Received: 10 January 2023 | Revised: 27 April 2023 | Accepted: 25 May 2023

DOI: 10.1111/jgs.18475

Journal of the
American Geriatrics Society

Retirement and cognitive aging in a racially diverse sample of older Americans

Ross Andel PhD[1,2] | **Britney M. Veal BA**[3] | **Virginia J. Howard PhD**[4] | **Leslie A. MacDonald ScD**[5] | **Suzanne E. Judd PhD**[6] | **Michael Crowe PhD**[7]

[1]Edson College of Nursing and Health Innovation, Arizona State University, Phoenix, Arizona, USA

[2]Department of Neurology, Charles University, Second Faculty of Medicine and Motol University Hospital, Prague, Czech Republic

[3]School of Aging Studies, University of South Florida, Tampa, Florida, USA

[4]Department of Epidemiology, University of Alabama at Birmingham, Birmingham, Alabama, USA

[5]Division of Field Studies and Engineering, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati, Ohio, USA

[6]Department of Biostatistics, University of Alabama at Birmingham, Birmingham, Alabama, USA

[7]Department of Psychology, University of Alabama at Birmingham, Birmingham, Alabama, USA

Correspondence
Ross Andel, ASU Edson College of Nursing and Health Innovation, 550 N 3rd Street MC 3020, Phoenix, AZ 85004, USA.
Email: randel1@asu.edu

Funding information
National Institute of Neurological Disorders and Stroke, Grant/Award Number: U01 NS041588; National Institute on Aging (NIA), National Institutes of Health, Department of Health and Human Services; National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention; European Union

Abstract

Background: Retirement represents a crucial transitional period for many adults with possible consequences for cognitive aging. We examined trajectories of cognitive change before and after retirement in Black and White adults.

Methods: Longitudinal examination of up to 10 years (mean = 7.1 ± 2.2 years) using data from the REasons for Geographic and Racial Differences in Stroke (REGARDS) study–a national, longitudinal study of Black and White adults ≥45 years of age. Data were from 2226 members of the REGARDS study who retired around the time when an occupational ancillary survey was administered. Cognitive function was an average of *z*-scores for tests of verbal fluency, memory, and global function.

Results: Cognitive functioning was stable before retirement (Estimate = 0.05, $p = 0.322$), followed by a significant decline after retirement (Estimate = −0.15, $p < 0.001$). The decline was particularly pronounced in White (Estimate = −0.19, $p < 0.001$) compared with Black (Estimate = −0.07, $p = 0.077$) participants, twice as large in men (Estimate = −0.20, $p < 0.001$) compared with women (Estimate = −0.11, $p < 0.001$), highest among White men (Estimate = −0.22, $p < 0.001$) and lowest in Black women (Estimate = −0.04, $p = 0.457$). Greater post-retirement cognitive decline was also observed among participants who attended college (Estimate = −0.14, $p = 0.016$). While greater work complexity (Estimate = 0.92, $p < 0.05$) and higher income (Estimate = 1.03, $p < 0.05$) were related to better cognitive function at retirement, neither was significantly related to cognitive change after retirement.

Conclusion: Cognitive functioning may decline at an accelerated rate immediately post-retirement, more so in White adults and men than Black adults and women. Lifelong structural inequalities including occupational segregation and other social determinants of cognitive health may obscure the role of retirement in cognitive aging.

KEYWORDS
cognitive aging, race, retirement, sex

INTRODUCTION

Increasing life expectancy has meant longer lives for more people but there is also a greater chance for more years with significant age-related morbidities such as dementia. Unprecedented numbers of older adults are entering into retirement, and they expect to spend a considerable amount of time in retirement (~8 years in 1960 vs. 20 years in 2013).[1] Thus, understanding how retirement may impact health is critical for the advancement of healthy aging. Given that cognitive impairment is among the major drivers of disability in old age,[2] understanding the link between retirement and cognitive aging appears particularly important.

Work contributes to the sense of purpose, daily routine, social interaction, and mental activity, all of which help support cognitive function.[3–5] A reduction in cognitive performance has been reported when these are removed with retirement.[4,6–8] However, recent systematic reviews highlight that results across studies cover the entire gamut of negative, null, and positive associations between retirement and cognitive outcomes,[9,10] bringing to light the notion that the relationship between retirement and cognitive aging is complex.

The concept of "mental retirement"[4] may help explain some of the variability in the findings so far. It posits that as people consider retirement, they may disengage intellectually from work, which may in turn accelerate cognitive aging. Perhaps those who can draw on work activities as a source of intellectual engagement experience mental retirement in a more profound way. Along these lines, Coe et al.[9] reported that cognition was adversely affected by retirement mainly among white collar, compared with blue collar, workers. Similarly, some[11,12] report that work complexity, a known source of occupational engagement, may relate to cognitive outcomes favorably only until retirement, although others report associations between higher work complexity and slower age-related cognitive decline beyond retirement.[3,5]

Sociodemographic factors may help explain discrepancies in post-retirement cognitive outcomes. The opportunity to maintain optimal health with age is not uniform across race,[13] sex,[14] and education,[15] which reflects disparities in exposure to work conditions that are health-enhancing or health-depleting. For example, mistreatment at work was recently reported to be about double for Black versus White workers, and for women versus men.[16] Furthermore, Black workers[17] and women[18] tend to be overrepresented in occupations that require less qualification such as manual labor and services or healthcare support, respectively. These findings point toward occupational discrimination occurring along two intersecting axes—race and sex. This phenomenon, referred to as "intersectionality,"[19] highlights the notion that inequities are driven by combinations of structural influences working synergistically and never in isolation.[19,20]

Key points

- White participants showed a significant decline in cognitive function immediately after retirement.
- Black participants showed minimal cognitive decline immediately after retirement.
- White men showed the steepest post-retirement cognitive decline across sex/race combinations.

Why does this paper matter?

Understanding trajectories of cognitive change coinciding with retirement across race and sex can have important implications for developing strategies to promote cognitive health during the retirement transition. By bringing attention to retirement, the results support public health education regarding healthy transition into retirement. By highlighting the intersection of sex and race, the results offer a roadmap for studying potentially distinct post-retirement cognitive pathways across these sociodemographic subgroups.

The role of these intersecting structural inequalities in health is understudied, and the role of retirement in the trajectories of cognitive aging across the intersection of race and sex has not yet been assessed. We examined retirement in relation to cognitive aging in the REasons for Geographic and Racial Differences in Stroke (REGARDS)—a national, racially diverse cohort study in the United States. We assessed the role of retirement in cognitive functioning and trajectories of cognitive aging over up to 10.5 years of follow-up across the intersection of race and sex while also considering the roles of education, work complexity, and income.

METHODS

Participants and procedures

Participants were members of the REGARDS cohort,[21] an ongoing national study of 30,239 Black and White American community-dwelling adults aged 45 years or older at enrollment, January 2003–October 2007. From March 2011–March 2013, a subsample of 17,333 active participants consented to be interviewed to obtain occupational data (87% participation).[22] Information about retirement age was also collected. To determine retirement status, participants who were not working for pay were asked, "Are you retired, out of work, unable to work, a student or a homemaker?" Those who responded "retired" ($n = 10{,}541$) were eligible for the study. Figure 1 displays the sample selection process. All participants with valid data who retired no sooner than 2 years after their first cognitive assessment were included. Of the 10,541 retired participants, we excluded: 266 missing retirement information; 940 who retired before age 50 or after age 75; 7002 who retired more than 2 years before cognitive baseline; 83 who screened as cognitively impaired at baseline (Six-Item Screener[23] score ≤ 4); and 24 who were missing covariates, leaving 2226 participants in the analytical sample. The REGARDS protocol and occupational survey were approved by the Institutional Review Boards at the collaborating institutions. All participants provided written informed consent for REGARDS and verbal consent for the survey.

Cognitive function

Biennial cognitive data were collected by computer-assisted telephone interviews (CATI).[24] Immediate

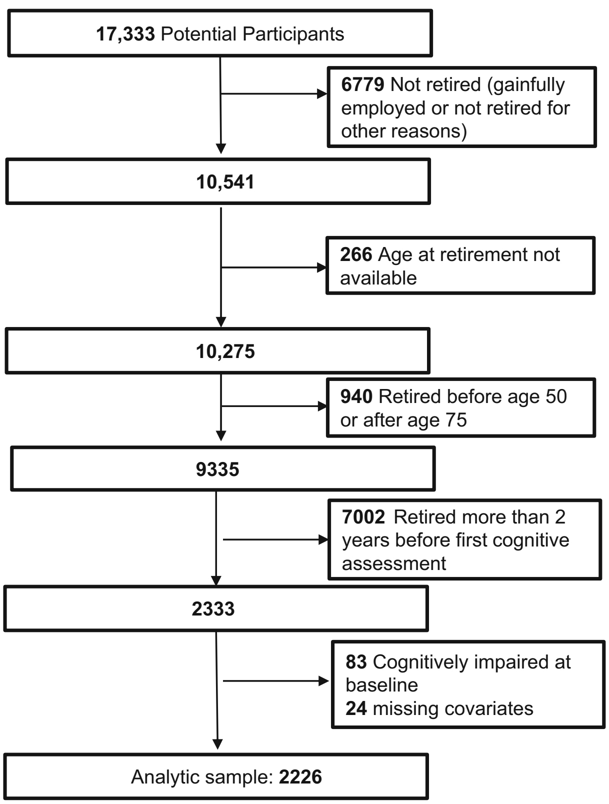

FIGURE 1 Flowchart representing determination of the analytical sample.

word recall of 10 words across three trials and delayed recall of the 10 words[25] measured verbal learning and memory. Semantic (Animal) Fluency Test (AFT) and Phonemic (Letter F) Fluency Test (LF)[25] measured language and executive function. Selected subtasks from the Montreal Cognitive Assessment (MoCA)[26] were also administered—5-word delayed recall and 6-item orientation (range 0–11 points). These assessment measures were selected for their sensitivity to the deficits commonly seen in vascular cognitive impairment.[24] At each timepoint, all available test scores were converted into *z*-scores and averaged.

Covariates

Sociodemographic variables

Age (years), sex (self-reported as male/female), race (Black/White), education (at least some college education vs. no college education), marital status (married/unmarried), and household income ($20,000, $20,000–$34,000, $35,000–$74,000, above $75,000, or unwilling to report) were included.

Work complexity was assigned based on participants' main lifetime occupation. Using the same procedure described in Fujishiro et al.,[27] work complexity was defined as a multi-item scale derived from the US Bureau of Labor Statistics Occupational Information Network (O*NET) data. Data linkage was based on 2002 US Census occupation codes assigned by coding experts to each participant's longest-held job.[22]

Physical and mental health

Self-reported health was measured as *poor/fair*, *good*, *very good*, or *excellent*. The four-item Center for Epidemiologic Studies Depression Scale (CES-D-4)[28] was used to measure depressive symptoms, with scores ranging from 0 to 12. The CES-D-4 has strong reliability and validity, similar to the original 20-item CES-D.[28,29] The 4-item Perceived Stress Scale (PSS)[30] was used, with 0–16 score range.

Analyses

Growth curve models in SAS (SAS Institute, Inc., Cary, NC) procedure MIXED[31] were used to analyze trajectories of cognitive change before/after retirement. The method uses all available data, is flexible in terms of covariance structure and accounts for random effects. Age (in years), centered around retirement age, defined the time scale. Intercept was specified as a random

TABLE 1 Sample characteristics.

Variables	All ($n = 2226$)	White ($n = 1429$)	Black ($n = 797$)
Age at baseline, mean (SD)	61.6 (5.4)	62.0 (5.4)	61.0 (5.3)
Age at retirement, mean (SD)	64.2 (4.6)	64.4 (4.5)	63.7 (4.8)
Sex: Female, *n* (%)	1230 (55)	704 (49)	526 (65)
College education, *n* (%)	1618 (72)	1096 (76)	522 (64)
Married, *n* (%)	1462 (65)	1060 (74)	402 (50)
Complexity of work, mean (SD)	0.4 (1.0)	0.5 (0.9)	0.1 (1.1)
Self-rated health, *n* (%)			
Fair or poor	270 (12)	113 (8)	157 (19)
Good	723 (32)	380 (26)	343 (42)
Very good	844 (38)	621 (43)	223 (28)
Excellent	409 (18)	322 (22)	87 (11)
CESD, mean (SD)	0.9 (1.8)	0.8 (1.7)	1.1 (2.0)
Perceived stress, mean (SD)	2.8 (2.6)	2.7 (2.5)	3.1 (3.0)
Income, *n* (%)			
Less than $20,000	203 (9)	92 (6)	111 (14)
$20,000–$34,000	410 (18)	226 (16)	184 (23)
$35,000–$74,000	836 (37)	534 (37)	302 (37)
$75,000 and above	601 (27)	459 (32)	142 (18)
Refused	200 (9)	128 (9)	72 (9)

Note: Income is presented in US dollars.
Abbreviation: CESD, Center for Epidemiological Studies Depression Scale.

effect. Restricted maximum likelihood was used in all models. We settled on "unstructured" covariance matrix because of its superior fit to data. We assessed two slopes simultaneously using retirement age as the pivot point. All covariates were centered at the sample mean and cognitive scores were converted to T-scores ($M = 50 \pm 10$). Quadratic age effects on cognition were also examined, but these did not improve model fit and were therefore not included in final models. Intraclass correlation obtained from an unconditional model indicated 50% of the variance in cognitive scores was within- and 50% between-person, suggesting sufficient variability at both levels.

Main models controlled baseline age, age at retirement, race, sex, education, marital status, self-rated health, CES-D-4 score, and perceived stress. Then, work complexity was added. Models were also estimated after stratification by sex and race, and by education and work complexity. Income was used as the independent variable in the same models with the subsample of those for whom this information was available ($n = 2028$). In post-hoc analyses, to reduce the influence of poor health on the decision to retire, we assessed main results only in those reporting "very good" or "excellent" health within 3 years before retirement ($n = 1203$).

RESULTS

Of the 10,541 retired participants, 2226 met inclusion criteria. Compared with retired participants who were not included, included participants were younger by an average of 6.7 ± 7.1 years (63.0 ± 5.4 vs. 69.7 ± 7.5 years at baseline), $t(10{,}539) = 39.89$, $p < 0.001$, had slightly more women (55% vs. 52%), $\chi^2 = 3.69$, $p = 0.055$, were more likely to have at least some college education (72% vs. 65%), $\chi^2 = 39.3$, $p < 0.001$, had slightly better health (1.6 ± 0.9 vs. 1.5 ± 0.9), $t(10{,}539) = 3.75$, $p < 0.001$, and were similar in depressive symptoms and perceived stress.

The 2226 participants contributed 9301 cognitive scores across up to 7 waves (mean $= 4.5 \pm 1.3$ waves) of cognitive data collected for up to 10.5 years (mean $= 7.4 \pm 2.1$ years, of which 1.2 ± 2.7 years occurred before and 6.2 ± 3.2 years after retirement). Table 1 displays descriptive characteristics.

Main results

Main results are displayed in Table 2. The rate of change in cognitive function was slightly positive and

TABLE 2 Trajectories of cognitive change before and after retirement overall and by race.

	All			
		95% CI		
Variable	Est.	Low	High	*p*-Value
All				
Intercept	48.85	47.93	49.77	<0.001
Change before retirement	0.05	−0.05	0.16	0.322
Change after retirement	**−0.15**	**−0.19**	**−0.10**	**<0.001**
Black participants				
Intercept	46.94	45.50	48.38	<0.001
Change before retirement	0.09	−0.10	0.28	0.359
Change after retirement	−0.07	−0.15	0.01	0.077
White participants				
Intercept	49.96	48.76	51.16	<0.001
Change before retirement	0.04	−0.09	0.17	0.565
Change after retirement	**−0.19**	**−0.24**	**−0.13**	**<0.001**

Note: Results are also adjusted for age at baseline, retirement age, college education, self-rated health, perceived stress, depressive symptoms, and practice effect. Statistically significant associations of interest are highlighted in bold.
Abbreviations: CI, confidence interval; Est., estimate.

non-significant pre-retirement (Estimate = 0.05, 95% confidence interval [CI] −0.05, 0.16, $p = 0.322$), which was similar for Black (Estimate = 0.09, 95% CI −0.10, 0.28, $p = 0.359$) and White participants (Estimate = 0.04, 95% CI −0.09, 0.17, $p = 0.565$) when examined separately. Post-retirement, there was an overall decline in cognitive function scores (−0.15, 95% CI −0.19, −0.10, $p < 0.001$). Stratification by race showed the post-retirement decline to be more prominent and almost three times greater among White (Estimate = −0.19, 95% CI −0.24, −0.13, $p < 0.001$) compared with Black (Estimate = −0.07, 95% CI −0.15, 0.01, $p = 0.077$) participants (also see Figure 2).

Sex-specific analyses are reported in Table 3. Pre-retirement, the rate of cognitive change was positive and non-significant among women (Estimate = 0.13, 95% CI −0.03, 0.28, $p = 0.106$), and stable among men (Estimate = −0.02, 95% CI −0.18, 0.14, $p = 0.774$). Post-retirement, both groups exhibited significant cognitive decline, with the effect almost twice as large for men than for women (Estimates = −0.20, $p < 0.001$ vs. −0.11, $p < 0.001$). Results for race-sex subgroups indicated no significant change in cognition pre-retirement and substantially stronger estimates for post-retirement decline among men compared with women. The pattern of results was unchanged after adjustment for work complexity (see Supplemental Table S1).

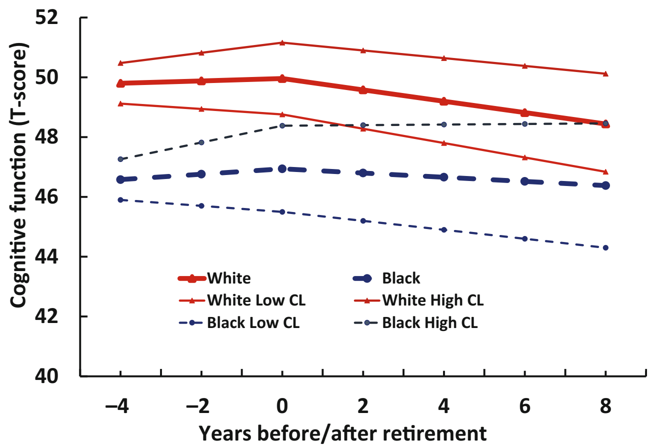

FIGURE 2 Overall trajectory of change before and after retirement for White and Black participants. The lines represent the overall estimate and the 95% lower and upper confidence limit (CL) around the estimate.

Role of income

In analyses with those reporting income data ($n = 2028$), higher income was related to better cognitive function at retirement overall (Estimate = 0.92, 95% CI 0.75, 1.09, $p < 0.001$) and across race and sex. Higher income was related to modest non-significant cognitive decline pre-retirement (Estimate = −0.05, 95% CI −0.11, 0.01,

$p = 0.082$) and essentially no change after retirement (Estimate = −0.02, 95% CI −0.04, 0.001, $p = 0.163$) in this subsample. Results of analyses stratified by race and sex are shown in Supplemental Table S2. The pre- and post-retirement slopes were non-significant for Black participants. Among White participants, there was a greater pre-retirement cognitive decline with higher income (Estimate = −0.09, 95% CI −0.16, −0.01, $p = 0.020$) but no significant association with post-retirement cognitive change. In women, trajectories of cognitive change before and after retirement were unaffected by income, but among men, there was a steeper cognitive decline with higher income pre-retirement (Estimate = −0.11, 95% CI −0.20, −0.01, $p = 0.030$). Analyses stratified by both race and sex (not shown in Supplemental Table S2) indicated that the association between greater pre-retirement cognitive decline and higher income was only significant among White men (Estimate = −0.13, 95% CI −0.25, −0.02, $p = 0.025$).

Role of education and work complexity

Using the entire sample, college education (Estimate = 2.73, 95% CI 2.03, 3.44, $p < 0.001$) and work complexity (Estimate = 1.03, 95% CI 0.70, 1.35, $p < 0.001$) were related to better cognitive function at retirement. Education did not modify pre-retirement change in cognition (Estimate = 0.10, 95% CI −0.17, 0.37, $p = 0.461$), but higher education was associated with significantly greater post-retirement decline (Estimate = −0.14, 95% CI −0.25, −0.02, $p = 0.016$). Work complexity did not modify trajectories of cognitive change before ($p = 0.307$) or after ($p = 0.699$) retirement.

We also evaluated the same relationships by race and sex (see Supplemental Table S3). Again, college education and greater work complexity were related to better cognitive function at retirement and there were no significant associations with cognitive change pre-retirement. Results for White participants were consistent with the aggregate results showing that higher education was related to a steeper decline in cognitive function post-retirement. The corresponding estimate for Black participants was smaller and non-significant.

Post-hoc analyses limited to those in very good or excellent health

A total of 1243 participants reported "very good" or "excellent" health at baseline. These participants did not differ from the 983 participants who reported "good," "fair," or "poor" health in terms of baseline age (mean age 63.0 ± 4.9 vs. 63.0 ± 4.7 years) and age at retirement (mean age 64.3 ± 4.6 vs. 64.0 ± 4.6 years). A slightly (but significantly) smaller proportion of women reported at least very good health (52% vs. 58%, $p = 0.007$). Those in better health were more likely to be White (66% vs. 38%,

TABLE 3 Trajectories of cognitive change before and after retirement by race and sex.

Variable	Men				Women			
		95% CI				95% CI		
	Est.	Low	High	*p*-Value	Est.	Low	High	*p*-Value
All								
Intercept	47.26	45.83	48.68	<0.001	49.50	48.25	50.74	<0.001
Change before retirement	−0.02	−0.18	0.14	0.782	0.13	−0.03	0.28	0.104
Change after retirement	**−0.20**	**−0.27**	**−0.13**	**<0.001**	**−0.11**	**−0.16**	**−0.05**	**<0.001**
Black participants								
Intercept	46.10	43.77	48.43	<0.001	47.80	45.96	49.63	<0.001
Change before retirement	−0.15	−0.46	0.16	0.344	0.21	−0.03	0.46	0.087
Change after retirement	**−0.13**	**−0.26**	**0.00**	**0.043**	−0.04	−0.13	0.06	0.457
White participants								
Intercept	48.12	46.36	49.87	<0.001	51.59	49.97	53.21	<0.001
Change before retirement	0.01	−0.17	0.19	0.908	0.04	−0.15	0.23	0.673
Change after retirement	**−0.22**	**−0.30**	**−0.15**	**<0.001**	**−0.14**	**−0.22**	**−0.07**	**<0.001**

Note: Results are also adjusted for age at baseline, retirement age, college education, self-rated health, perceived stress, depressive symptoms, and practice effect. Statistically significant associations of interest are highlighted in bold.

Abbreviations: CI, confidence interval; Est., estimate.

$p < 0.001$) and have some college education (78% vs. 64%, $p < 0.001$).

Results of mixed effects models estimating trajectories of cognitive change before/after retirement for this subsample are presented in Supplemental Table S4. The previously described pattern of results in the overall sample was preserved in all analyses except that post-retirement cognitive decline was now non-significant among Black men.

DISCUSSION

We assessed the role of retirement in cognitive aging using a diverse sample of middle-aged and older adults with up to 10.5 years of cognitive follow-up. To the best of our knowledge, this is the first attempt to study trajectories of cognitive aging modeled simultaneously before and after retirement across the intersection of race and sex, establishing new information about possible differences in cognitive response to retirement within the context of intersectionality.[19] We found mainly cognitive stability as participants approached retirement and cognitive decline in the years right after retirement. Of particular note is that the age-related cognitive decline observed immediately following retirement was almost three times steeper in White compared with Black individuals and twice as large in men compared with women. Black women showed very little post-retirement cognitive decline and White men experienced the highest rate of cognitive decline once they retired.

We considered the possibility that the divergent results for White and Black participants were a function of differences in cognitive scores at retirement. However, if that solely was the case, we would expect to observe greatest cognitive decline in White women because they had better cognitive scores at retirement (as reflected by the intercept; see Table 3) than any other sociodemographic subgroup, including White men ($t[1437] = 3.14$, $p = 0.002$). In fact, Black women and White men exhibited about equal cognitive scores at retirement, however their trajectories of post-retirement cognitive change were substantially different. The finding that Black women and White men had similar cognition at retirement deviates from expectations under the concept of intersectionality.[19] Notably, high income White men experienced cognitive decline before retirement, which may have influenced aggregate subgroup cognition at retirement. Regardless, employed Black women within this study may represent a distinct group that is more resilient to influences brought about by structural inequalities. This finding deserves attention in future research.

Considering the entire sample, higher education was associated with significantly better cognitive function at retirement but also a steeper rate of cognitive decline post-retirement. Stratified analyses indicated that this result was particularly pronounced among White participants (Estimate $= -0.17$ in White vs. -0.05 in Black participants; see Supplemental Table S3). Employment in complex jobs was associated with better cognitive function at retirement, but was not associated with cognitive change pre- or post-retirement. Collectively, these findings have important public health and public policy implications for alleviating cognitive decline potentially occurring in conjunction with retirement across sociodemographic subgroups.

There are several plausible explanations for the greater adverse effect of retirement on cognitive function in White compared with Black participants. Black retirees may adjust to retirement better than White participants because of better established social support networks and cultural practices that favor community cohesiveness to a greater extent than is typical for White adults.[32] The finding is also consistent with prior research showing that Black participants have lower initial cognitive scores but less decline than White participants as they enter older adulthood, irrespective of retirement considerations,[33] and that Black adults may experience brain aging earlier than White (or Hispanic) adults.[34]

Historically, Black workers in the United States have faced substantial barriers to more engaging occupations due to longstanding structural disparities in education and hiring practices in the United States.[35] Our findings suggest that one outcome of the resulting race-based occupational segregation is that Black workers may not experience the same level of disruption in engagement and other health-enhancing aspects of employment when they retire, reducing the expected rate of post-retirement cognitive decline. Conversely, White workers, and particularly White men, may be more likely to experience a greater loss of identity, engagement, and life direction as they enter retirement. This explanation goes along with the productive aging framework,[36,37] whereby facets of employment such as routine and engagement offer important contributions to a healthy life that are difficult to replace in retirement. It also goes along with Hamm et al.[38] who recently reported that the negative effect of retirement on cognitive function disproportionately impacts those for whom retiring represents a major "goal disengagement" (loss of identity). Future research should examine specifically how these concepts apply across the intersection of race and sex.

That those with higher education experienced greater cognitive decline immediately after retirement appears to deviate from the generally accepted, and empirically supported, notion that education slows cognitive aging in general.[39] However, these studies may primarily reflect overall cognitive advantage attributable to education that is "preserved" over time rather than permanently slowed cognitive aging as a function of more education,[40] a finding likely magnified by consideration of cognitive change before/after retirement.[11]

It is also possible that post-retirement cognitive outcomes may largely reflect functional health at retirement, which would influence the decision to retire in the first place. With this in mind, we (a) controlled for self-rated health in all analyses and (b) conducted post-hoc analyses including only those reporting very good or excellent health close to retirement. The pattern of results did not change appreciably, suggesting that health status at retirement does not explain the post-retirement trajectories of cognitive change observed in this study.

We were able to evaluate change in cognitive function for up to approximately 7 years after retirement, which is a relatively short time. The slopes of cognitive trajectories by education after retirement may change with additional years of follow-up, which will be important to evaluate in future research. In addition, we did not consider the quality or type of education, which may play its own unique role, particularly in racially diverse populations. Finally, although we statistically controlled for age at retirement, future research should still assess the potential role of retirement timing on trajectories of post-retirement change. To date, there is a paucity of research addressing cognitive trajectories in relation to retirement, and the finding of a more rapid decline among more highly educated individuals post-retirement requires further investigation.

We found that those with greater work complexity performed better cognitively at retirement and maintained their advantage in cognitive functioning *about evenly* after retirement. Conversely, findings from the Health and Retirement Study (HRS)[3,41] and the Midlife in the United States (MIDUS) study[5] indicate that greater work complexity is associated with *slowed* decline after retirement. But the HRS-based studies included longer post-retirement follow-up with 14[41] and 15[3,5] years of follow-up. It may be that longer post-retirement follow-up is necessary to detect significant results by allowing for a post-retirement adjustment period to pass. In addition, our REGARDS sample skews toward high education, with 72% having some college education, which can help explain these results. In contrast, ~35% report some college education in HRS- and MIDUS-based studies.[3,5,41]

Finally, the finding that higher income men, especially White men, experience significant cognitive decline immediately before retirement may represent the phenomenon of "mental retirement" or disengagement as posited by Rohwedder and Willis.[4] Possibilities to be explored include whether antecedent job demands help explain these observations or whether White men and those with higher income or education may be more likely to retire due to oncoming cognitive problems not easily captured by cognitive screening tests.

STRENGTHS AND LIMITATIONS

Strengths of our study include use of a diverse sample to examine trajectories of cognitive aging in relation to retirement. We included a comprehensive list of variables encompassing sociodemographic characteristics as well as measures of work complexity, and mental and physical health. Finally, we estimated the pre- and post-retirement trajectories of cognitive aging within a single piecewise model using a retirement-based pivot point, providing a more complete picture of the possible role of retirement on cognitive change in Black and White men and women.

The study is not without limitations. The size of our analytic sample was limited because some members of the cohort retired prior to REGARDS enrollment and the start of cognitive testing, and some were still actively employed, potentially reducing generalizability of our results and statistical power. Our cognitive measure was not based on a full neuropsychological battery, although the measure did include several cognitive domains most important for cognitive aging. Finally, although we considered the physical and mental health of the participants, we cannot rule out the influence of unmeasured drivers for both retirement and accelerated cognitive decline. Therefore, we caution that the results can be interpreted simply as associations, with further research needed to understand causality behind the observation of retirement coinciding with differential trajectories in cognitive change across race and sex. Still, we provide initial evidence that race and sex relate to differential post-retirement cognitive outcomes.

CONCLUSIONS

We found that post-retirement cognitive decline was almost three times steeper in White compared with Black individuals, twice as large in men compared with women, and most substantial for White men but minimal for Black women. One possibility is that lifelong structural inequalities including occupational segregation and other social determinants of cognitive health may accelerate age-related cognitive decline among Black workers and women. High education appeared to predispose individuals to greater post-retirement cognitive decline. These results provide at least partial support for "mental retirement"[4] and the productive aging framework,[36,37] whereby better job opportunities may be reflected in greater cognitive losses following the cessation of work.

AUTHOR CONTRIBUTIONS

All authors listed on this submission contributed significantly to the preparation of the manuscript.

ACKNOWLEDGMENTS

The authors thank the other investigators, the staff, and the participants of the REGARDS study for their valuable contributions. A full list of participating REGARDS investigators and institutions can be found at: https://www.uab.edu/soph/regardsstudy/.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts of interest in the context of this manuscript, including no financial, personal, or potential conflicts.

SPONSOR'S ROLE

Sponsors had no role in the design, methods, subject recruitment, data collections, analysis, or preparation of this manuscript.

FINANCIAL DISCLOSURE

This project was supported by cooperative agreement U01 NS041588 co-funded by the National Institute of Neurological Disorders and Stroke (NINDS) and the National Institute on Aging (NIA), National Institutes of Health, Department of Health and Human Services. The REGARDS occupational ancillary study was supported by intramural funding by the National Institute for Occupational Safety and Health (NIOSH), Centers for Disease Control and Prevention. RA was supported by project no. LX22NPO5107 (MEYS): Financed by European Union—Next Generation EU. The content is solely the responsibility of the authors and does not necessarily represent the official views of any of the funding entities.

ORCID

Ross Andel https://orcid.org/0000-0003-4083-4790

REFERENCES

1. Heimlich R. Baby boomers retire. Pew Research Center. Accessed February 22, 2023. https://www.pewresearch.org/fact-tank/2010/12/29/baby-boomers-retire/
2. Lindbergh CA, Dishman RK, Miller LS. Functional disability in mild cognitive impairment: a systematic review and meta-analysis. *Neuropsychol Rev*. 2016;26(2):129-159.
3. Fisher GG, Stachowski A, Infurna FJ, Faul JD, Grosch J, Tetrick LE. Mental work demands, retirement, and longitudinal trajectories of cognitive functioning. *J Occup Health Psychol*. 2014;19(2):231.
4. Rohwedder S, Willis RJ. Mental retirement. *J Econ Perspect*. 2010;24(1):119-138.
5. Vélez-Coto M, Andel R, Pérez-García M, Caracuel A. Complexity of work with people: associations with cognitive functioning and change after retirement. *Psychol Aging*. 2021;36(2):143.
6. Bonsang E, Adam S, Perelman S. Does retirement affect cognitive functioning? *J Health Econ*. 2012;31(3):490-501.
7. Xue B, Cadar D, Fleischmann M, et al. Effect of retirement on cognitive function: the Whitehall II cohort study. *Eur J Epidemiol*. 2018;33:989-1001.
8. Mazzonna F, Peracchi F. Ageing, cognitive abilities and retirement. *Eur Econ Rev*. 2012;56(4):691-710.
9. Coe NB, von Gaudecker HM, Lindeboom M, Maurer J. The effect of retirement on cognitive functioning. *Health Econ*. 2012;21(8):913-927.
10. Alvarez-Bueno C, Cavero-Redondo I, Jimenez-Lopez E, Visier-Alfonso ME, Sequi-Dominguez I, Martinez-Vizcaino V. Effect of retirement on cognitive function: a systematic review and meta-analysis. *Occup Environ Med*. 2021;78(10):761-768.
11. Finkel D, Andel R, Gatz M, Pedersen NL. The role of occupational complexity in trajectories of cognitive aging before and after retirement. *Psychol Aging*. 2009;24(3):563.
12. Lane AP, Windsor TD, Andel R, Luszcz MA. Is occupational complexity associated with cognitive performance or decline? Results from the Australian Longitudinal Study of Ageing. *Gerontology*. 2017;63(6):550-559.
13. Taylor J. *Racism, Inequality, and Health Care for African Americans*. The Century Foundation: New York; 2019.
14. Oi K. Does gender differentiate the effects of retirement on cognitive health? *Res Aging*. 2019;41(6):575-601.
15. Zajacova A, Montez JK, Herd P. Socioeconomic disparities in health among older adults and the implications for the retirement age debate: a brief report. *J Gerontol B Psychol Sci Soc Sci*. 2014;69(6):973-978.
16. Fekedulegn D, Alterman T, Charles LE, et al. Prevalence of workplace discrimination and mistreatment in a national sample of older US workers: the REGARDS cohort study. *SSM Popul Health*. 2019;8:100444.
17. Stanbury M, Rosenman KD. Occupational health disparities: a state public health-based approach. *Am J Ind Med*. 2014;57(5):596-604.
18. Campos-Serna J, Ronda-Pérez E, Artazcoz L, Moen BE, Benavides FG. Gender inequalities in occupational health related to the unequal distribution of working and employment conditions: a systematic review. *Int J Equity Health*. 2013;12(1):1-18.
19. Crenshaw K. Demarginalizing the intersection of race and sex: a black feminist critique of antidiscrimination doctrine, feminist theory and antiracist politics. *Univ Chic Leg Forum*. 1989;1989(1):139-167.
20. Hankivsky O. *Intersectionality 101*. Institute for Intersectionality Research and Policy; 2014:1-34.
21. Howard VJ, Cushman M, Pulley L, et al. The REasons for Geographic and Racial Differences in Stroke study: objectives and design. *Neuroepidemiology*. 2005;25(3):135-143.

22. MacDonald LA, Pulley L, Hein MJ, Howard VJ. Methods and feasibility of collecting occupational data for a large population-based cohort study in the United States: the REasons for Geographic and Racial Differences in Stroke study. *BMC Public Health*. 2014;14(1):1-12.
23. Callahan CM, Unverzagt FW, Hui SL, Perkins AJ, Hendrie HC. Six-item screener to identify cognitive impairment among potential subjects for clinical research. *Med Care*. 2002;40:771-781.
24. Finlay J, Esposito M, Tang S, et al. Fast-food for thought: retail food environments as resources for cognitive health and wellbeing among aging Americans? *Health Place*. 2020;64:102379 (pp. 1-9).
25. Welsh KA, Butters N, Mohs RC, et al. The Consortium to Establish a Registry for Alzheimer's Disease (CERAD). Part V. A normative study of the neuropsychological battery. *Neurology*. 1994;44(4):609. doi:10.1212/WNL.44.4.609
26. Nasreddine ZS, Phillips NA, Bédirian V, et al. The Montreal Cognitive Assessment, MoCA: a brief screening tool for mild cognitive impairment. *J Am Geriatr Soc*. 2005;53(4):695-699.
27. Fujishiro K, MacDonald LA, Crowe M, McClure LA, Howard VJ, Wadley VG. The role of occupation in explaining cognitive functioning in later life: education and occupational complexity in a US national sample of black and white men and women. *J Gerontol B*. 2019;74(7):1189-1199.
28. Melchior LA, Huba GJ, Brown VB, Reback CJ. A short depression index for women. *Educ Psychol Meas*. 1993;53(4):1117-1125.
29. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. *Appl Psychol Measur*. 1977;1(3):385-401.
30. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav*. 1983;24:385-396.
31. Stroup WW, Milliken GA, Claassen EA, Wolfinger RD. *SAS for Mixed Models: Introduction and Basic Applications*. SAS Institute; 2018.
32. Benca-Bachman CE, Najera DD, Whitfield KE, Taylor JL, Thorpe RJ Jr, Palmer RH. Quality and quantity of social support show differential associations with stress and depression in African Americans. *Am J Geriatr Psychiatry*. 2020;28(6):597-605.
33. Gross AL, Mungas DM, Crane PK, et al. Effects of education and race on cognitive decline: an integrative study of generalizability versus study-specific results. *Psychol Aging*. 2015;30(4):863.
34. Turney IC, Lao PJ, Rentería MA, et al. Brain aging among racially and ethnically diverse middle-aged and older adults. *JAMA Neurol*. 2023;80(1):73-81. doi:10.1001/jamaneurol.2022.3919
35. Lavalley R, Johnson KR. Occupation, injustice, and anti-Black racism in the United States of America. *J Occup Sci*. 2022;29(4):487-499.
36. Morrow-Howell N, Hinterlong J, Sherraden M. *Productive Aging: Concepts and Challenges*. JHU Press; 2001.
37. Morrow-Howell N, Halvorsen CJ, Hovmand P, Lee C, Ballard E. Conceptualizing productive engagement in a system dynamics framework. *Innov Aging*. 2017;1(1):igx018.
38. Hamm JM, Heckhausen J, Shane J, Lachman ME. Risk of cognitive declines with retirement: who declines and why? *Psychol Aging*. 2020;35(3):449.
39. Vemuri P, Lesnick TG, Przybelski SA, et al. Association of lifetime intellectual enrichment with cognitive decline in the older population. *JAMA Neurol*. 2014;71(8):1017-1024.
40. Wilson RS, Hebert LE, Scherr PA, Barnes LL, de Leon CFM, Evans DA. Educational attainment and cognitive decline in old age. *Neurology*. 2009;72(5):460.
41. Carr DC, Willis R, Kail BL, Carstensen LL. Alternative retirement paths and cognitive performance: exploring the role of preretirement job complexity. *Gerontologist*. 2020;60(3):460-471.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

Supplemental Table S1. Trajectories of cognitive change before and after retirement overall and by race and sex, work complexity added as a covariate.
Supplemental Table S2. Associations between income and trajectories of cognitive change before and after retirement by race and sex ($n = 2028$).
Supplemental Table S3. Associations between education or work complexity with trajectories of cognitive change before and after retirement by race and sex.
Supplemental Table S4. Trajectories of cognitive change before and after retirement overall and by race and sex for those reporting very good or excellent self-rated health.

How to cite this article: Andel R, Veal BM, Howard VJ, MacDonald LA, Judd SE, Crowe M. Retirement and cognitive aging in a racially diverse sample of older Americans. *J Am Geriatr Soc*. 2023;71(9):2769-2778. doi:10.1111/jgs.18475