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# The impact of region and urbanicity on the discrimination-cognitive health link among older Blacks

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## Abstract

Little research has examined how the link between discrimination and cognitive health varies by where people live. This study investigates how living in non-urban versus urban areas in different regions in the United States moderates the discrimination-cognitive health link among older non-Hispanic Blacks. Data are from the 2012 and 2014 waves of the Health and Retirement Study (HRS; N=2,347). Regression analyses indicate that experiencing more everyday discrimination is significantly associated with lower episodic memory when living in urban areas. Among non-Hispanic Blacks, the discrimination-episodic memory link does not significantly vary across U.S. regional contexts. Findings highlight variation in the association between everyday discrimination and cognitive health by where older non-Hispanic Blacks live. Results suggest the importance of socio-environmental factors in shaping how stressful experiences such as discrimination are linked to cognitive health in later life.

## INTRODUCTION

Increasingly, empirical evidence indicates that aging occurs within the context of individuals' families, homes, and neighborhoods. Specifically, this research suggests that health outcomes are related to the effects of neighborhoods, including quality of life and cognition. Racial differences in late-life cognitive health suggests that older adults who identify as Black are more likely to experience cognitive decline compared to non-Hispanic Whites (Lee, Richardson, Black, Shore, Kasper & Rabins, 2012; Sachs-Ericsson & Blazer, 2005). While several biological, psychological, and social factors contribute to cognitive decline, discrimination is an important factor. In particular, the effects of discrimination over time may play an important role in cognitive health among racial and ethnic minorities (Glymour & Manly, 2008; Williams, Lawrence, Davis, & Vu, 2019) and play a role in

exacerbating disparities. Despite research documenting the unique effects of discrimination and living environment on cognitive health outcomes, little research has examined their interactive influence. In this study, we examine how the discrimination-cognitive health link varies across non-urban versus urban areas and regions in the United States (U.S.).

## Perceived Discrimination and Cognitive Health

Perceived discrimination is common, with one-third of adults in the U.S. indicating at least one discrimination-related event and more than three-fifths reporting everyday discrimination (Kessler, Mickelson, & Williams, 1999). Past research underscores the relationship between discrimination and health, suggesting that stressful life experiences related to race disproportionately affects Blacks. Such life experiences include limited job opportunities, highly segregated housing or neighborhoods, and institutional racism (Boardman, 2004). For older Blacks in the U.S., perceived discrimination may be particularly relevant since members of this cohort likely experienced discrimination when it was still legal in the early and mid-20th century. Given that discrimination may be characterized as a stressful experience (Barnes, Lewis, Begeny, Yu, Bennett, & Wilson, 2012), and increased stress has been associated with worse health outcomes (Korten, Comijs, Penninx, & Deeg, 2017), older Blacks may have increased vulnerability to adverse health outcomes (Barnes et al., 2012), including memory performance (Barnes et al., 2012; Zahodne, Sol, & Kraal, 2019). A focus on episodic memory functioning is key given that impaired functioning in this cognitive domain is associated with elevated risk of pathological outcomes such as Alzheimer's disease (Tierney et al., 1996). Further, older Blacks tend to experience more rapid decline in episodic memory compared to their non-Black counterparts (Turner et al., 2017). Therefore, the current study focuses on the role of perceived discrimination and relevant geographic factors on episodic memory performance.

## Geographic Differences in Cognitive Health

**Urbanicity, locality, and cognitive health:** Increasingly, there is interest in understanding associations between where people live (i.e. locality) and cognitive health. Specifically, a number of empirical studies outside of the U.S. suggest that older adults living in non-urban areas experience higher prevalence of cognitive impairment than their urban counterparts (Jia, Wang, Zhou, et al., 2014; Nunes, Silva, Cruz et al., 2010; Prince, Acosta, Ferri et al., 2012). Further, Saenz and colleagues note in their study of participants in Mexico, the differences between non-urban and urban participants may be related to historical educational disadvantage in non-urban areas as well as to the role of migration from non-urban to urban areas for employment (Saenz, Downer, Garcia, & Wong, 2018). In contrast, Weden and colleagues noted in their study that non-urban adults' cognitive functioning increased between 2000 and 2010 and the gains are linked to increased educational attainment (Weden, Shih, Kabeto & Langa, 2018). Further, they suggested that the persistent disparity in cognitive functioning among non-urban adults compared to their urban counterparts highlights the importance of public health planning for rapidly aging non-urban communities.

Urban residence has also been associated with differential cognitive outcomes compared to non-urban residence. This literature is generally focused on comparing non-urban to urban

contexts. Results in this area of investigation show that living in a non-urban setting is associated with poorer cognitive function (Saenz et al., 2018; Xiang, Zare, Guan &Gaskin, 2018), and with an increased risk of cognitive impairment (Weden et al., 2018) compared to living in an urban setting. The association between non-urban settings and poor cognitive health may partly be explained by educational disadvantage (Saenz et al., 2018; Weden et al., 2018). The primary indicators of an urban versus a non-urban living environment are population size or density and proximity to metropolitan areas, which are contexts that are associated with greater access to resources essential for maintaining and promoting cognitive health (Xiang et al., 2018; Van Dis, 2002).

**Region and cognitive health:** It is important to note that the current cohort of older Blacks in the U.S. (born between the 1910s and 1950s) may have likely originated from the South and, as part of the "Great Migration," some moved to the urban North. The living conditions in the South, particularly in the non-urban South, were different than those of the North. This includes the presence of explicit discrimination and significant racial health disparities in the South compared to the North (Glymour & Manly, 2008). Little research has examined differences in cognitive health across U.S. geographic regions (i.e., North vs. South). Those that have examined these differences have found higher incidence of cognitive impairment in the Southeastern U.S. compared to other regions after adjusting for age, sex, race, and education (Wadley et al., 2011; Case & Paxson, 2009).

The South region of the U.S. tends to be less urbanized than the North (McDonald, 2013). Given that both South vs. North and urban vs. non-urban living environments tend to be associated with differences in cognitive health outcomes, it is likely that regional and non-urban (versus urban) differences together play a role in shaping cognitive health outcomes among older Blacks in the U.S. Previous literature indicates that discrimination in general has detrimental effects on a wide range of health outcomes and there is a need for future research to elucidate reasons for these geographic differences, specifically the effect of local-level geographic factors (Kim et al., 2017).

## Present Study

Glymour and Manly (2008) suggest a framework that considers multiple pathways to cognitive health. This framework considers race, geographic experiences, and discrimination to be important pathways in this process. We build upon this framework through examination of multiple indicators of both geographic context (U.S. region and non-urban v. urban) and discrimination and their association with cognitive health. Additionally, we extend this work by employing a within-group approach to the study of racial influences on cognitive health. Specifically, we investigate interactive effects between discrimination, region, and urbanicity among a U.S. nationally representative sample of non-Hispanic Blacks. A within group approach is needed given prevalent within group heterogeneity in non-Hispanic Blacks, thus offering a unique understanding of pathways between race and cognitive health that an across group approach cannot provide. Guided by Glymour and Manly's framework and the reviewed empirical research, we hypothesize that among Blacks living in the South and non-urban areas, the association between everyday discrimination

and worse episodic memory will be stronger compared to Blacks living in other geographic contexts.

## METHOD

### Data

Data for the current study were drawn from the Health and Retirement Study (HRS; Sonnega and Weir, 2014). The HRS is a nationally representative, longitudinal study that began in 1992 and surveys Americans aged 51 years and older every two years. The HRS collects extensive data on demographics, cognitive functioning, social and physical health characteristics. Starting in 2006, participants were also administered the HRS Leave-Behind Participant Lifestyle Questionnaire (Smith, Ryan, Sonnega, & Weir, 2017) which collects psychosocial and lifestyle data from participants. While core HRS items--which includes measures of cognitive function--are administered biannually, half of the HRS sample receives the Leave Behind Questionnaire at one administration year, while the other half receives the Leave Behind Questionnaires at the next administration year. Thus, all participants receive the Leave Behind Questionnaire every four years. In order to maximize sample size with items from the Leave Behind Questionnaire, the half-samples from two administration cycles were combined in this study. Information about all HRS instruments, sampling procedures, and study design are publicly available online (http://hrsonline.isr.umich.edu).

HRS participants' data from the 2012 and 2014 waves were used for this cross-sectional study. Exclusion criteria were employed such that participants with missing data on the following measures were excluded from the analytic sample: immediate memory (n=447) and delayed memory (n=451) total scores, discrimination mean from the Leave Behind Questionnaire (n=238), age (n=0), gender (n=0), race (n=38), and Hispanic ethnicity (n=14), highest degree (n=110), region (n=38), and urbanicity (n=51). This resulted in a final sample size of N=2,347. Compared to those with data on all components in the final analytic sample, dropped cases were older, had significantly worse episodic memory, lower levels of education, and more lived in urban areas. There was no significant difference between the final analytic sample and dropped cases on gender, region, discrimination. Characteristics of the final sample are summarized in Table 1. This sample was reduced further to a final analytic N=2,169 when accounting for the complex design of the sample during analyses.

### Measures

**Outcome measure - Episodic Memory:** Memory was assessed using a ten-item list learning task adapted from the list learning task in the Consortium to Establish a Registry for Alzheimer's Disease (CERAD) (Ofstedal, Fisher & Herzog, 2005). In face-to-face interviews, participants were orally presented a single list of words, and were asked to orally recall it after a five-minute delay. Immediate and delayed trials were standardized using mean and standard deviations of the final sample to create z-scores. Immediate and delayed recall standardized scores were then averaged to create a z-score composite for episodic memory for each participant. This z-score composite of episodic memory was used as the outcome measure in this study's analyses.

**Discrimination:** The discrimination measure used in this study is a combination of two self-reported measures of perceived discrimination administered in the HRS Leave-Behind Questionnaire: The Everyday Discrimination scale (Williams, Yu, Jackson, & Anderson, 1997) and attributions of everyday discrimination. The Everyday Discrimination scale includes six items to assess the frequency of day-to-day hassles attributed to discrimination (i.e., *You are treated with less courtesy or respect than other people*; *You receive poorer service than other people at restaurants or stores*) measured on a six-point scale ranging from 1=Almost every day to 6=Never. An index of discrimination was created by averaging the frequency across all items if responses were given for at least three items after reverse-coding all items such that higher ratings corresponded with greater frequency. Discrimination mean was coded as missing if less than three responses were given.

### Geographic measures:

**1) Urbanicity.:** The U.S. Department of Agriculture Economic Research Service classifies all U.S. counties using the Beale Rural-Urban Continuum Codes that distinguishes metropolitan counties by the population size of their metro area, and nonmetropolitan counties by degree of urbanization and adjacency to metropolitan areas (USDA ERS, 2013; Cohen,Cook, Sando & Sabik 2018). The HRS 2012 and 2014 Beale Rural-Urban Continuum Codes were collapsed into five categories to preserve respondent confidentiality (HRS Codebook, 2012 and 2014), resulting in the following classifications: Urban (Beale Rural-Urban Continuum code 0), Suburban (Beale Rural-Urban Continuum codes 1,2); Ex-urban (Beale Rural-Urban Continuum codes 3,4,5,6,7,8,9); No match for Rural-Urban code; not interviewed this wave. For the current study, HRS rural-urban classification codes were further collapsed resulting in a single dichotomous item to distinguish between non-urban and urban living contexts. The Urban category includes data for Beale Rural-Urban Continuum code 0, and the non-urban category collapsed the Suburban and Ex-urban variables to include Beale Rural-Urban Continuum codes 1-9. Respondents who did not have rural-urban codes or were not interviewed in the 2012 and 2014 waves were excluded from the final analysis.

**2) Region:** The region measure was created from an 11-category classification of U.S. Census regions and sub-divisions determined by the state where the respondent was interviewed in 2012 and 2014. Respondents indicated living in the following U.S. regions and sub-divisions (HRS Codebook, 2012;2014): Northeast Region New England Division (which included the following states: ME, NH, VT, MA, RI, CT); Northeast Region Middle Atlantic Division (NY, NJ, PA); Midwest Region East North Central Division (OH, IN, IL, MI, WI); Midwest Region West North Central Division (MN, IA, MO, ND, SD, NE, KS); South Region South Atlantic Division (DE, MD, DC, VA, WV, NC, SC, GA, FL); South Region East South-Central Division (KY, TN, AL, MS); South Region West South-Central Division (AR, LA, OK, TX); West Region Mountain Division (MT, ID, WY, CO, NM, AZ, UT, NV); West Region Pacific Division (WA, OR, CA, AK, HI); Not in a Census Division (includes U.S. territories and Puerto Rico); Foreign Country. The ‘Not in a Census Division’ and the ‘Foreign Countries’ were not interviewed in these waves, resulting in a 9-category classification of regions for the current analyses.

For the current study, a new region variable was created that collapsed the codes, resulting in a dichotomized variable of South Region and Other Regions. The South Region category includes respondents who reported living in the South Atlantic, East South-Central, and West South-Central Divisions. The Other Regions category includes respondents who reported living in the North East Region (New England, East North Central, and West North Central Divisions), Midwest Region (East North Central and West North Central Divisions), and West Region (Mountain and Pacific Divisions). Respondents who did not live in a census division or were not interviewed in the 2012 and 2014 waves were not included in the final analysis.

**Covariates:** *Age* was calculated using the date of birth given at the time of the respondent's baseline interview. If respondents provided different ages in follow up waves, the "best source method" was used to calculate age with the most reliable source being the respondent's self-report, followed by the spouse report, and then a non-spouse proxy report (HRS Codebook, 2012;2014). At baseline, the respondents' ages ranged from 51 to 104 years of age. *Gender* was assessed using a single, self-report dichotomous item indicating male (N=802) or female (N=1,545). *Education* was collected as an ordinal variable, in which participants reported the highest degree of education they completed using the following categories: No degree, GED, High School degree, Degree unknown/Some College, Two year College degree, Four year College degree, Master degree, Professional degree (Ph.D., M.D., J.D.). The analysis modeled education as a continuous variable.

## Statistical Analysis

Descriptive statistics were conducted and summarized for all study variables on the final analytic sample. Three separate linear regression models were conducted to test our hypotheses test. All models controlled for age, gender, and education. Main and interaction effects were considered statistically significant when $p < .05$. Interaction effects were tested by the creation and inclusion of product terms into each of the three models. If a significant interaction was found, average marginal effects were examined to explore how the association between discrimination and episodic memory differed across levels of the moderator. Model 1 tested the two-way interaction between discrimination x region. Model 2 tested the two-way interaction between discrimination x non-urban. Model 3 tested the three-way interaction between discrimination x region x non-urban.

Listwise deletion was employed such that cases without data on all components of the outcome variable, predictor variables, and covariates were removed from analyses. Data was included in the analysis if complete data was available for all of the variables listed above for the HRS study participants. STATA's survey command (Stata Corporation, College Station, TX) and sample weight, strata, and cluster variables were used to account for the complex sample survey design and provide subpopulation estimates. All of the statistical models were estimated using STATA 15.1 (College Station, TX).

### Sensitivity analyses:

**1) By region:** We conducted a stratified analysis by U.S regions to examine if the magnitude of the coefficients differed for geographic measures and discrimination across the

North East, West, Midwest, and South Regions. All three models tested prior were re-tested using the more detailed (four category) region variable. It is important to note that both the North East non-urban and West non-urban regions had less than 10 cases each. Research suggests there should be at least ten cases to reasonably estimate a model, rule out anomalous cases or overestimate significant deviance from the rest of the sample due to measurement error (Hollenstein, 2013). This was a guiding reason for our dichotomizing the region variable. Results from the region sensitivity analyses were substantively the same as the analyses conducted with the two-category region measure. Specifically, discrimination was not associated with episodic memory in any of the region categories. This supports the robustness of the findings when collapsing U.S. regions.

**2) By urbanicity:** We conducted a sensitivity analysis stratified by the three-categories of urbanicity to examine if the significance and direction of the coefficients differed for discrimination across urban, suburban, ex-urban Beale codes. All three models tested prior were re-tested using the more detailed (three-category) urbanicity variable and we compared results to the two category urbanicity variable. Results from the sensitivity analyses showed that the suburban (versus urban) x discrimination two-way interaction was not significantly associated with episodic memory, while the ex-urban x discrimination interaction was significant. However, the direction of the coefficient was the same for both. This supports our concern regarding the small size of the suburban sample size. The three-way interaction of South region x suburban x discrimination and South region x ex-urban x discrimination were both not significantly associated with episodic memory, which is consistent with the analyses when suburban and ex-urban categories are combined. Together these findings support the robustness of the findings when collapsing these two categories and comparing with participants living in urban areas.

# RESULTS

## Sample Characteristics

As described in Table 1 and Table 2, participants had a mean age of 64.27 years (SD=9.80) and were mostly female (65.8%). More than half (58.5%) of respondents resided in the South at the time of their interview (2012 or 2014) and most (85.3%) lived in urban areas. The mean standardized episodic memory composite score was −.22 (SD=0.17) with a range of −2.56 to 2.73. The mean episodic memory score for the South region was −0.24 (SD=.85) and the Other region in the analysis was −0.20 (SD=.81). The mean episodic memory score for the urban region was −0.20 (SD=.84) and the non-urban region was −0.33 (SD=.80). The mean discrimination score was 4.7 (SD=.68), with a range of 1 to 6.

A Pearson Correlation test was conducted to examine the unadjusted strength and direction of associations between episodic memory and all other variables included in the models, including covariates (see Appendices, Supplementary Table 1). Results indicated that worse episodic memory has a strong correlation with gender and education. Specifically, females ($r = .12$, $p < .001$) and those with higher levels of education ($r = .15$, $p < .001$) had better episodic memory. Results also indicated that poor episodic memory has a weak correlation with urbanicity in those participants living in non-urban areas had worse episodic memory (r

= −.06, p< .05). Poor episodic memory was also found to have a moderately strong correlation with age in that older adults showed worse memory (r = −.29, p < .001). Lastly, results indicated that episodic memory was not significantly related to region (r = −.03, p > .05) or discrimination (r = .03, p > .05).

Neither region nor everyday discrimination were found to be associated with episodic memory. Also, the region x discrimination interaction was not significant (B = −0.01, p > .05; Table 3). Higher educational attainment (B = 0.08, p <.001) and female gender (B = 0.18, p <.001) was associated with better episodic memory, and older age was associated with worse episodic memory (B = −.03, p <.001).

Living in a non-urban environment (B = −0.28, p < .05) and experiencing more frequent everyday discrimination (B = −0.06, p < .05) were associated with worse episodic memory. There were no significant moderating effects of urban vs. non-urban environment on the relationship between everyday discrimination and episodic memory (B = 0.09, p > .05; Table 4). Higher educational attainment (B = 0.08, p <.001) and female gender (B = 0.18, p < .001) had significantly better episodic memory, and older age was associated with worse episodic memory (B = −0.03, p < .001; Table 3).We did not find support for our hypothesis, that among Blacks living in non-urban areas, the association between everyday discrimination and worse episodic memory would be stronger compared to Blacks living in urban areas. This was indicated by the interaction between non-urban and perceived discrimination not being significant (B = 0.09; p > .05).

Additional results from Model 3 in this full model (Table 5) includes both region and non-urban together, indicating the two-way interaction between non-urban x discrimination. Opposite from the hypothesized direction, we found that among Blacks living in non-urban areas, more frequent everyday discrimination was associated with better episodic memory (B = 0.31, p < .01). As with the prior models, those with higher educational attainment (B = 0.08, p < .001) and female gender (B = 0.18, p < .001) had better episodic memory, and older age was associated with significantly worse episodic memory (B = −0.03, p < .001; Table 5). In contrast among Blacks living in urban areas more frequent everyday discrimination was associated with worse episodic memory. This was supported by examination of the average marginal effects, which indicate that the slope for discrimination-episodic memory link was .04 among Blacks in non-urban areas and −.05 among those living in urban areas (Figure 1).

## DISCUSSION

This study aimed to examine the interactive effects of everyday discrimination, region, and urbanicity on episodic memory in a nationally representative sample of non-Hispanic Black older adults in the U.S. Findings from the final model 3 (presented in Table 5) indicated that while everyday discrimination and living in the U.S. South region was not associated with episodic memory, urbanicity was independently associated with episodic memory. Furthermore, the final model indicated the presence of a significant interaction between everyday discrimination and urbanicity. Specifically, we found that more frequent experience of everyday discrimination was associated with better episodic memory among

those living in non-urban areas. However, this association was not additionally modified by residence in any geographic region (South or Other).

Contrary to our hypothesis, we found no association between geographic region and episodic memory after controlling for demographic characteristics known to be related to cognitive outcomes (episodic memory mean South = −0.24, SD = .85; mean Other = −0.20, SD = .81, ns). While there were not adequate group differences in episodic memory for geographic region, which may have impacted findings in the current study, this finding is surprising given that the literature suggests that living in the U.S. South may have adverse health effects on non-Hispanic Blacks, with particularly poor effects on cognition (Wadley et al., 2011). One reason for the lack of an association could be that information on the region of current residence in the HRS was gathered during individuals' older adult years. The impact of region on cognitive health in older adulthood may be less salient compared to region of residence in earlier or mid-life. This explanation is supported by evidence which suggests that impacts on late life cognitive health begin during early life and even at conception (Barnett, Hachinski & Blackwell, 2013). Without knowledge of where these individuals grew up, we cannot be certain that those individuals who currently live in the North or other regions have always resided there. Information on where these individuals grew up were not available for these analyses. However, future research could examine a similar research question from a life span development perspective, utilizing information from the HRS Life History Survey. This survey collects data about residential history over the life course, which would allow for a better understanding of the impact of region over the life span on later life cognitive health.

Some findings from our study are consistent with previous studies. For example, we found that living in a non-urban area (including suburban and ex-urban areas) and experiencing discrimination each, independently, are linked with worse episodic memory. Further, these findings remained robust after controlling for demographic factors, including education, an established correlate of episodic memory. This is interesting since approximately 78 percent of the population living in non-urban area are non-Hispanic White(Council, H.A, 2012). Also, in 2010, Hispanics surpassed Blacks as the largest minority group living in non-urban areas. This finding is particularly important, given the smaller numbers of Blacks living in non-urban areas and small-town populations (Council, H.A, 2012). This finding provides further support to the existing knowledge base about the role of living in a non-urban area and discrimination experiences concerning episodic memory among non-Hispanic Blacks. Previous literature suggests that the educational disadvantage that exists for non-urban residents affect cognitive health (Saenz et al., 2018). Educational disadvantage combined with discrimination experiences that this age cohort may have experienced could result in a cumulative disadvantage for these individuals leading to our finding (Wheaton & Clark, 2003).

Our findings are also consistent with the framework proposed by Glymour & Manly (2008) to understand multiple pathways to cognitive health. This framework considers race, geographic experiences, and discrimination to be important pathways in this process. Importantly, our study provides a within race group perspective on this process by focusing

only on potential pathways to cognitive health among non-Hispanic Blacks. This approach recognizes the variability that exists within non-Hispanic Blacks in the U.S.

Interestingly, findings from this study indicate a counterintuitive result for the interaction between non-urban and everyday discrimination. We hypothesized that among Blacks living in non-urban areas, the association between everyday discrimination and worse episodic memory will be stronger compared to Blacks living in urban areas. However, we found that non-urban non-Hispanic Blacks who endorsed some form of everyday discrimination had better episodic memory than those residing in urban areas. Also, interesting is the fact that this interaction was only present when controlling for region.

While the direction of this finding may appear paradoxical, studies have found that non-urban faith communities often provide places of safety and empowerment for non-Hispanic Blacks (Hill, 2008; Wilson, Wilson, & Usher,2015). While faith communities are important aspects in the lives of Blacks generally, evidence indicates that Blacks living in non-urban areas tend to be more religious than their urban counterparts (Taylor, Chatters, & Brown, 2014). Specifically, Taylor, Chatters, & Brown (2014) note that Blacks living in non-urban areas in the South in particular are more likely than their urban South counterparts to be official members of a church, read religious materials more frequently, and feel that religion was important in their home during childhood.

Furthermore, another study found that non-Hispanic Black race was associated with better episodic memory through increased religious attendance, after accounting for non-religious social participation (Kraal, Sharifian, Zaheed, Sol, & Zahodne, 2019). This evidence suggests that the role of social resources afforded through religious participation may be protective for the cognitive health of older Blacks living in non-urban environments. Additionally, this may facilitate an increased sense of community and social cohesion among non-urban older Blacks that may be protective against cognitive decline. Further support for this explanation is provided by a study by Zaheed, Sharifian, Kraal, Sol, Hence and Zahodne (2019) which found an association between more social cohesion within a residential context (i.e., neighborhoods) and better cognition. Additional research is needed to determine if these findings extend or are applicable in non-urban versus urban contexts.

## Limitations and Future Directions

One limitation of our study is our use of cross-sectional data. Given this limitation, we cannot fully determine whether a change in episodic memory was present before perceived discrimination occurred or perceived discrimination had a direct impact on episodic memory (Sedgwick, 2014). Future research focusing on longitudinal associations between discrimination, episodic memory, and geographical contexts will elucidate these dynamics. Another limitation of this study is the small non-urban sample of non-Hispanic Blacks. Given this limitation our results could be underestimating the role of perceived discrimination and geographical measures on episodic memory.

One strength of this study is that, to our knowledge, this is one of a few studies to have examined how the link between discrimination and cognitive health varies by where individuals live. An additional strength of our study is our examination of within-group

differences among older Blacks. While previous studies have confirmed that older Blacks have higher rates of cognitive decline than non-Hispanic Whites (Díaz-Venegas, Downer, Langa & Wong, R. 2016), that perceived discrimination was related to poor episodic memory among Blacks (Barnes et al.,2012), and that non-urban older adults had lower cognitive performance than urban older adults (Weden et al., 2018), within group examination of these factors provides stronger support for the role that these geographic and psychosocial factors have for cognitive health among older Blacks in the U.S.

An additional area in need of further study is the important role that education plays in the complex interaction between discrimination, region, and urbanicity. Consistent with previous studies, we found a link between higher levels of education and better episodic memory. Also, educational attainment is known to be associated with living environment, such that people in non-urban areas often report lower educational levels than those in other areas. This suggests education may play some role (mediating and/or moderating) in the links between living environment, discrimination and cognitive health that should be explored in future studies. In conclusion, our study found that non-urban residence may be more predictive in the cognitive health of older Blacks than discrimination or region of residence alone. Examining the cumulative and interactive effects of major life experiences such as discrimination and living environment on episodic memory provides insights to understanding factors related to cognitive health. Further, within group examination of these influences can provide essential information needed to inform and direct policy initiatives. This information can also help in the development of upstream interventions focused on underlying determinants to work towards reducing racial disparities in cognitive aging (Aneshensel, Ko, Chodosh, & Wight, 2011).

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## Appendices

**Supplementary Table 1:**

Zero-order correlations among variables of interest among non-Hispanic Blacks

| Measure | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| 1.Episodic Memory | — | | | | | | |
| 2.South Region | −.03 | — | | | | | |
| 3. Non-urban | −.06* | .28*** | — | | | | |
| 4. Female | .12*** | .03 | −.01 | — | | | |
| 5. Age | −.29*** | −.03 | −.01 | −.04*** | — | | |
| 6.Education | .15*** | .01 | −.05* | −.04 | −.04* | — | |
| 7.Everyday Discrimination | −.03 | −.04 | −.00 | −.07*** | −.16*** | −.02* | — |

*** p<.001
** p<.01
* p<.05

## Discrimination Scale Classification

| Category | Question | Responses |
|---|---|---|
| BE TREATED WITH LESS RESPECT | In your day-to-day life, HOW OFTEN HAVE ANY OF THE FOLLOWING THINGS HAPPENED TO YOU? You are treated with less courtesy or respect than other people. | 1.ALMOST EVERYDAY<br>2.AT LEAST ONCE A WEEK<br>3.A FEW TIMES A MONTH<br>4.A FEW TIMES A YEAR<br>5.LESS THAN ONCE A YEAR<br>6.NEVER<br>Blank. INAP (Inapplicable); Partial Interview; Missing |
| RECEIVE POORER SERVICE | In your day-to-day life, HOW | |
| THAN OTHERS | OFTEN HAVE ANY OF THE FOLLOWING THINGS HAPPENED TO YOU? You receive poorer service than other people at restaurants or stores. | |
| PEOPLE ACT AS IF YOU NOT SMART | In your day-to-day life, HOW OFTEN HAVE ANY OF THE FOLLOWING THINGS HAPPENED TO YOU? People act as if they think you are not smart. | |
| PEOPLE ACT AS IF AFRAID OF YOU | In your day-to-day life, HOW OFTEN HAVE ANY OF THE FOLLOWING THINGS HAPPENED TO YOU? People act as if they are afraid of you. | |
| YOU ARE THREATENED OR HARASSED | In your day-to-day life, HOW OFTEN HAVE ANY OF THE FOLLOWING THINGS HAPPENED TO YOU? You are threatened or harassed. | |
| WORSE TREATMENT FROM DOCTORS | In your day-to-day life, HOW OFTEN HAVE ANY OF THE FOLLOWING THINGS HAPPENED TO YOU? You receive poorer service or treatment than other people from doctors or hospitals. | |

Note: Blanks were treated as missing. An index of discrimination was created from the values measured on a six-point scale ranging from 1=Almost every day to 6=Never.

## Regional Classification

| Category | Question | Responses | |
|---|---|---|---|
| CENSUS REGION-DIVISION OF RESIDENCE | Census Region/ Division of Residence: Based on state where respondent was interviewed in 2012 and 2014. | **1** | Northeast Region: New England Division (ME,NH,VT,MA,RI,CT) |
| | | **2** | Northeast Region: Middle Atlantic Division (NY,NJ,PA) |
| | | **3** | Midwest Region: East North Central Division (OH,IN,IL,MI,WI) |
| | | **4** | Midwest Region: West North Central Division(MN,IA,MO,ND,SD,NE,KS) |
| | | **5** | South Region: South Atlantic Division(DE,MD,DC,VA,WV,NC,SC,GA,FL) |
| | | **6** | South Region: East South Central Division (KY,TN,AL,MS) |
| | | **7** | South Region: West South Central Division (AR,LA,OK,TX) |
| | | **8** | West Region: Mountain Division (MT,ID,WY,CO,NM,AZ,UT,NV) |
| | | **9** | West Region: Pacific Division (WA,OR,CA,AK,HI) |

| Category | Question | Responses | |
|---|---|---|---|
| | | **10** | US, NA state |
| | | **11** | Foreign county; Puerto Rico; Other US Territory |
| | | | 98. DK |
| | | | 99. NA |
| | | | Blank. Never interviewed |

Note: 1=Other (1,2,3,4,8,9); 2=South (5,6,7); 10,11,98,99 and Blanks were treated as missing

Non-urban vs Urban Classifications

| Category | Question | Responses |
|---|---|---|
| BealeCode2014_2012 | This code is based on the 2012 and 2014 Beale Rural-Urban Continuum Code, collapsed to preserve respondent confidentiality | 1.Urban (Beale Rural-Urban Continuum code 0)<br>2.Suburban (Beale Rural-Urban Continuum code 1,2)<br>3.Ex-urban (Beale Rural-Urban Continuum codes 3,4,5,6,7,8,9)<br>9. No match for Rural-Urban code<br>Blank. Not interviewed this wave |

Note: 1=Urban (1); 2=Non-urban (2,3); 9 and Blanks were treated as missing

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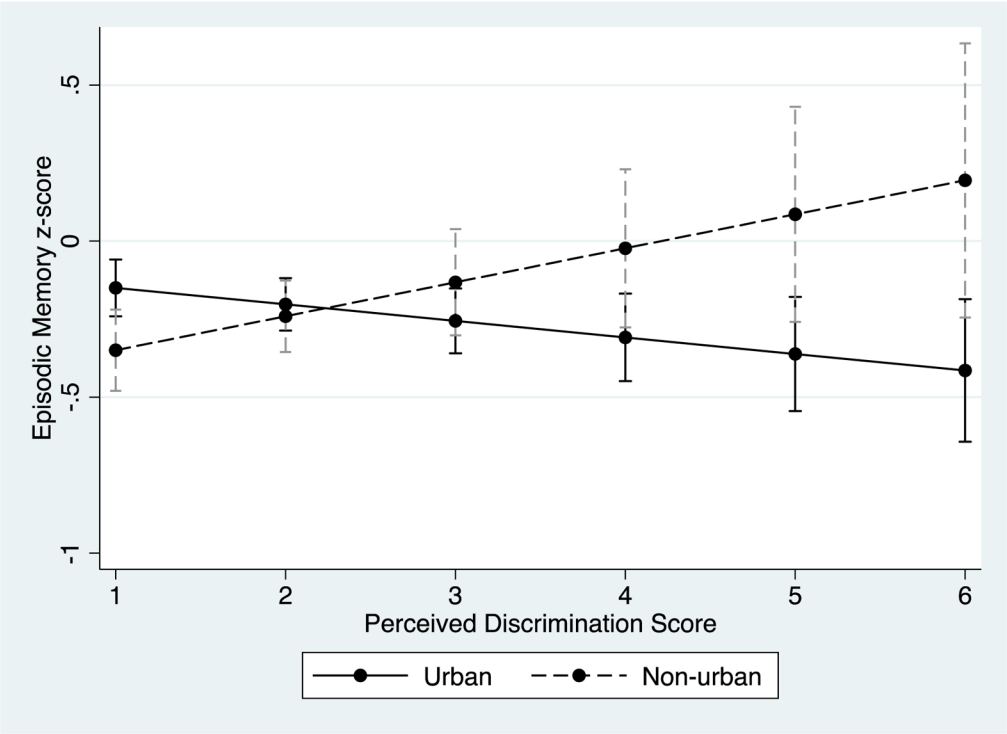


**Figure 1.**
Predictive Margins of Non-urban–Urban Differences.
Note. 95% Confidence intervals are presented.

## Table 1

Participant Demographics (N=2,347)

| | Entire Sample | | Region | | | | |
|---|---|---|---|---|---|---|---|
| | | | South N=1,372 (58.46%) | | Other N=975 (41.54%) | | Group diff |
| | Mean /Freq | SD / % | Mean / Freq | SD / % | Mean/Freq | SD / % | |
| Age | 64.27 | 9.80 | 64.07 | 9.54 | 64.56 | 10.09 | S=O |
| Gender | | | | | | | |
| Female | 1,545 | 65.83% | 917 | 66.84% | 628 | 64.41% | S=O |
| Male | 802 | 34.17% | 455 | 33.16% | 347 | 35.59% | S=O |
| Education | 1.10 | .03 | 1.11 | 1.60 | 1.08 | 1.61 | S=O |
| Discrimination | 4.70 | .68 | 1.68 | .81 | 1.74 | .90 | S=O |
| Episodic memory | −0.22 | .17 | −0.24 | .85 | −0.20 | .81 | S=O |

*Note*. Means and standard deviations presented for continuous variables and frequencies and percentages for categorical variables.

Note. Region was dichotomous (1 = Other (O); 2 = South (S))

Note. Group differences at $p < .05$

Education: 0=No Degree, 1=GED, 2=High school Diploma, 3=Degree unknown/Some College, 4=Two year College Degree, 5= Four year College Degree, 6= Master Degree, 7=Professional degree (Ph.D., M.D., J.D.). Education was treated as continuous in the model

*** p<.001

** p<.01

* p<.05

## Table 2

Participant Demographics (N=2,347)

| | Entire Sample | | Urbanicity | | | | |
|---|---|---|---|---|---|---|---|
| | | | Urban N=2,003 (85.34%) | | Non-Urban N=344 (14.66%) | | Group diff |
| | Mean / Freq | SD / % | Mean / Freq | SD / % | Mean / Freq | SD / % | |
| Age | 64.27 | 9.80 | 64.33 | 9.74 | 63.96 | 9.96 | U=NU |
| Gender | | | | | | | |
| Female | 1,545 | 65.83% | 1,322 | 85.87% | 223 | 64.83% | U=NU |
| Male | 802 | 34.17% | 681 | 34.02% | 121 | 35.17% | U=NU |
| Education | 1.10 | .03 | 2.02 | 1.55 | 1.71 | 1.46 | U>NU |
| Discrimination | 4.70 | 0.68 | 1.70 | 0.85 | 1.70 | 0.82 | U=NU |
| Episodic Memory | −0.22 | 0.17 | −0.20 | 0.84 | −0.33 | 0.80 | U<NU |

*Note*. Means and standard deviations presented for continuous variables and frequencies and percentages for categorical variables

Note. Urbanicity was coded dichotomous (0 = urban (U); 1 =non-urban (NU))

Note: Group differences at $p < .05$

Education: 0=No Degree, 1=GED, 2=High school Diploma, 3=Two-year College Degree, 4= Four year College Degree, 5= Master Degree, 6=Professional degree (Ph.D., M.D., J.D.), 9= Degree unknown/Some College. Education was treated as continuous in the model

*** p<.0001

** p<.01

* p<.05

**Table 3**

Multiple linear regression Results: Two-Way interaction effect of region and discrimination on episodic memory among non-Hispanic Blacks

| | B | SE | [95% CI] |
|---|---|---|---|
| Intercept | 1.59*** | .17 | [1.22, 1.91] |
| Education | 0.08*** | .01 | [0.57, 0.11] |
| Female gender (ref = Male) | 0.18*** | .04 | [0.09, 0.27] |
| Age | −0.03*** | .00 | [−0.04, −0.03] |
| South Region | −0.03 | .11 | [−0.25, 0.18] |
| Discrimination | −0.05 | .03 | [−0.11, 0.02] |
| South Region x Discrimination | −0.01 | .05 | [−0.11, 0.09] |

Note: Region was coded dichotomous (1 = Other; 2 = South)

*** p<.001

**Table 4**

Multiple Linear Regression Results: Two-way interaction effect of urbanicity and discrimination on episodic memory among non-Hispanic Blacks

| | B | SE | [95% CI] |
|---|---|---|---|
| Intercept | 1.59*** | .21 | [1.18, 2.01] |
| Education | 0.08*** | .01 | [0.06, 0.11] |
| Female gender (ref = Male) | 0.18*** | .04 | [0.09, 0.03] |
| Age | −0.03*** | .00 | [−0.04, −0.03] |
| Non-urban | −0.28* | .12 | [−0.53, −0.03] |
| Discrimination | −0.06* | .02 | [−0.11, −0.02] |
| Non-urban x Discrimination | 0.09 | .07 | [−0.06, 0.24] |

*Note:* Urbanicity was coded dichotomous (0 = urban; 1 = non-urban)

*** p<.001

** p<.01

* p<.05

**Table 5**

Multiple Linear Regression Results: Three-way interaction effect of region, urbanicity and discrimination on episodic memory among non-Hispanic Blacks

| | B | SE | [95% CI] |
|---|---|---|---|
| Intercept | 1.59*** | .18 | [1.23, 1.94] |
| Education | 0.08*** | .01 | [0.50, 0.11] |
| Female gender (ref = Male) | 0.18*** | .05 | [0.09, 0.27] |
| Age | −0.03*** | .00 | [−0.04, −0.03] |
| Discrimination | −0.05 | .03 | [−0.12, 0.01] |
| South Region | 0.02 | .87 | [−0.23, .027] |
| Non-urban | −0.55* | .19 | [−0.96, −0.17] |
| South Region x Non-urban | 0.27 | .26 | [−0.25, 0.80] |
| South Region x Discrimination | −0.03 | .06 | [−0.14, 0.09] |
| Non-urban x Discrimination | 0.31** | .10 | [0.11, 0.51] |
| South Region x Non-urban x Discrimination | −0.22 | .14 | [−0.50, 0.07] |

*Note:* Region was coded dichotomous (1 = Other; 2 = South)

Urbanicity was coded dichotomous (0 = urban; 1 = non-urban)

*** p<.001

** p<.01

* p<.05