.3	41.0	68.5	30.7
	12	65-69	N	41	41	41	41	40	41	38	41	40	38
			M	17.8	14.1	28.2	18.2	10.2	4.8	21.1	53.6	120.6	62.1
		70-74	S	6.0	1.3	1.6	3.0	1.2	1.7	1.7	21.5	50.4	21.0
			N	55	55	55	55	55	54	54	55	55	54
	75-84		M	16.8	14.3	27.9	17.6	10.0	4.3	20.8	60.8	145.6	66.1
			SD	4.8	1.2	1.6	3.1	1.4	1.9	2.4	23.2	60.5	24.6
			N	51	51	51	51	51	51	51	50	51	49
			M	15.7	13.2	27.4	16.3	9.8	4.0	21.3	68.6	160.0	67.5
	13+	65-69	SD	4.6	1.9	1.5	3.8	1.5	1.7	1.5	25.5	68.4	25.5
			N	42	42	42	42	42	42	41	42	40	41
		70-74	M	20.2	14.3	28.6	19.6	10.3	5.3	21.3	46.8	99.3	59.3
			SD	6.5	1.0	1.6	3.2	1.1	2.1	1.7	15.6	37.2	24.3
	75-84		N	94	94	93	94	92	94	92	94	93	88
			M	18.3	14.2	28.6	18.4	10.3	4.6	21.6	50.9	109.8	58.3
			SD	5.4	1.3	1.3	3.4	1.2	2.2	1.9	17.8	36.7	21.4
			N	82	82	82	82	82	81	82	82	82	81
	75-84		M	16.4	14.0	28.6	18.1	10.4	4.7	21.0	58.6	122.3	58.5
			SD	5.0	1.2	1.6	4.0	1.1	2.1	2.0	21.4	38.7	17.3
		N	68	68	68	68	68	68	63	68	68	65	
		M	16.4	14.0	28.6	18.1	10.4	4.7	21.0	58.6	122.3	58.5	

Gender	Educ	Age	FAS	LM-I	LM-D	Similarities	Digit Span-F	Digit Span-B	Digit-symbol		
Male	0 – 11	65-69	M	24.1	11.6	9.4	18.1	8.3	4.8	31.3	
			SD	10.7	4.0	3.9	6.3	1.8	1.5	10.0	
			N	44	45	45	45	45	45	45	
	70-74		M	23.0	10.3	8.6	19.4	8.0	5.0	30.0	
			SD	8.2	3.5	3.6	5.6	1.8	1.8	9.8	
			N	40	41	41	41	41	41	41	
	75-84		M	21.7	10.7	8.2	18.9	8.1	5.1	27.0	
			SD	12.1	3.2	3.0	5.4	2.0	1.6	9.6	
			N	41	41	41	41	41	41	41	
		12	65-69	M	27.0	11.5	8.9	20.5	9.0	6.0	34.9
				SD	12.5	3.2	3.3	6.2	1.6	2.1	9.3
				N	54	55	55	54	55	55	55
70-74			M	24.3	11.1	9.1	21.5	8.2	5.3	32.6	
			SD	7.7	3.6	3.8	5.4	1.8	1.7	9.9	
			N	48	51	51	51	51	51.0	51	
75-84			M	22.4	10.7	9.3	19.0	8.1	5.3	29.2	
			SD	9.7	4.1	4.3	4.6	1.9	2.0	8.9	
			N	39	42	42	42	42	42	42	
		13+	65-69	M	33.5	13.3	11.2	24.9	9.2	6.4	41.0
				SD	13.7	3.5	3.8	4.7	1.8	2.0	10.3
				N	91	94	94	94	94	94	94
		70-74		M	30.6	11.9	10.0	24.5	8.7	6.5	40.1
				SD	11.8	3.2	3.4	5.7	1.7	2.1	9.6
				N	80	82	82	82	82	82	82
	75-84		M	29.0	12.6	10.8	23.7	8.4	5.8	35.0	
			SD	10.3	4.2	4.5	5.5	1.8	2.2	9.4	
			N	66	68	68	68	68	68	68	
	Gender	Educ	Age	Fluency	Boston	MMSE	Word List-I	Praxis	Word List-D	Word List-Rec	
	Female	0 – 11	65-69	M	16.4	13.2	27.8	19.3	9.4	5.6	20.9
				SD	4.2	2.0	1.6	3.2	1.7	2.1	2.3
				N	27	27	27	27	27	27	26

Gender	Educ	Age	Fluency	Boston	MMSE	Word List-I	Praxis	Word List-D	Word List-Rec	Trails A	Trails B	Shape
Female	0 – 11	65-69	M	16.4	13.2	27.8	19.3	9.4	5.6	66.6	142.7	71.4
			SD	4.2	2.0	1.6	3.2	1.7	2.1	35.9	64.7	35.0
			N	27	27	27	27	27	27	27	26	27

Gender	Educ	Age	Fluency	Boston	MMSE	Word List-I	Praxis	Word List-D	Word List-Rec	Trails A	Trails B	Shape	
		70-74	M	14.7	12.6	27.2	17.2	8.7	5.3	20.6	68.3	158.1	79.9
			SD	3.5	2.7	1.8	3.4	1.7	2.2	2.4	28.2	53.3	27.5
			N	34	34	34	34	33	34	34	34	31	33
			75-84	M	13.2	12.2	27.3	17.6	9.0	5.3	21.0	77.0	169.7
		SD		4.1	2.8	1.7	3.9	1.7	1.9	2.6	34.1	76.9	26.2
		N	25	25	25	25	25	24	25	22	25	25	
	12	65-69	M	18.4	13.8	27.9	19.1	10.1	5.8	21.2	61.7	138.6	75.8
			SD	4.9	1.6	1.9	3.6	1.2	2.2	2.0	25.5	59.3	35.6
			N	43	42	43	43	43	43	42	43	42	39
			70-74	M	15.8	13.3	26.9	18.2	9.5	5.2	21.4	59.5	154.6
		SD		5.0	1.5	2.9	4.0	1.4	2.1	1.8	23.6	72.3	25.5
		N	47	47	47	47	44	47	47	42	47	42	47
	75-84	M	14.3	12.7	27.5	17.6	9.2	4.2	20.6	71.1	160.2	74.9	
		SD	4.3	2.8	1.8	3.8	1.6	2.5	2.3	26.4	72.5	28.6	
		N	38	38	38	38	37	38	38	38	33	35	
		13+	M	19.0	14.3	28.5	20.9	10.5	6.4	21.4	50.4	104.8	62.8
	SD		4.8	1.2	1.4	3.4	.8	1.8	1.4	19.5	45.7	24.3	
	N	51	51	51	51	51	51	51	51	51	50	49	
	70-74	M	19.3	13.7	28.4	19.8	10.3	6.2	21.5	54.4	117.6	60.9	
		SD	5.6	1.6	1.2	3.6	1.2	2.2	1.7	20.0	44.8	22.8	
		N	46	46	46	46	44	46	46	46	46	44	
		75-84	M	18.0	13.5	28.5	18.8	10.3	5.2	21.2	57.3	117.9	67.8
			SD	5.7	2.8	1.7	3.2	1.4	2.2	1.6	17.3	50.3	22.1
		N	32	32	32	32	32	32	32	32	31	32	

Gender	Educ	Age	FAS	LM-I	LM-D	Similarities	Digit Span-F	Digit Span-B	Digit Symbol	
Female	0 – 11	65-69	M	25.0	12.6	10.5	18.9	7.3	4.9	32.7
			SD	7.2	3.8	3.5	5.8	1.8	1.5	9.2
			N	26	27	27	27	27	27	27
	70-74	M	21.8	10.9	8.7	17.1	7.1	4.9	27.3	
		SD	8.8	4.1	4.1	6.5	1.1	1.6	11.4	
		N	33	34	34	34	34	34	33	

Gender	Educ	Age	FAS	LM-I	LM-D	Similarities	Digit Span-F	Digit Span-B	Digit Symbol	
		75-84	M	20.8	11.0	9.3	7.6	4.7	26.4	
			SD	13.3	3.0	3.2	1.8	1.5	12.5	
			N	24	25	25	25	25	25	
		65-69	M	29.1	12.7	10.9	7.9	4.9	36.1	
			SD	10.8	3.6	3.6	1.7	1.5	10.4	
			N	42	43	43	43	43	43	
		70-74	M	25.0	11.1	9.3	7.8	4.8	34.2	
			SD	12.6	3.8	4.0	2.0	1.7	10.0	
			N	45	47	47	47	47	47	
		75-84	M	23.1	12.7	10.6	8.4	5.3	29.5	
			SD	8.1	4.0	4.4	1.4	1.8	8.2	
			N	37	38	38	37	38	38	
		65-69	M	35.4	14.9	12.5	8.6	6.1	40.7	
			SD	11.5	3.2	3.2	1.7	1.9	9.1	
			N	48	51	51	51	51	51	
		70-74	M	35.8	13.9	11.8	8.9	6.0	38.8	
			SD	12.7	3.5	3.5	1.7	2.0	8.7	
			N	44	46	46	46	46	45	
		75-84	M	33.1	14.0	11.8	8.7	6.1	37.3	
			SD	11.5	3.3	3.6	1.6	1.9	8.1	
			N	29	32	32	32	32	32	

Note: MMSE = Mini-Mental State Examination, I = Immediate, D = Delayed, Rec = Recognition, F = Forward, B = Backward, LM

Note: MMSE = Mini-Mental State Examination, I = Immediate, D = Delayed, Rec = Recognition, F = Forward, B = Backward, LM = Logical Memory.