

## RESEARCH ARTICLE

# Experiences of racism and subjective cognitive function in African American women

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## Abstract

**Introduction:** We hypothesized that frequent experiences of racism among African American women would adversely affect subjective cognitive function (SCF), based on the established association of psychological stress with memory decline.

**Methods:** We used multinomial logistic regression to quantify the association between experiences of racism and SCF, based on six questions, among 17,320 participants in the prospective Black Women's Health Study.

**Results:** The multivariable odds ratio (OR, 95% confidence interval [CI]) for poor compared to good SCF among women at the highest versus the lowest level of daily racism (eg, poorer service in stores) was 2.75 (2.34 to 3.23); for the same comparison among women at the highest level of institutional racism (eg, discriminated against in housing) relative to the lowest, the OR was 2.66 (2.24 to 3.15). The associations were mediated, in part, by depression and insomnia.

**Discussion:** Experiences of racism, a highly prevalent psychosocial stressor among African Americans, were associated with lower SCF.

## KEYWORDS

African Americans, cognition, epidemiology, racial discrimination, women

## 1 | INTRODUCTION

Rates of incident dementia and Alzheimer's disease (AD) are higher in African Americans than in white Americans.<sup>1</sup> Older African Americans perform more poorly on neuropsychological tests of cognition compared to white Americans of similar ages in many studies of community and clinical populations.<sup>2,3</sup> Control for education and socioeconomic status (SES), both independently associated with cognitive function,<sup>4</sup> may attenuate observed racial disparities but does not typically eliminate them.<sup>1-3</sup> Racial discrimination, which is a prominent feature of an unequal society, has been associated with many adverse

health outcomes,<sup>5</sup> and may contribute to deficits in cognition in African Americans compared with white Americans.

Interpersonal stressors predict self-reported memory failures in older adults independently of other stressors.<sup>6</sup> The hippocampus, a brain area critical for episodic memory, is among the first brain areas to show neurodegenerative changes in the most common form of AD, its amnesic presentation.<sup>7</sup> The hippocampus also has a high concentration of glucocorticoid receptors,<sup>8</sup> which are the primary binding sites for the stress hormone cortisol. Chronic stress is associated with reduced hippocampal volume and impaired hippocampal-dependent memory in older adults.<sup>9,10</sup> It is plausible that a prominent stressor

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among African Americans, racial discrimination, could contribute to deficits in their cognition.

Experiences of racism are common among African Americans, with 50% or more respondents to a 2017 nationally representative survey reporting experiences of institutional racism (eg, having been discriminated against in pay or promotions in the workplace) and daily interpersonal racism (eg, having experienced racial slurs).<sup>11</sup> These institutional and daily forms of racism have been associated with increased risks of various conditions that can impair cognition, including depression,<sup>12</sup> poor sleep,<sup>13</sup> type 2 diabetes,<sup>14</sup> and hypertension.<sup>15</sup> Two experimental studies have reported immediate adverse effects on cognition when African American subjects were exposed to fictional vignettes describing discrimination,<sup>16</sup> or when cognitive tests were administered by a white person and levels of perceived discrimination were high.<sup>17</sup> Whether cumulative experiences of racism affect cognition in the long term is unclear. In a cross-sectional epidemiologic study, racial discrimination was associated with poorer cognition, particularly episodic memory and perceptual speed, in African American participants.<sup>18</sup> Among African Americans in the longitudinal Health and Retirement Study, greater discrimination reported at baseline was associated with lower memory scores at baseline.<sup>19</sup> Among all participants, greater baseline discrimination was also associated with lower memory scores 6 years later, although race-specific longitudinal results were not reported.<sup>19</sup>

The Black Women's Health Study (BWHS), a follow-up study of 59,000 black women, has queried participants on experiences of racism and subjective cognitive function (SCF). In prior analyses in the BWHS, greater experiences of racism were associated with increases in incidence of breast cancer,<sup>20</sup> asthma,<sup>21</sup> type 2 diabetes,<sup>14</sup> and obesity,<sup>22</sup> and with the prevalence of insomnia.<sup>13</sup> We hypothesized that greater experiences of racism would be associated with lower levels of SCF.

## 2 | METHODS

### 2.1 | Establishment of the BWHS

The BWHS is a prospective cohort study established in 1995, when 59,000 black women aged 21 through 69 years enrolled by completing health questionnaires. The baseline questionnaire elicited information on demographic and lifestyle factors, reproductive history, and medical conditions. The cohort is followed biennially by mailed and web-based questionnaires to update exposures and ascertain incident disease. Follow-up of the baseline cohort has been complete for >85% of potential person-years of follow-up through 2015. The study protocol was approved by the institutional review board of Boston University Medical Campus. Participants indicate consent by completing and returning the questionnaires.

### 2.2 | Analytic cohort

The present analyses include women age 55 and older in 2015 who answered questionnaires in 2009, when experiences of racism were

### RESEARCH IN CONTEXT

1. Systematic review: The authors reviewed the literature using traditional (eg, PubMed) sources. A substantial body of literature demonstrates associations of subjective memory complaints with objective measures of memory, and of experiences of racism with adverse health outcomes, for which representative articles are cited. There are fewer studies on the effect of experiences of racism on cognition, and they are cited.
2. Interpretation: Our results suggest that experiences of racism adversely affect subjective cognitive function, consistent with findings from other studies demonstrating that higher perceived psychological stress is associated with greater subjective memory decline.
3. Future directions: These findings should motivate similar analyses of data from other cohorts that include African Americans and use more extensive objective cognitive measures. Information on experiences of racism over the lifecourse would allow for assessment of the importance of the timing of exposure. Identification of specific cognitive domains affected would also be desirable.

assessed, and in 2015, when SCF was assessed. Of 28,855 participants who met those criteria, we excluded women with incomplete data on SCF (1548) or racism (2984), leaving a total of 17,323 in the analytic cohort. Compared to women who were included, women who were excluded were older (66.3 vs. 64.3 years in 2015), less likely to have 16 or more years of education (49.9% vs. 58.8%), and scored higher on the Center for Epidemiology Studies - Depression (CES-D) scale (11.7 vs. 10.3). Included and excluded women had similar levels of physical activity, body mass index (BMI), prevalence of chronic disease, smoking history, and scores on a diet quality index and on the racism scales (data not shown).

### 2.3 | Assessment of SCF

SCF was ascertained in 2015 using six yes/no questions listed in Table 1. Each positive response was assigned 1 point for a total cognitive score ranging from 0 to 6. The questions were developed for the short Structured Telephone Interview for Dementia Assessment (STIDA), a telephone screener for dementia.<sup>23</sup> Scores based on the questions have correlated well with results from more extensive cognitive assessments.<sup>23-25</sup> SCF scores were categorized as indicating good cognitive function (0 positive responses), moderate cognitive function (1 to 2 positive responses), and poor cognitive function (3 to 6 positive responses).

**TABLE 1** Responses to cognitive questions among BWHS participants aged  $\geq 55$  in 2015

Cognition score (number of positive responses)	Prevalence (n)
Good (0)	60.0% (10,388)
Moderate (1-2)	28.1 (4865)
Poor ( $\geq 3$ )	12.0 (2070)
3-4	10.0 (1727)
5-6	2.0 (343)
Positive responses to specific questions	
Do you have more trouble than usual remembering:	
Recent events?	20.0 (3464)
A short list of items?	26.8 (4647)
Things from one second to the next?	21.7 (3759)
Do you have difficulty understanding spoken instructions?	6.4 (1105)
Do you have more trouble than usual following a group conversation/TV plot due to memory?	4.8 (824)
Do you have trouble finding your way around familiar streets?	2.3 (392)

## 2.4 | Assessment of experiences of racism

The 2009 follow-up questionnaire contained eight questions on experiences of racism adapted from an instrument developed by Williams et al.<sup>26</sup> Daily racism was ascertained with the question "In your day-to-day life, how often have any of the following things happened to you?" followed by five specific situations: "You receive poorer service than other people in restaurants or stores," "People act as if they think you are not intelligent," "People act as if they are afraid of you," "People act as if they think you are dishonest," and "People act as if they are better than you." Response options were "never," "a few times a year," "once a month," "once a week," and "almost every day," coded as 1 through 5. A daily racism score was created by averaging subjects' responses to the five questions. Institutional racism was ascertained with the question "Have you ever been treated unfairly due to your race in any of the following circumstances? (1) Job (hiring, promotion, firing), (2) Housing (renting, buying, mortgage), (3) Police (stopped, searched, threatened), (4) In the courts, (5) At school, (6) Getting medical care." The institutional racism score summed the positive responses (range, 0 to 6). Experiences of racism were ascertained in the same way as on the 1997 questionnaire, with the exception of the institutional racism question, which queried about three circumstances only (housing, job, and police) rather than six. In 2009 we assessed coping style by asking "If you feel you have been treated unfairly due to your race, do you (1) usually accept it as a fact or life or (2) usually try to do something about it."

## 2.5 | Covariate assessment

Self-reported height and weight were ascertained at baseline, and weight was updated on all follow-up questionnaires. BMI was calculated as weight in kilograms divided by height in meters squared. On all follow-up questionnaires women were asked about doctor-diagnosed type 2 diabetes, defined as such a report at age 30 or older, and doctor-diagnosed hypertension, defined as such a report together with concurrent use of a diuretic, or report of use of an antihypertensive medication with or without a diagnosis of hypertension. Validation studies have indicated highly accurate reporting for height and weight,<sup>27</sup> diabetes,<sup>14</sup> and hypertension.<sup>28</sup>

Based on food-frequency questionnaire data collected in 1995 and 2001, we calculated Alternative Healthy Eating Index-2010 (AHEI) scores.<sup>29</sup> Smoking history, hours/week of vigorous physical activity, and years of education were obtained at baseline and updated on various follow-up questionnaires. Whether a woman ever received public assistance as a child, teen, or adult, and the attained educational levels of her parents were queried in 2013. Depressive symptoms were ascertained in 2005 by the 20-item CES-D scale.<sup>30</sup> Insomnia was ascertained in 2015 with the 7-item Insomnia Severity Index (ISI).<sup>31</sup>

## 2.6 | Statistical analysis

We used multinomial logistic regression to compute the odds ratios (OR) and 95% confidence intervals (CIs) for moderate and poor versus good SCF in quartiles of the daily racism scale and in categories of the institutional racism scale (0, 1-2, 3-4, 5-6) ascertained in 2009. We tested for trend by including the racism scores in the model as continuous variables. We conducted analyses stratified by age, education, coping style, smoking, and BMI, and tested for interaction using the log likelihood test. In secondary analyses we estimated ORs using daily and institutional racism reported in 1997 rather than in 2009. To assess the effect of consistently reported experiences of racism, we identified women who were in the same quartile of daily racism in 1997 and 2009, using quartiles based on the 2009 distribution. We identified women who reported consistently on the institutional racism scale in 1997 and 2009 based on the three circumstances that were asked in 1997 (housing, job, police). We also conducted analyses assessing each constituent of the daily and institutional racism scales separately in relation to SCF. We calculated age-adjusted OR estimates, and multivariable OR estimates that additionally adjusted for participant education, receipt of public assistance as an adult, and smoking history. The addition of BMI, parental education, public assistance during childhood, AHEI score, vigorous physical activity, hypertension, and type 2 diabetes did not materially change the ORs. Time-varying covariates collected every 2 years (ie, BMI, smoking, vigorous activity, occurrence of hypertension, and diabetes) were included as their 2009 values; in a sensitivity analysis, we used the 2015 values and results did not materially change.

**TABLE 2** Characteristics of Black Women's Health Study participants in 2009 by extremes of daily and institutional racism scores<sup>a</sup>

Mean (SD)	Daily racism score 2009		Institutional racism 2009	
	Quartile 1	Quartile 4	No to all	Yes to 5 or 6
Age	60.1 (7.7)	56.4 (5.8)	58.6 (7.3)	57.3 (6.2)
AHEI score <sup>b</sup> (2010)	45.7 (10.2)	45.3 (10.2)	44.4 (10.2)	46.8 (10.0)
% with characteristic				
<1 h/wk vigorous activity	64.3%	67.7%	66.5%	64.4%
BMI $\geq$ 30 kg/m <sup>2</sup>	42.4	51.6	44.7	49.3
Never smoker	60.6	53.1	59.3	52.2
Hypertension	59.7	63.5	61.4	60.9
Diabetes	17.8	21.1	19.1	17.1
CES-D score $\geq$ 16	10.2	25.8	12.4	24.5
Moderate/severe insomnia (2015)	8.5	18.7	8.9	20.5
Participant education $\geq$ 16 years	53.8	59.8	48.0	67.6
Parental education $\geq$ 12 years	72.8	69.1	39.5	68.3
Public assistance as child (2013)	16.8	22.8	18.0	26.5
Public assistance as adult (2013)	14.2	23.5	14.9	26.3

Abbreviations: AHEI, Alternative Healthy Eating Index; BMI, body mass index; BWHS, Black Women's Health Study; CES-D, Center for Epidemiological Studies-Depression.

<sup>a</sup>Data presented as means and standard deviations (SD) or percentages, standardized to the age distribution of the cohort in 2009; characteristics as of 2009 unless noted otherwise.

<sup>b</sup>Median AHEI-2010 score in total cohort was 45.2, and ranged from 11.7 (least healthy diet) to 85.4 (most healthy diet).

Women who experience high levels of racism are more likely to be depressed and/or have insomnia, and both factors adversely affect cognition.<sup>32,33</sup> Thus we assessed depression and insomnia as potential mediators. We estimated the mediation proportion and its 95% CI using the difference method<sup>34</sup> with the publicly available %Mediate macro (<https://www.hsph.harvard.edu/donna-spiegelman/software/mediate/>).<sup>35</sup> The mediation proportion is the proportion of excess poor or moderate SCF in women at the highest compared to the lowest levels of daily or institutional racism that can be attributed to a higher prevalence of depression or insomnia.

### 3 | RESULTS

In 2015 when SCF was assessed, the mean age of the analytic cohort was 64.3 years, the mean BMI was 30.6 kg/m<sup>2</sup>, 58.8% of participants had 16 or more years of education, 57.1% were never smokers, and 20.9% had ever received public assistance as an adult. Sixty percent of participants fell in the good SCF category, 28% in the moderate category, and 12% in the poor category (Table 1). Table 2 shows characteristics of the participants in 2009, the point at which they reported their experiences of racism; if the variable was ascertained in a year after 2009, the year of collection is indicated in the table. Compared to women in the lowest categories of daily and institutional racism, those in the highest categories were younger, heavier, and more likely to have smoked, to score as depressed (CES-D  $\geq$ 16, the score customarily used to identify individuals at high risk of depression,<sup>30</sup>) to score as hav-

ing clinical insomnia (ISI  $\geq$ 15), to have more years of education, and to have received public assistance as a child or adult (Table 2). Characteristics of women with poor compared to good SCF were as follows: they were less physically active, more likely to have smoked and to have type 2 diabetes, hypertension, depression and/or insomnia, and had fewer years of education and higher levels of receiving public assistance as child or adult (data not shown).

Table 3 shows age-adjusted and multivariable ORs for moderate and poor SCF compared to good SCF in quartiles of the daily racism scale, compared to the lowest quartile. Age-adjusted and multivariable ORs were closely similar. The multivariable ORs for poor compared to good SCF in the highest quartile of daily racism increased from 1.54 (95% CI 1.32 to 1.79) in quartile 2, to 1.88 (95% CI 1.61 to 2.19) in quartile 3, to 2.75 (95% CI 2.34 to 3.23) in quartile 4 (*P* trend < .0001) (table 3). The corresponding ORs for moderate SCF were 1.30 (95% CI 1.18 to 1.44) (quartile 2) and 1.76 (95% CI 1.57 to 1.98) (quartile 4) (*P* trend < .0001) (Table 3). There were also significant increasing trends in ORs for moderate and poor compared to good cognition in strata of age, education, BMI, smoking status, and coping style (data not shown).

The multivariable ORs for poor compared to good SCF ranged from 1.31 (95% CI 1.15 to 1.48) among women who reported 1 to 2 domains of institutional racism to 2.66 (95% CI 2.24 to 3.15) among those who reported 5 to 6 domains (*P* trend < .0001) (Table 4). A linear trend was also evident for moderate SCF; the multivariate OR for moderate SCF in the highest category of institutional racism was 1.70 (95% CI 1.49 to 1.94) (*P* trend < .0001). ORs increased across strata of age, education, BMI, smoking status, and coping style (data not shown).

**TABLE 3** Daily racism in 2009 and odds ratios and 95% confidence intervals for subjective cognitive function

Cognition category	Quartiles of daily racism score			
	1	2	3	4
<b>Good (ref)</b>				
N	2351	3294	3032	1711
<b>Moderate versus good</b>				
N	805	1456	1572	1032
Age-adjusted OR (95% CI)	1.0	1.30 (1.18-1.44)	1.53 (1.38-1.69)	1.80 (1.60-2.01)
Multivariable OR <sup>a</sup> (95% CI)	1.0	1.30 (1.18-1.44)	1.53 (1.39-1.70)	1.76 (1.57-1.98)
<b>Poor versus good</b>				
N	275	584	651	560
Age-adjusted OR (95% CI)	1.0	1.52 (1.30-1.77)	1.84 (1.58-2.14)	2.81 (2.40-3.30)
Multivariable OR <sup>a</sup> (95% CI)	1.0	1.54 (1.32-1.79)	1.88 (1.61-2.19)	2.75 (2.34-3.23)

Abbreviations: CI, confidence interval; OR, odds ratio.

<sup>a</sup>Adjusted for age (continuous), years of participant education ( $\leq 12$ , 13-15, 16,  $\geq 17$ ), was ever on public assistance as an adult (yes, no, missing), and pack-years of smoking (never, <10, 10-19, 20-29,  $\geq 30$ ).

**TABLE 4** Institutional racism in 2009 and odds ratios and 95% confidence intervals for subjective cognitive function

	Number of circumstances reported			
	0	1-2	3-4	5-6
<b>Good (ref)</b>				
N	3154	4001	2215	805
<b>Moderate versus good</b>				
N	1188	1838	1219	507
Age-adjusted OR (95% CI)	1.0	1.22 (1.12-1.33)	1.46 (1.33-1.61)	1.68 (1.47-1.91)
Multivariable OR* (95% CI)	1.0	1.25 (1.15-1.37)	1.51 (1.37-1.67)	1.70 (1.49-1.94)
<b>Poor versus good</b>				
N	463	720	526	296
Age-adjusted OR (95% CI)	1.0	1.22 (1.08-1.39)	1.61 (1.41-1.85)	2.49 (2.11-2.93)
Multivariable OR <sup>a</sup> (95% CI)	1.0	1.31 (1.15-1.48)	1.76 (1.53-2.03)	2.66 (2.24-3.15)

Abbreviations: CI, confidence interval; OR, odds ratio.

<sup>a</sup>Adjusted for age (continuous), years of participant education ( $\leq 12$ , 13-15, 16,  $\geq 17$ ), ever was on public assistance as an adult (yes, no, missing), and pack-years of smoking (never, <10, 10-19, 20-29,  $\geq 30$ ).

As shown in Tables S1 and S2, each item of the institutional and daily racism scales was significantly associated with SCF, with greater ORs for more intense and more frequent perceived experiences of racism.

The proportion of excess poor SCF in women in the highest compared to the lowest quartile of daily racism attributable to depression (CES-D  $\geq 16$ ) was 31% (95% CI 23% to 39%). The equivalent proportion of poor SCF attributable to moderate or severe insomnia (ISI  $\geq 15$ ) was 41% (95% CI 33% to 50%). The proportion of excess poor SCF in women reporting five to six experiences of institutional racism compared to no such experiences that was attributable to depression was 23% (95% CI 17% to 32%) and it was 43% (95% CI 33% to 53%) attributable to insomnia.

There was a linear trend in ORs for SCF across quartiles of the daily racism scale as reported in 1997 (*P* trend for both moderate and poor

cognition <.0001), but the magnitude of the ORs was less than those for racism reported in 2009. For example, the multivariable OR for poor SCF in the highest quartile of 1997 daily racism was 1.96 (95% CI 1.70 to 2.26). There was a significant trend (*P* < .0001) for ORs for moderate and poor SCF associated with institutional racism as reported in 1997, based on the domains of housing, jobs, and police. The OR for poor SCF among women who reported all three domains was 2.24 (95% CI 1.91 to 2.64). (The comparable OR based on the same three domains as reported in 2009 was 2.07 [95% CI 1.78 to 2.41]). The ORs for poor SCF associated with daily racism were stronger among women who reported consistent levels of daily racism in 1997 and 2009 (eg, OR 4.18 (95% CI 3.24 to 5.39) in the highest quartile) (Table 5). All other ORs were similar to those reported based on 2009 racism scores.

**TABLE 5** Multivariable odds ratios<sup>a</sup> for subjective cognitive function in consistent categories of daily and institutional racism<sup>b</sup> in 1997 and 2009

Cognition category	Quartiles of daily racism score in 1997 and 2009			
	1	2	3	4
<b>Good (ref)</b>				
N	1171	1268	1163	837
<b>Moderate versus good</b>				
N	382	544	566	536
OR (95% CI)	1.0	1.32 (1.13-1.54)	1.50 (1.28-1.76)	1.96 (1.66-2.31)
<b>Poor versus good</b>				
N	98	218	253	295
OR (95% CI)	1.0	2.08 (1.62-2.68)	2.64 (2.05-3.40)	4.18 (3.24-5.39)
<b>Institutional racism—number of positive responses</b>				
	0	1	2	3
<b>Good (ref)</b>				
N	2007	1366	1038	532
<b>Moderate versus good</b>				
N	766	574	537	339
OR (95% CI)	1.0	1.11 (0.97-1.26)	1.36 (1.19-1.58)	1.64 (1.40-1.94)
<b>Poor versus good</b>				
N	256	228	232	180
OR (95% CI)	1.0	1.37 (1.13-1.67)	1.87 (1.53-2.28)	2.77 (2.22-3.45)

Abbreviations: CI, confidence interval; OR, odds ratio.

<sup>a</sup>Adjusted for age (continuous), years of participant education ( $\leq 12$ , 13-15, 16,  $\geq 17$ ), ever was on public assistance as an adult (yes, no, missing), and pack-years of smoking (never,  $< 10$ , 10-19, 20-29,  $\geq 30$ ).

<sup>b</sup>Participants who were in the same quartile of daily racism score in 1997 and 2009 based on the 2009 distribution, and participants in the same category of institutional racism based on the three domains queried in 1997 (jobs, housing, police).

Finally, we calculated ORs separately for the first three cognitive questions that directly addressed memory, and the last three questions that captured other aspects of cognition. Odds ratios were similar for both types of questions. For example, the multivariable OR for three positive responses compared to none in the highest compared to the lowest quartile of daily racism for the first three questions was 2.50 (95% CI 2.09 to 2.98) and for the last three questions the comparable OR was also 2.50 (95% CI 1.37 to 4.56).

## 4 | DISCUSSION

In this large cohort of African American women, experiences of both daily and institutional racism were associated with decreased SCF. Women in the highest quartile of the 2009 daily racism score had 2.75 times the risk of poor SCF as women in the lowest quartile, and women who were in the highest quartile in both 1997 and 2009 had over four times the risk. Women reporting institutional racism in five to six

domains had 2.66 times the risk of poor SCF as those who reported no such experiences. A substantial proportion of the adverse effects on SCF of daily and institutional racism appeared to be mediated by depression and insomnia.

A large body of literature has documented the adverse effects of racial discrimination on health,<sup>5,36</sup> but to our knowledge only three epidemiologic studies have assessed its effect on cognition in African Americans.<sup>18,19,37</sup> Among 407 African American participants in the Minority Aging Research Study (MARS), a perceived discrimination score was calculated similar to the daily racism score used in the present study. Cognition was assessed via a battery of 19 in-person tests. Higher levels of perceived discrimination were associated with worse global cognition and performance on tests of episodic memory and perceptual speed, after accounting for age, sex, and education. When CES-D score was added to the model, the associations were attenuated and were no longer significant, consistent with depression being a mediator. However, no formal mediation analysis was conducted. In prospective analyses among 12,624 participants of all races

in the Health and Retirement Study, daily racism at baseline was associated with lower scores on episodic memory at baseline and greater rate of change in memory 6 years later.<sup>19</sup> Black participants reported greater discrimination and had lower memory scores at baseline, although race-specific results for memory scores 6 years later were not reported. There were significant indirect effects of black race on baseline memory through discrimination. Models were adjusted for age, gender, and years of education. A third study assessed the mediating role of psychosocial factors, including perceived daily discrimination, in cognitive disparities between black (n = 796) and white (n = 4405) adults aged 28-85 years who participated in the National Survey of Midlife Development in the United States.<sup>37</sup> The prevalence of discrimination varied by no more than 2% between black and white participants and it was not associated with cognition in the combined sample. Results were not reported separately for the black participants.

Strengths of the present study include the large sample size, which provided excellent statistical power. The measures of racism used have been associated in BWHS with increased incidence of asthma,<sup>21</sup> type 2 diabetes,<sup>14</sup> and obesity,<sup>22</sup> and with higher prevalence of insomnia,<sup>13</sup> as expected. The participants were drawn from many parts of the United States, and represent the neighborhoods and SES of most African American women.<sup>38,39</sup> Women whose educational level was lower than completion of high school were underrepresented in the sample.

A limitation of the present study was its cross-sectional nature. We did not know the trajectory of the participants' SCF over the years. Thus, to some degree, poor subjective cognition may have preceded, and perhaps influenced, perceptions of racism. However, results using racism ascertained in 1997 and in 2009 were similar, suggesting bias from this source is minimal because cognition function would have been rated higher in 1997 than in 2009. However, a truly prospective analysis requires that changes in cognition be assessed after experiences of racism are reported.

It would be optimal to have objective measures of cognition rather than subjective assessments by the subjects. Nonetheless, studies have demonstrated that subjective assessment of memory is associated with objective measures of memory.<sup>40</sup> In addition, self-awareness of poor memory is predictive of dementia and AD onset,<sup>40,41</sup> and has been associated with dementia-related brain pathology including amyloid beta (A $\beta$ ) accumulation and neurodegeneration,<sup>24</sup> and reduced gray matter<sup>42</sup> and hippocampal<sup>43</sup> volumes. Furthermore, in an assessment in a study of older persons of the six cognitive questions used in the present study, there was a positive association of SCF scores and cognitive impairment measured using the Telephone Interview for Cognitive Status (TICS), a cognitive screener similar to the Mini-Mental State Examination.<sup>25</sup> In that study, there were  $\approx$ 20% greater odds of cognitive impairment for each additional positive response to the six questions.

Perceived racial discrimination is associated with depression and anxiety<sup>12</sup> and poorer sleep quality.<sup>13</sup> The relationship between chronic stress exposure and depression is well established.<sup>44</sup> In fact, animal models of depression use stress-exposure paradigms, such as social defeat stress and chronic mild unpredictable stress paradigms, to elicit

depression-like symptoms in animals. In one study, 4 weeks of chronic unpredictable mild stress, a putative animal model for day to day social stressors in humans, demonstrated hippocampal volume loss after 4 weeks of stress exposure.<sup>5</sup> Both depression<sup>46</sup> and insomnia<sup>47</sup> are associated with memory impairment. Slow wave sleep is critical for memory consolidation, and patients with primary insomnia exhibit reduced slow-wave sleep and impaired memory consolidation.<sup>47</sup> The mediation by depression and insomnia between experiences of racism and SCF in the present study is consistent with this evidence and suggests that insomnia and depression are a pathway by which chronic stress associated with racial discrimination may impact cognition.

In summary, our findings of a positive association of experiences of racism with poorer SCF are consistent with previous work demonstrating that higher perceived psychological stress is associated with greater subjective memory decline. Our work suggests that the chronic stress associated with racial discrimination may contribute to racial disparities in cognition and AD. Future work is needed to examine whether exposure to institutional and daily racism accelerates conversion to Alzheimer's dementia and/or increases levels of AD biomarkers, such as cerebrospinal fluid or PET markers of A $\beta$  and tau pathology.

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## SUPPORTING INFORMATION

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

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