Published in final edited form as:

Alzheimer Dis Assoc Disord. 2018 ; 32(3): 207–213. doi:10.1097/WAD.0000000000000241.

Cognitive Function and Its Risk Factors Among Older US Adults Living at Home

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Abstract

Background—The Montreal Cognitive Assessment (MoCA) has not been administered to a representative national sample, precluding comparison of patient scores to the general population and risk factor identification.

Methods—A validated survey-based adaptation of the MoCA (MoCA-SA) was administered to a probability sample of home-dwelling US adults aged 62–90, National Social Life, Health, and Aging Project (n=3,129), yielding estimates of prevalence in the US. The association between MoCA-SA scores and sociodemographic and health-related risk factors were determined.

Results—MoCA-SA scores declined with age, and there were substantial differences among gender, education, and race/ethnicity groups. Poor physical health, functional status, and depression were also associated with lower cognitive performance; current health behaviors were not. Using the recommended MoCA cut-point score for Mild Cognitive Impairment (MCI) (MoCA score < 26; MoCA-SA score < 17), 72% (95% CI: 69%–74%) of older US adults would be classified as having some degree of cognitive impairment.

Conclusions—Our results provide an important national estimate for interpreting MoCA scores from individual patients, and establish wide variability in cognition among older home-dwelling

US adults. Care should be taken in applying previously established MoCA cut-points to the general population, especially when evaluating individuals from educationally and ethnically-diverse groups.

Keywords

Cognition; Older Adults; Dementia; Population; Epidemiology; Geriatric Assessment

INTRODUCTION

Declining cognitive ability is a substantial health concern among older adults.¹ Like other “silent” age-associated deficits (e.g. renal function) cognitive loss occurs silently among most older adults.² While clinical tools for evaluating cognitive function exist, population-based estimates of cognition are more limited, particularly in domains other than memory loss, such as language, abstraction, and executive function.³ Given the expanding older adult population at risk for cognitive decline, a better understanding of the older population’s overall cognitive function is needed.⁴ Providers would benefit from being able to compare clinical cognition measures to the distribution of their scores among the general population of older adults.

Cognitive function varies among community-dwelling older adults.⁵ A priority has been identifying individual risk-factors associated with dementia, such as educational attainment and Apolipoprotein-E (Apo-E) status.⁶ Less is known regarding overall cognitive ability and factors associated with cognitive function among older adults without impairment. Information on cognition among home-dwelling older adults comes from two sources.¹ The first are studies employing detailed cognition measures, but with non-representative, smaller samples, few participants over 75 years, and most participants with known cognitive deficits.³ The second are larger epidemiological studies of older adults which measure cognition more narrowly, typically focusing on memory loss and disorientation.⁵ Ideally, one would administer a comprehensive assessment to a nationally-representative, community-dwelling sample, incorporating items from detailed tests.

To help fill this gap, we adapted a well-regarded clinical test of cognitive function, the Montreal Cognitive Assessment (MoCA)⁷, for use in a survey setting (MoCA-SA).^{8,9} It was administered to a nationally-representative, probability sample of home-dwelling older adults, within Wave 2 of the National Social Life, Health, and Aging Project (NSHAP).¹⁰ We have three objectives: 1) estimating the distribution of cognitive function in the home-dwelling US population (62–90 years); 2) characterizing how cognition varies with age, education, gender, and race/ethnicity; and 3) estimating the association between cognition and sociodemographic characteristics, health status, and health behaviors in the older US population.

METHODS

Study Population

A household survey, NSHAP began in 2005–6 with a multistage, area-probability sample of 3,005 adults born between 1920–1947, with one individual selected to be interviewed per household. This sample was balanced across six age and gender subgroups, including oversampling of African-Americans and Hispanics to provide statistical power for comparisons.¹¹ In 2010–11, the (surviving) original respondents were re-interviewed, together with their spouses or cohabiting partners (Wave 2). The overall (i.e., unconditional) weighted response rate for Wave 2 of NSHAP was 74%. For this Wave 2 analysis, we restricted the sample to those born between 1920–1947 (i.e., we excluded those spouses/partners born outside this interval), leaving a total of 3,196 respondents. Based on this sampling strategy, an appropriately weighted analyses using this sample can be used to estimate parameters for the US population of adults aged 62–90, which is what was done in this analysis.¹⁰

Respondents were surveyed by professional, non-medically trained interviewers using Computer Assisted Personal Interviewing (CAPI). Individuals judged by the interviewer to be incapable of providing written consent or of completing the interview, due to physical or cognitive limitations, were defined to be “out-of-scope” and were not interviewed. For this analysis, we excluded an additional 67 respondents reporting that they had been diagnosed with Alzheimer’s disease (AD) or other dementia, yielding a final analytic sample of 3,129. All respondents provided written, informed consent and the protocol was approved by the Institutional Review Board (IRB) of NORC. Use of the data was approved by the IRB of the University of Chicago.

MoCA-SA

The MoCA is a commonly-used assessment tool for cognitive function among older adults.⁷ Based on extensive pilot testing, an 18-item survey-adapted MoCA (MoCA-SA) was developed, validated, and administered during Wave 2 of NSHAP.^{8,9} The MoCA-SA is specifically designed for administration by non-medical personnel using CAPI. It consists of a subset of items selected to shorten administration time and respondent burden for inclusion in an omnibus, in-home survey while preserving the MoCA’s sensitivity to a broad range of cognitive abilities; MoCA-SA scores correlate highly with scores from the full MoCA and permit high fidelity estimation of the latter.⁹ Information on MoCA-SA development, testing and psychometric properties are detailed elsewhere.^{8,9}

The MoCA-SA incorporates items from each of the original eight domains, including: 1) Orientation: date and month (2 points total); 2) Naming: rhinoceros (1 point); 3) Executive function: trails-b (1 point); 4) Visuo-construction: clock contour, numbers, and hands (3 points total); 5) Memory: 5-word delayed recall (5 points); 6) Attention: forward digits, backward digits, serial 7’s (5 points total); 7) Language: phonemic fluency via words with the letter “F,” and sentence repetition (2 points total); and 8) Abstraction: similarity of watch and ruler (1 point). Items that have been removed are as follows: 1) From the orientation domain, 4 items were excluded due to similarity to other orientation items: day, year, place,

and city; 2) from the visuospatial skills domain, the cube item was excluded based on difficulty administering the item in the field and longer administration time; 3) from executive function domain, the abstraction item “train-bicycle” was removed it being the easier of the two items; 4) from the language domain, first, the camel and lion items were excluded, and second, the sentence item “John”, translated from the French, was removed due difficulty administering in the field; and 5) from the attention domain, the vigilance item was excluded due to low item difficulty and difficulty with field administration.

MoCA-SA scores range from 0 to 20, with higher scores indicating better cognitive functioning. We also present results scaled to the range of the full MoCA (0–30) using the high-fidelity prediction equation described in detail elsewhere (validated in two independent samples, with 99% cases yielding identical scores):

$$\text{MoCA} = 6.83 + (1.14 \times \text{MoCA-SA}).^9$$

Sociodemographics

Age was computed based on reported date of birth. Gender, race/ethnicity, educational attainment and marital status were all obtained via self-report. Racial identity (white/Caucasian, black/African American, American Indian or Alaskan native, Asian or Pacific Islander, or other) and Hispanic ethnicity (yes or no) were collected with separate items, which were then recoded into a single variable with four categories: white, black/African American, Hispanic (non-black) and Other. Educational attainment was recoded into four categories: less than high school, high school graduate or GED, some college or certificate and bachelor’s degree (or more). Marital status was recoded in four categories: married or living with a partner, divorced or separated, widowed and never married.

Health and Functional Status

Respondents rated both their physical and mental health independently as Excellent, Very good, Good, Fair, or Poor; these were then recoded into “Excellent/Very Good/Good” or “Fair/Poor”.¹² Respondents were asked whether they had ever been “told by a physician” that they had any of the following: hypertension, congestive heart failure, myocardial infarction, stroke, localized cancer, metastatic cancer, melanoma, diabetes, rheumatoid arthritis, osteoarthritis, osteoporosis, hip fracture, emphysema/asthma/chronic bronchitis/COPD, Parkinson’s disease, Alzheimer’s disease or other dementia. They were asked if they had had a procedure to treat coronary artery disease or had experienced symptoms associated with urinary or stool incontinence. These items were combined into a comorbidity index ranging from 0–21, patterned after the Charlson index.¹³ Depressive symptoms were measured using a modified Center for Epidemiological Studies-Depression (CES-D) scale (Iowa form),^{14,15} recoded to a range of 0–22 points and a cutoff of 9+ points for significant depressive symptoms.¹⁶ Declines in physical function were measured by self-report of needing no help (0 points), some help (0.5 points) or being unable to do (1 point) 7 Instrumental Activities of Daily Living (IADLs) and 5 Activities of Daily Living (ADLs). Each was scored by summing the points across the corresponding items. IADLs included: preparing meals, taking medications, managing finances, shopping for groceries, light

housework, driving a car during the day, and using a telephone. ADLs included: using the toilet, bathing, dressing, eating, and transferring.

Health Behaviors

Health behaviors, including tobacco use, alcohol intake, and physical activity, have been associated with differences in cognition.^{17–19} Self-reported lifetime smoking status was coded as non-smoker, current smoker, and ex-smoker. Physical activity was assessed by asking how frequently respondents participated in vigorous physical activity or exercise for 30 minutes or more over the last 12 months, with possible responses of 5 or more times/week, 3–4 times/week, 1–2 times/week, 1–3 times/month, less than 1 time/month, or never. Problem drinking was defined based on two criteria: 1) 14 or more drinks/week for men or 9 or more drinks/week for women over the last 3 months, or 2) 3 or more days in last 3 months in which four or more drinks were consumed in a single day.²⁰

Statistical Analysis

The overall distribution of MoCA-SA scores, its domains, and individual items were estimated for the US population aged 62–90. All analyses were weighted using the NSHAP-provided individual-level weights; these weights adjust for differences in the probability of selection as well as differential non-response, permitting inferences about the US population of home-dwelling adults born between 1920–1947. Design-based variance estimates obtained using Balanced Repeated Replication (BRR) were used throughout to account for the stratification and clustering in the sample design.²¹

Ninety-five percent confidence intervals for percentage estimates were calculated using the logit transform. Quantile regression was used to estimate the 10th, 50th (median) and 90th percentiles by age, separately by groups based on gender, race/ethnicity and education.²² These models included both linear and quadratic terms for age, and corresponding models using piecewise linear splines (with 5 knots equally spaced according to the percentiles of the data) were used to verify the functional form.²³ Predicted quantiles are plotted by age, together with approximate 90% pointwise confidence intervals obtained by inverting the corresponding Wald statistic (variance estimation is described below). Multiple linear regressions were used to examine the association between mean MoCA score and a literature-based pre-specified set of covariates.

Self-rated mental health was excluded because poor mental health is largely captured by depressive symptoms, and because cognitive decline may itself be perceived by respondents as poor mental health. In addition, IADLs were selected for inclusion over ADLs because 85% of those with an ADL score of one or higher also have a non-zero IADL score (i.e., the IADL score identifies most of those with ADLs as well as those with less severe limitations). To simplify coefficient interpretations, age was mean-deviated and divided by 10, and both depressive symptom and IADL scores were standardized to have mean 0 and variance 1. Sixty-six respondents with missing data for one or more of the covariates were excluded when model fitting. Once all of the covariates had been added, a quadratic term for age was examined, as were interactions between age with gender, race/ethnicity and

education (all were evaluated using a Wald test). All analyses were performed using Stata 14.²⁴

RESULTS

The distributions of variables for US older adults are shown in Table 1. The mean age is 72.3, and 20% are 80 or older. The distributions of the sociodemographic variables among those 65 and older are similar to those for adults aged 65 or older in the 2010 Census (not shown).²⁵ In addition, the prevalence of several individual chronic conditions is similar to that from the National Health Interview Survey (NHIS; not shown).¹³ Twenty-four percent rated their physical health as fair/poor, 11% rated their mental health as poor, and 20% had significant depressive symptoms. Twenty-eight percent reported needing at least some help with a IADLs, and 21% reported needing some help with at least one ADL. Only 13 percent reported smoking currently, and another 47 percent reported having previously smoked. Eleven percent reported problem drinking. Finally, while 59% reported exercising weekly, nearly a third (32%) reported exercising less than once a month.

There was variability in MoCA-SA scores among older US adults living at home without a dementia diagnosis (Figure 1). Based on the MoCA cut point for MCI (< 26, corresponding to < 17 on the MoCA-SA), 72 % (95% CI, 69–74%) would be classified as having some form of cognitive impairment (shaded region of Figure 1). The distributions of the specific domains of the MoCA-SA and their constituent items are shown in a supplementary table. The easiest domains were Orientation and Naming which were performed correctly by 91% and 84% of respondents, respectively. Although 97% were able to draw the clock contour, only 44% successfully completed the entire visuo-construction task. Similarly, although 89% and 80% correctly performed the forward and backward digit components of the attention domain, only 57% were able to perform 3 serial subtractions. Executive function was also more difficult, with 59% completing the trails item correctly, as was abstraction (59% correct) and language (only 34% with both items correct). Finally, memory was the most difficult domain, with only 17% remembering all 5 words and 40% missing 3 or more of 5 words.

As expected, MoCA-SA scores decline steadily with increasing age. For example, among men, the median score decreases from 15.0 (95% CI, 14.2–15.8) at age 62 to 10.3 (95% CI, 9.0–11.7) at age 90, with a corresponding decrease from 16.3 (95% CI, 15.5–17.1) to 10.0 (95% CI, 8.5–11.5) among women. At age 62, the percentiles of the distribution for women are all higher (except for the 10th percentile) than those for men, though by age 90, the two distributions are nearly equivalent (Figure 2). The rate of decrease with age across the distribution is slightly greater among those with at least a high school degree than among those who did not complete high school, while those with a bachelors' degree do not begin to exhibit a decline until age 70, after which a relatively steep decline yields a distribution that at age 90 is very close to those for the high school group (Figure 3, Panel A). Finally, the rates of decrease with age are similar for the three primary racial/ethnic groups, though the distributions among blacks and Hispanics are more variable than among whites (Figure 3, Panel B).

Estimates from a multiple linear regression of MoCA-SA on selected sociodemographic and health-related risk factors are shown in Table 2. The model accounts for 42% of the variability in MoCA-SA scores ($R^2 = 0.42$). Among men, each additional decade of age is associated with a reduction in the mean score of 1.1 points (95% CI, 0.8, 1.3); a quadratic term for age was not statistically significant ($p = 0.638$). Although women have higher mean scores than men at younger ages, their rate of decrease with age is approximately one-third greater (-1.4 versus -1.1 point per decade, $p = 0.044$), essentially eliminating the gender difference by age 90. The mean score is higher for each additional level of education: 2.1 points (95% CI, 1.6–2.5) for high school versus less than high school, 0.9 points (95% CI, 0.5–1.2) for some college versus high school, and 1.1 points (95% CI, 0.7–1.4) for bachelors versus some college. Mean scores for blacks and Hispanics are lower than for whites by 2.7 (95% CI, 2.3–3.1) and 2.5 (95% CI, 1.9–3.1) points, respectively. There is no evidence of an interaction between either education or race/ethnicity and age ($F_{3,61} = 1.68$, $p = 0.181$ and $F_{3,61} = 1.56$, $p = 0.209$, respectively). Finally, there is also no evidence of a difference in mean score by marital status ($F_{3,61} = 0.29$, $p = 0.831$).

Several of the health-related risk factors are associated with MoCA-SA. Standard deviation Increases in depressive symptoms and IADLs are associated with decreases of 0.3 points (95% CI, 0.1–0.4) and 0.6 points (95% CI, 0.4–0.8), respectively; those reporting fair or poor health score 0.4 points (95% CI, 0.0–0.8) lower, on average, than those with good, very good or excellent health. Perhaps surprisingly, those with a comorbidity index of zero score on average 0.5 points (95% CI, 0.0–1.1; $p = 0.057$) *less* than those reporting at least one comorbid condition; among the latter, there was little evidence of an association between comorbidity and MoCA-SA scores ($F_{3,61} = 2.05$, $p = 0.116$ for testing the null hypothesis that the coefficients for 1, 2, 3 and 4–12 are identical). Although there is no evidence that current smokers score differently on average from non-smokers, ex-smokers score 0.3 points (95% CI, 0.0–0.6) *higher* than non-smokers. Finally, there is no evidence that self-reported exercise frequency ($F_{5,59} = 1.33$, $p = 0.265$) or problem drinking ($p = 0.170$) are associated with MoCA-SA.

DISCUSSION

We evaluated cognitive function among the general population of older US adults by administering a survey-adapted version of the MoCA to a nationally-representative sample aged 62–90. Our estimates of the distribution of MoCA scores—both overall and by age among subgroups based on gender, education and race/ethnicity (Figures 1–3)—may be used as population norms. Our findings regarding the sociodemographic correlates of cognition are similar to other findings,^{26–27} but expand on these findings by using a large, probability sample of the US population including adequate statistical representation of the major racial/ethnic minorities. This addresses an important limitation of the largest known community-based study in the US where few respondents were more than 70 years old.²⁷ In addition to estimating the distribution of the total MoCA score, we also provide estimates of the performance on specific cognitive domains within the MoCA.⁹ Thus, we provide normative estimates of MoCA scores for older age groups to whom the clinical MoCA is most commonly administered.⁹

The usual cut-off score of <26 on the MoCA for MCI identification is based on strict clinical inclusion criteria in a well-educated clinical Canadian sample.⁷ The application of this cutoff to a population-based US sample labels 72% of older adults without diagnosed AD or dementia as being at risk for MCI or dementia. Other clinical and community-based studies using the MoCA have recommended cutoffs between 20–24,^{28–30} raising the possibility that an appropriate threshold be lower in more general, community-based samples.^{7,28} A study of the MoCA in a selected group of older adults in Italy found much lower average MoCA values than the original Canadian sample,³¹ as did a rural population in Canada,³² and a larger clinical sample.³³ We extend this to a US nationally-representative sample. Providers should be cautious when interpreting MoCA scores using proposed thresholds, as more work is needed to link the distribution of MoCA scores in the general population to thresholds for identifying cognitive impairment.⁷

Our results identify several variables associated with worse cognitive function. Lower MoCA-SA scores were associated with older age, male gender, lower education levels, minority status, higher depressive symptoms, and more IADL deficits, consistent with prior studies of cognitive decline,^{2,34} including among cognitively-intact individuals.³⁵ We did not find a significant difference in cognition associated with health behaviors such as exercise or problem drinking.

These results suggest caution when applying the initially recommended cut-points for MCI to interpreting scores in diverse groups. Potential explanations for this include: 1) that cut-offs used for the MoCA-SA for identifying those with impairment should be different, or 2) that these groups do have different likelihoods of being impaired. Likely, both are, in part, true. Consider the effects of educational attainment as an example. The original population for which the MoCA “cut-point” for MCI was developed was for patients with higher educational attainment.⁷ Such patients are known to score better on neuropsychological tests, possibly due to their premorbid cognitive abilities or “cognitive reserve”.³⁶ Even when detailed neuropsychological testing is used to carefully categorize patients to have the same degree of impairment, those with higher education levels have worse brain pathology.³⁷ Conversely, those with higher education would require a higher cut-point to correspond to the same level of brain pathology, as appears to be the case if we apply the original MoCA cut-point to the US population. Therefore, “cut-points” on any cognitive testing, whether a full battery or a shorter test, will not fully capture the degree of cognitive impairment unless cognitive reserve is considered.³⁶ This would be true for any demographic characteristic, including gender and race/ethnicity. For example, it may be that ethnicity for Hispanic participants is a consequence of poorer scores on the language items. However, NSHAP was offered to participants in either English or Spanish, whichever they preferred, and those who chose Spanish could complete the MoCA-SA in that language. To further test this possibility of language differences, we compared item-by-item scores by ethnicity in a prior publication.⁹ No differences were found for the language items.. Therefore, rather than using such cut-points as “markers” for disease, we offer our representative-sample study as a way to “benchmark” individuals from the community against their demographic peers based on age, gender, educational level, and race/ethnicity.

Our study has limitations. First, while our large, cross-sectional dataset provides information about the distribution of MoCA scores across diverse groups,³⁸ longitudinal data will be necessary to determine how these differences are related to within-person changes in cognitive decline over time. Longitudinal data is necessary to estimate the causal effects of health and social factors on cognitive decline (and vice versa). Second, while we have shown that the MoCA-SA can be used to accurately and reliably predict scores for the full MoCA,⁹ minor differences occurred 1% of the time, most likely at the relatively rare extreme values. Despite this, the estimated MoCA scores we present here, while lower than those for clinical cohorts, are similar to recent estimates from other community samples.^{28,39} We thus believe that the distributions presented here represent the best estimates currently available of the distributions of MoCA scores for the US population of older adults living at home. Finally, sampled individuals judged by the interviewer to be incapable of providing written consent and/or of completing the two-hour interview were defined to be “out-of-scope” for the survey. While some of these individuals may have already been diagnosed by a physician as having dementia and would therefore have been excluded from this analysis, there may be a small number from our sample who have not been diagnosed with dementia but nonetheless have substantial cognitive deficits consistent with that diagnosis.

Our observed age differences in cognition might result from the Flynn Effect. This effect is the change in IQ scores noted over historical time, in which more recent (i.e. younger) birth cohorts have had higher absolute IQ scores than did earlier (i.e. older) birth cohorts, presumably because changes in education of more recent cohorts has familiarized them with the types of questions used to evaluate cognition. Our analysis presented in panel A of Figure 3, shows that for those with similar numbers of years of education (less than HS, HS graduates, some college, and college graduates and more), an age difference remains in MoCA-SA scores, which argues against the Flynn Effect being sufficient to account for age differences. However, this does not fully account for the possibility that, even for those with similar amounts of education, but from different demographic cohorts, a Flynn Effect from increasing familiarity with testing, separate from that from being in school, does not account for these differences. Our forthcoming longitudinal data and birth cohort comparisons will address these questions.

In summary, this study provides a description of normative cognitive function among community-dwelling US adults as measured by the MoCA, separately by age and within subgroups based on gender, education and race/ethnicity. It also describes the associations between cognition and several sociodemographic and health correlates. Care should be taken in applying previously established cutoffs for the MoCA, especially when evaluating individuals from educationally and ethnically diverse groups.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgements

Priya D. Sunkara for data collection and pilot testing.

FUNDING

This work was supported by funding for *MERIT* Award R37 AG030481 (PI: Waite) from the National Institute on Aging, and from the National Institutes of Health, including the National Institute on Aging, the Office of Women's Health Research, the Office of AIDS Research, the Office of Behavioral and Social Sciences Research, and the National Institute on Child Health and Human Development for the National Health, Social Life, and Aging Project (NSHAP R01AG021487, R37AG030481) and the NSHAP Wave 2 Partner Project (R01AG033903).

Conflicts of Interest and Source of Funding

The National Social Life, Health, and Aging Project is supported by the National Institutes of Health, including the National Institute on Aging, the Office of Women's Health Research, the Office of AIDS Research, and the Office of Behavioral and Social Sciences Research (R01AG021487, R37AG030481; R01AG033903). All authors declare no conflicts of interest.

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Figure 1.

Weighted distribution of Survey-Adapted Montreal Cognitive Assessment (MoCA-SA) scores among NSHAP Wave 2 sample age 62–90 (projected scores for full MoCA shown at top). Grey area indicates the proportion of the population falling below the recommended cut point for cognitive dysfunction (MoCA < 26; MoCA-SA < 17).

Figure 2. Estimated percentiles of Survey-Adapted Montreal Cognitive Assessment (MoCA-SA) scores by age, separately for men and women (shown with 90% pointwise confidence bands).

Figure 3.

Estimated percentiles of Survey-Adapted Montreal Cognitive Assessment (MoCA-SA) scores by age, separately by education and separately for whites, blacks, and Hispanics (shown with 90% pointwise confidence bands).

Table 1.

National Social Life Health and Aging Project (NSHAP) Wave 2 Sample Characteristics (n = 3,129)

Variable	%	95% CI
Demographic Characteristics		
Age	62–64	15.8 (13.8, 18.1)
	65–69	28.3 (26.4, 30.3)
	70–74	20.0 (18.4, 21.7)
	75–79	16.2 (14.6, 17.9)
	80–84	13.0 (11.7, 14.3)
	85–91	6.8 (5.9, 7.8)
	Mean (SD = 7.3)	72.3 (71.9, 72.7)
Gender		
	Male	47.4 (45.5, 49.3)
	Female	52.6 (50.7, 54.5)
Education		
	Less than high school	16.2 (13.4, 19.5)
	High school/GED	25.4 (22.8, 28.1)
	Some college/Certificate	32.1 (29.5, 34.8)
	Bachelors or more	26.4 (22.8, 30.2)
Race/Ethnicity		
	White	81.4 (77.7, 84.6)
	Black	9.2 (7.2, 11.8)
	Non-Black Hispanic	6.7 (4.3, 10.4)
	Other	2.6 (1.8, 3.8)
Marital status		
	Married	65.4 (63.1, 67.6)
	Divorced/Separated	10.4 (9.1, 11.9)
	Widowed	21.6 (19.4, 24.0)
	Never married	2.6 (2.0, 3.5)
Health Characteristics		
Self-rated physical health		
	Poor/Fair	23.8 (21.3, 26.5)
	Good/Very Gd./Excellent	76.2 (73.6, 78.7)

Variable	95% CI	
	%	
Self-rated mental health		
	Poor/Fair	10.7 (9.4, 12.3)
	Good/Very Gd./Excellent	89.3 (87.8, 90.6)
Comorbidity score		
	0	9.8 (8.3, 11.6)
	1	21.2 (19.2, 23.3)
	2	23.7 (21.9, 25.6)
	3	19.3 (17.8, 21.0)
	4–12	26.0 (24.0, 28.0)
	Mean (SD = 1.8)	2.6 (2.5, 2.7)
Depressive symptoms		
	0–8	80.3 (78.1, 82.4)
	9–33	19.7 (17.6, 21.9)
	Mean (SD = 4.8)	4.9 (4.7, 5.2)
Functional Status		
Activities of daily living (ADLs)		
	0	78.9 (77.1, 80.7)
	0.5	10.0 (8.8, 11.2)
	1–5	11.1 (9.5, 13.1)
	Mean (SD = 0.6)	0.2 (0.2, 0.3)
Instrumental activities of daily living (IADLs)		
	0	71.7 (69.0, 74.4)
	0.5	11.3 (10.1, 12.7)
	1–7	16.9 (14.7, 19.5)
	Mean (SD = 0.9)	0.4 (0.3, 0.4)
Health Behaviors		
Smoking status		
	Non-smoker	40.1 (37.6, 42.6)
	Current	13.3 (12.0, 14.8)
	Ex-smoker	46.6 (44.3, 48.9)
Exercise		
	Never	23.5 (20.9, 26.4)
	< 1 times/month	8.9 (7.8, 10.3)
	1–3 times/month	8.2 (7.0, 9.6)

Variable		%	95% CI
	1–2 times/week	16.6	(15.0, 18.3)
	3–4 times/week	20.8	(18.8, 22.9)
	5+ times/week	22.0	(20.0, 24.1)
Problem drinking	No	89.2	(87.7, 90.4)
	Yes	10.8	(9.6, 12.3)

Estimates are weighted to account for differential probabilities of selection and differential non-response using the weights distributed with the dataset. Approximate 95% confidence intervals (CI) were obtained using design-based standard errors.

[†]Includes only those respondents born between 1920–1947. Sixty-seven individuals who reported being diagnosed with Alzheimer’s disease or dementia were also excluded.

Table 2:

Multiple Linear Regression of MoCA-SA Scores on Selected Demographic and Health-Related Covariates
Among Adults Age 62–90 (n = 3,063^f)

Covariate		Estimate	95% CI	p-value
Demographic Characteristics				
Age	(decades)	−1.07	(−1.30, −0.83)	< 0.001
Gender	Male	ref.		
	Female	0.67	(0.40, 0.93)	< 0.001
Age × Gender	Male	ref.		
	Female	−0.33	(−0.66, −0.01)	0.044
Education	< High school	ref.		
	High school/GED	2.06	(1.63, 2.50)	< 0.001
	Some college	2.94	(2.51, 3.36)	< 0.001
	Bachelors or more	3.99	(3.55, 4.43)	< 0.001
Race/Ethnicity	White	ref.		
	Black	−2.72	(−3.10, −2.34)	< 0.001
	Non-Black Hispanic	−2.52	(−3.10, −1.94)	< 0.001
	Other	−1.66	(−2.98, −0.34)	0.015
Marital status	Married	ref.		
	Divorced/Separated	−0.17	(−0.61, 0.28)	0.454
	Widowed	−0.08	(−0.45, 0.29)	0.663
	Never married	−0.34	(−1.33, 0.65)	0.494
Health Characteristics				
Self-rated physical health	Poor/Fair	−0.40	(−0.84, 0.04)	0.072
	Good/Very Gd./Exc.	ref.		
Comorbidity score	0	ref.		
	1	0.28	(−0.37, 0.92)	0.393
	2	0.52	(−0.09, 1.14)	0.096
	3	0.73	(0.14, 1.31)	0.016
	4–12	0.66	(0.08, 1.25)	0.027
Depressive symptoms	(standardized)	−0.26	(−0.41, −0.11)	0.001
IADLs	(standardized)	−0.58	(−0.76, −0.40)	< 0.001
Health Behaviors				
Smoking status	Non-smoker	ref.		
	Current	−0.26	(−0.76, 0.25)	0.312
	Ex-smoker	0.31	(0.02, 0.60)	0.037
Exercise	Never	ref.		
	< 1 times/month	0.36	(−0.06, 0.79)	0.094
	1–3 times/month	0.38	(−0.20, 0.97)	0.194
	1–2 times/week	0.18	(−0.22, 0.58)	0.378
	3–4 times/week	0.15	(−0.29, 0.58)	0.505

Covariate		Estimate	95% CI	p-value
Problem drinking	5+ times/week	−0.12	(−0.53, 0.29)	0.560
	No	ref.		
	Yes	0.29	(−0.13, 0.70)	0.170
Constant		10.83	(10.01, 11.65)	< 0.001
R-squared		0.42		

Note: Estimates are weighted to account for differential probabilities of selection and differential non-response using the weights distributed with the dataset. Approximate 95% confidence intervals (CI) were obtained using design-based standard errors.

¹ Sixty-six respondents with missing data for one or more covariates were excluded.