A Longitudinal Analysis of the Influence of Race on Cognitive Performance

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Abstract

Objectives. Whether there are racial and ethnic disparities in the rate of cognitive decline among older adults is not clear. The purpose of this study was to determine if there are differences in cognitive decline among racial and ethnic older adults.

Method. Data were from the Health and Retirement Study, waves 1998–2010. Participants were community dwelling at baseline (n = 9,492), mostly female participants (58.8%), ranged in age from 65 to 105 years (M = 74.41, SD = 6.97), and had education levels that averaged less than high school (M = 11.7, SD = 3.4). Cognition was examined using a combined score from word recall, Serial 7’s, backward counting, and naming tasks. To determine changes in cognition across 12 years, we utilized mixed effects models.

Results. Results indicated that after adjusting for covariates, race or ethnicity was unrelated to changes in cognitive performance, but there were significant differences in baseline cognition and these differences were more pronounced after adjusting for age, gender, education, poverty, heart disease, diabetes, high blood pressure.

Discussion. It is evident that there are significant differences in baseline cognition, although the rate of cognitive decline across 12 years did not vary significantly by race. These findings support previous assertions that the rate of cognitive decline is not associated with race and suggest that it is likely that baseline cognitive performance is a better indicator of performance over time.

Key Words: Cognitive decline—Health and Retirement Study—Racial disparities.

Research has documented that some degree of cognitive decline may be expected with advancing age, but that considerable individual differences are also apparent (Craik & Salthouse, 2007; Hofer & Alwin, 2008). Of concern, however, is when this decline becomes an impairment and increases risk for formal assistance including nursing home placement (Wattmo, Wallin, Londos, & Minthon, 2011). One possible source of variation in cognitive decline among older adults is race (Sachs-Ericsson & Blazer, 2005). However, many factors other than race or ethnicity, such as education, health, and poverty level, could account for disparities in rates of cognitive decline. This investigation aimed to determine whether age-related differences in cognitive decline differed between race and ethnicity among adults aged 65–105 while controlling for potential confounds.

The existing literature varies in regard to the effect of race on cognitive decline. Several studies have found a difference in the rate of cognitive decline by race, with African Americans declining at faster rates than their white counterparts (Lee et al., 2011; Sachs-Ericsson & Blazer, 2005; Yaffe et al., 2009). By contrast, others have found no difference in cognitive decline by race (Atkinson et al., 2005; Masel & Peek, 2009). Still others report that African Americans have slower rates of cognitive decline than whites (Alley, Suthers, & Crimmins, 2007; Barnes et al., 2006; Karlamangla et al., 2009; Sloan & Wang, 2005). This makes a firm conclusion regarding whether there are differences between racial groups in terms of cognitive decline challenging.

Little research has been conducted to examine differences among races in the rate of cognitive decline that include Hispanic ethnicity. Studies examining rate of decline by ethnicity, like those examining racial differences, have yielded varying results. Two studies reported that Hispanic ethnicity was not a predictor of rate of decline (Karlamangla et al., 2009; Masel & Peek, 2009), whereas another suggested that Hispanics declined at faster rates (Alley et al., 2007). These varying findings, as well as the relatively small number of studies, indicate a need for further investigation of the effect of Hispanic ethnicity on the rate of cognitive decline.

In order to better understand the effect of race on the rate of cognitive decline, several confounding factors known to vary by race that also affect cognitive decline should be examined. Factors such as education, socioeconomic status, and health may differ among race/ethnicity and thus could account for differential rates of cognitive decline. For instance, evidence suggests that better cognitive scores are associated with more years of education (Jefferson et al., 2011).
Relationships between educational attainment, cumulative socioeconomic status, and cognition have been found in international studies (Turrell et al., 2002). Specifically, Turrell and colleagues (2002) found that socioeconomic conditions across the life course affect cognition in midlife. Specifically, those in disadvantaged socioeconomic positions performed worse on measures of executive function and mental status. This was supported by Gilmour (2011), who found low income to be associated with worse scores on four measures of cognitive functioning tapping memory, executive function, and processing speed. Other evidence suggests that lifetime wealth is associated with cognitive health in later life, but this effect was found only among white respondents (Cagney & Lauderdale, 2002).

These findings are noteworthy given the racial differences in the United States between educational attainment, occupational status, and socioeconomic status. For example, in 2009, on average, 93.8% of whites had received a high school diploma or alternative credential, such as the General Education Diploma, whereas only 87.1% of African Americans and 76.8% of Hispanics achieved this status (Chapman, Laird, Ifill, & KewalRamani, 2011). Moreover, in 2009, the average white American family earned $62,545 compared with the average earnings of African American families, which were $38,409 and Hispanic American, which were $39,730 (U.S. Census Bureau, 2012). The combination of the evidence coupled with known inequities warrants the need to determine if cognitive decline differs by race or ethnicity after controlling for education, socioeconomic status (in this case, poverty), and age.

Also, potentially accounting for racial differences in cognitive decline are several biomedical factors such as coronary heart disease, diabetes, and hypertension, which vary in incidence among racial and ethnic groups and may mediate the relationship between socioeconomic status and cognitive decline (Koster et al., 2005). For instance, the prevalence of coronary heart disease is higher among blacks (6.7%) than Hispanics (6.1%) or whites (5.8%; Centers for Disease Control and Prevention, 2011b) and the incidence of diagnosed diabetes significantly increased from 2004 to 2008 for blacks and Hispanics, and especially among older individuals living with socioeconomic disparities and disabilities (Centers for Disease Control and Prevention, 2011a). Also, more prevalent among blacks (40.4%) than whites (27.4%) and Hispanics (26.1%) is hypertension, which increases an individual’s risk of heart disease (Yoon, Burt, Louis, & Carroll, 2012). These findings are important to consider given that heart disease and diabetes are associated with worse cognitive performance (Gilmour, 2011). Moreover, Cahana-Amitay and colleagues (2012) examined the effects of hypertension and diabetes on an older adult’s ability to comprehend embedded sentences and multiple negatives, where plausibility and syntactic structure had to be judged by the participant. Their results indicated having diabetes, hypertension, or both, negatively affected performance. Due to these associations with cognition, we include measures of heart disease, diabetes, and high blood pressure in our study to examine the relationship between race and cognition.

Taken together, the literature reviewed earlier suggests that there is potential for differences between race/ethnicity affecting cognitive decline among older adults; however, the variation in findings from prior studies make firm conclusions difficult. In the current study, we examine changes in cognitive performance among black, Hispanic, and white participants, controlling for potential covariates that are known to affect cognitive performance and also vary by race.

METHOD

Participants

Initial respondents of the Health and Retirement Study (HRS) were born between 1931 and 1941 and were originally interviewed in 1992 (Wave 1). Another cohort included those born before 1924 and were originally interviewed in 1993. Finally, two more cohorts entered the study in 1998: those born between 1924 and 1930 and were born between 1942 and 1947. Our study selected respondents from waves 1998 through 2010 of the HRS (for a complete description of this study, see St. Clair et al., 2011). The year 1998 was selected as baseline because measures are consistent from this wave forward. To be included in our sample, respondents had to be in the 1998 wave of data collection and community dwelling. Therefore, the cohorts that were added to HRS in 2004 and 2010 were not included.

Overall, there were 21,159 respondents aged 25–105 (M = 65.86, SD = 11.06) in the 1998 baseline wave of data. We restricted the sample to those aged 65 years and older (N = 10,617) because cognitive assessments were not conducted for individuals younger than 65. There were a total of 1,125 (or 10.6%) respondents who used proxy respondents and these persons were excluded from our study sample. The final sample (n = 9,492) consisted of community-dwelling individuals at baseline, mostly female participants (58.8%), who ranged in age from 65 to 105 years (M = 74.41, SD = 6.97), and had education levels, which ranged from less than high school to doctoral level (M = 11.67, SD = 3.42). Participants were mostly white (n = 7,661; 80.71%), followed by black (n = 1,110; 11.69%), Hispanic (n = 570; 6.01%), and Other (n = 151; 1.59%). At baseline, 55% of participants completed telephone interviews, whereas 44% completed face-to-face interviews (it was not confirmed which interview mode was completed for <1% of the respondents). The measures reported in this study did not vary by interview mode.

Measures

Total cognition score.—Cognition was the outcome of interest and measured as a summary variable using the total
cognition score from HRS (Fisher, Halimah, Rodgers, & Weir, 2009; Ofstedal, Fisher, & Herzog, 2005). This score was calculated by combining the scores for immediate and delayed word recall, working memory, and mental status (range: 0–35; higher score represents better cognition). To measure immediate word recall, the interviewer read one of four equivalent lists of 10 nouns to the respondent. The four possible lists of nouns did not overlap in word content and the initial word list was randomly assigned for each respondent. Interviewers were trained to read the nouns at a rate of 2 s per word and did not read the nouns more than once. The respondents received a different set of words in each of four successive waves. The immediate word recall task was scored from 0 to 10, with higher scores indicating better cognitive performance. Following an approximate 5 min of other survey questions, the interviewer asked the respondent to recall the nouns previously presented in the immediate recall task. This delayed recall task and was scored from 0 to 10, with higher scores indicating better cognitive performance.

Working memory was measured by the Serial 7’s Test. This is a verbal task in which the respondent is asked to subtract 7 from 100, and continue subtracting 7 from each subsequent number for a total of five trials. Serial 7’s was scored 0 to 5 with higher scores indicating better cognitive performance.

Mental status was assessed using a variety of tasks that measure knowledge, language, and orientation. These tasks included backward counting from 20 (respondents were asked to begin at the number 20 and count backward as quickly as possible for 10 continuous numbers, scored 0–2), and date, object, and naming tasks, which included respondents being asked to report “today’s date,” including month (score 0–1), day (score 0–1), year (score 0–1), and day of the week (score 0–1); object naming, “what do you usually use to cut paper?” (score 0–1) and “what do you call the kind of prickly plant that grows in the desert?” (score 0–1); and name the current president (score 0–1) and vice president of the United States (score 0–1).

Combining these tasks created the total cognition score, which has a range from 0 to 35 with higher scores indicating better cognitive performance. It is worth noting that the cognitive measures were selected to be included in the HRS because they provide descriptive information on a range of cognitive functions, span all difficulty levels, are efficient to administer, are sensitive to change over time, and are valid and reliable (Ofstedal et al., 2005). Additionally, due to the mixed-mode interviewing technique used by HRS, cognitive measures exclude nonverbal tests (Fisher, Hassan, Rodgers, & Weir, 2012) and therefore, the study did not capture assessments on visual perception or psychomotor functioning.

**Race/ethnicity.**—Respondents were first asked if they consider themselves as white, black, or Other. Subsequently, respondents were asked if they were of Hispanic origin. Therefore, our category of Hispanic ethnicity included those that answered affirmative to being from Hispanic regardless of their racial identification, whereas black and white race included those that identified as such and did not identify as being from Hispanic origin.

**Sociodemographic characteristics.**—We included the following baseline characteristics: age, gender, and education. Age was measured continuously in years. Gender was coded 0/1 where 1 represented female. Education was measured as the number of years of completed education (range: 0–17).

**Biomedical factors.**—Respondents were asked if a doctor had ever told them that they had diabetes, heart disease, or high blood pressure. If respondents reported yes to any one of these three conditions they were coded as 1, otherwise they were coded as 0. Each condition was used as a separate dummy variable in the analyses.

**Poverty.**—Poverty level was based on self-reported yearly income at baseline (1998) and was divided into five categories: Category 1 = under 100% of the federal poverty level (FPL), Category 2 = 100%–199%, Category 3 = 200%–299%, Category 4 = 300%–499%, and Category 5 = ≥500% of the FPL.

**Analytic Strategy**

The categories of black and Hispanic were constructed as separate dummy variables and compared with all other nonblack and non-Hispanic categories. We used mixed effects models to study the relationship between cognition scores and race by allowing the relationship between cognition and race to vary from individual to individual. Mixed effects models indicate within-person and between-person change as well as provide an estimate of the individual variability around the population trend. Because of the large sample size used in the current study, the models were carried out using the HPMIXED procedure with SAS software (SAS Institute Inc., 2009).

The analyses consisted of two conditional growth models. The first model included race and ethnicity as a predictor of differences in cognitive performance on the intercept as well as the effect of race and ethnicity on cognitive performance over time. The second model expands the first by adjusting for covariates (i.e., age, gender, education, poverty, heart disease, diabetes, high blood pressure). Linear and quadratic effects of time and the linear and quadratic time interactions with model terms were tested in both models. In addition, the second model included interacting all model terms by race, three-way interactions by race and age, and four-way interactions by race, time, and age. The purpose of this complex model was to determine if race
alone affected cognition over time, or if race, age, the effect of time, or a combination of these resulted in differences in cognitive performance.

**RESULTS**

**Sample Characteristics**

On average, participants were assessed a median number of 3.86 times between 1998 and 2010. The attrition rate due to mortality included 7.12% of respondents in 2000, 16.47% in 2002, 25.15% in 2004, 34.13% in 2006, 42.43% in 2008, and 52.20% in 2010. The range per wave of those lost to attrition for other reasons was between 4.53% in 2000 and 11.33% in 2010. Univariate analysis of variance and chi-square tests were used to test for differences in baseline characteristics by race. Several differences existed between races (see Table 1), including differences by age (Hispanic ethnicity tended to be younger compared with other races), $F(2, 9489)=8.42, p<.0001$; baseline cognition (between all three categories with white race performing best at baseline), $F(2, 9484)=441.08, p<.001$; education (between all three categories with Hispanic ethnicity least educated), $F(2, 9489)=862.98, p<.001$; diabetes diagnosis, $\chi^2(3)=95.34, p<.001$ (with the lowest incidence among white race); heart disease diagnosis, $\chi^2(3)=44.38, p<.001$ (with the lowest incidence among Hispanic ethnicity); high blood pressure diagnosis, $\chi^2(3)=117.78, p<.0001$ (with the lowest incidence among white race); gender, $\chi^2(3)=10.78, p=0.01$ (with more females among black race); and poverty level, $\chi^2(12)=1,356.42, p<.0001$ (with white race least likely to be in poverty). These group differences underscore the rationale to control for these factors in subsequent analyses. The average cognitive scores by race over time are shown in Table 2.

**Changes in Cognition Across 12 Years**

As shown in Table 3, the results of the first model indicated that there were statistically significant linear changes in cognition Across 12 years (Est. = −0.07, SE = 0.02, CI: −0.12 to −0.03). However, none of the interactions of linear or quadratic time by racial groups were statistically significant indicating that there was not a significant difference by race in the rate of cognitive decline over time.

In Model 2 (Table 3), covariates were added and all interactions described earlier were also included. Still, there were no significant differences between race or ethnicity in the rate of cognitive decline over the 12 years examined. Additionally, after covariates were controlled for, time itself was no longer a predictor of cognitive performance. Because of the complexity of the second model, only the main effects are presented.
Both the unadjusted (Model 1) and adjusted (Model 2) models indicated a difference in baseline cognitive performance by race even though there were not significant differences over time. After adjusting for covariates, these differences in baseline performance are more pronounced. Specifically, black race performs on average more than 13 points lower than other races and Hispanic ethnicity performs on average more than 8 points lower compared with other races at baseline.

Covariates that had a significant negative effect on cognitive performance were older age (Est. = −0.27, SE = 0.01, CI: −0.28 to −0.26), diabetes (Est. = −0.58, SE = 0.14, CI: −0.85 to −0.31), and the interactions between gender, race (for black and Hispanic), and age, and between poverty, Hispanic ethnicity, and age. Other significant predictors of cognitive performance were poverty (Est. = 0.43, SE = 0.01, CI: 0.35 to 0.51), education (Est. = 0.51, SE = 0.01, CI: 0.48 to 0.55), and the interactions between age and race (for black and Hispanic), and between poverty and Hispanic ethnicity.

**DISCUSSION**

In this study, we sought to determine if there was a difference in the rate of cognitive decline by race/ethnicity when controlling for gender, educational attainment, poverty, heart disease, diabetes, and high blood pressure. This was done because each of these factors, according to previously cited research, influence cognitive decline; however, the evidence to date has produced various results in terms of the effect of race/ethnicity on cognitive performance. Our findings indicated that before and after controlling for these influencing factors, there are not significant differences in cognitive performance over time by race/ethnicity.

Although the aim of this article was not to examine baseline cognitive scores, it is evident there were significant differences by race and ethnicity in baseline cognition. Average unadjusted baseline cognitive scores were 17.64 for black race, 18.48 for Hispanic ethnicity, and 22.22 for white race. Furthermore, poverty seemed to affect baseline cognitive performance in general with a greater impact among Hispanic ethnicity.

Poverty has been shown to be associated with poorer health (Ingram, Scutchfield, Charnigo, & Riddell, 2012), lower educational attainment, and higher rates of functional limitations (Louie & Ward, 2011). Although those in poverty are a diverse group, older African Americans and Hispanics have, on average, lower incomes than older white adults in the United States (Administration on Aging, 2008). Specifically, 23.2% of older African Americans and 17.1% of older Hispanics are poor compared with 7.4% of white older adults (Administration on Aging, 2008). Furthermore, older women, specifically those over the age of 85 years, who live in rural areas, or who outlive their husbands are particularly at risk for poverty (Administration on Aging, 2008). Understanding the association of poverty and cognition can assist with targeting interventions, such as cognitive training, for those at higher risk of decline in older age.

The mechanisms of this association between poverty level, race, and cognition are currently unknown. However, it is possible that cumulative disadvantage over the life course plays a role in the association between the rate of cognitive decline, poverty, and race. The majority of researchers interested in this relationship have focused on the impact of poverty in early life cognitive development (Farah et al., 2006; Hackman & Farah, 2009). For example, in a review of the association between socioeconomic status and the developing brain, Hackman and Farah (2009) discussed how environments and experiences of childhood in different socioeconomic strata are, in part, responsible for different neurocognitive outcomes in children. However, less is known about the mechanisms explaining the association between poverty and cognition in older adults. Nevertheless, this relationship warrants further investigation.

Related to the theory of cumulative disadvantage is the surmounting evidence suggesting that cumulative lead exposure is related to several late-life conditions, including Parkinson’s disease (Weisskopf et al., 2010), cardiovascular disease (Peters et al., 2012), hearing loss (Park et al., 2010), decreased cognitive performance in women (Weuve et al., 2009), and metabolic abnormalities (Park et al., 2006). Furthermore, environmental pollutants, such as lead exposure, are more common among those in poverty (Environmental Protection Agency, 2000) suggesting that increased lead exposure over the life course could be a possible mediator in the association between poverty and cognitive decline.

It is important to note that studies have used different measures to understand the relationship between socioeconomic position and cognition. Our study focused on poverty levels; however, other studies have used income,
assets, wealth, and/or education in combination or as stand-alone measures of socioeconomic position. This can lead to varying results in the association between socioeconomic position and cognition in later life. Comparing studies that have varying measures of socioeconomic position should be done with caution.

This study is not without limitations. First, individuals with more severe levels of cognitive impairment used proxies and were excluded from our study, and therefore, the results should be interpreted in the context of a relatively cognitively intact sample. Additionally, some factors related to cognitive performance, such as lead exposure and sensory measures, were not accounted for in this study. Sensory impairment can negatively affect cognitive performance on an array of cognitive measures (Scialfa, 2002). Therefore, it is difficult to conclude if participants had access to the corrective devices commonly used among older adults suffering from sensory decline, such as hearing aids, which might have had an effect on their performance. Finally, cognitive measures could have been improved by including nonverbal assessments such as tasks measuring visual perception or psychomotor functioning. However, due to the mixed-mode interviewing technique used by HRS, cognitive measures exclude nonverbal tests (Fisher et al., 2012). It should also be recognized that the measures of biomedical factors are limited to a physician’s report of heart disease, diabetes, and high blood pressure.

In sum, our study did not find an association between race and cognitive performance over time, which supports some of the previous literature on differences in cognitive decline by race (Atkinson et al., 2005; Karlamangla et al., 2009; Masel & Peek, 2009). Our investigation focused on racial/ethnic differences, and therefore, the findings that are illuminating are the differences in baseline cognitive performance between races/ethnicity. These baseline differences are likely better predictors of cognitive performance over time. As it relates to the study objective, what should be highlighted here is that although differences in baseline cognitive performance appear to exist between races and within race by certain factors such as age or poverty, the linear and quadratic effects of time (and all model term interactions with time) failed to show a significant difference in cognitive performance between race or ethnicity over the 12 years examined.

**Supplementary Material**

Supplementary material can be found at: [http://psychsocgerontology.oxfordjournals.org/](http://psychsocgerontology.oxfordjournals.org/)

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