



# Socioeconomic status discrimination is associated with poor sleep in African-Americans, but not Whites



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## ARTICLE INFO

### Article history:

Received 7 September 2015

Received in revised form

18 January 2016

Accepted 8 February 2016

Available online 11 February 2016

### Keywords:

African-Americans

Social discrimination

Sleep

## ABSTRACT

**Rationale:** Research on self-reported experiences of discrimination and health has grown in recent decades, but has largely focused on racial discrimination or overall mistreatment. Less is known about reports of discrimination on the basis of socioeconomic status (SES), despite the fact that SES is one of the most powerful social determinants of health.

**Objective:** We sought to examine the cross-sectional association between self-reported SES discrimination and subjective sleep quality, an emerging risk factor for disease. We further examined whether associations differed by race or SES.

**Methods:** We used logistic and linear regression to analyze data from a population-based cohort of 425 African-American and White middle-aged adults (67.5% female) in the Southeastern United States. SES discrimination was assessed with a modified Experiences of Discrimination Scale and poor subjective sleep quality was assessed with the Pittsburgh Sleep Quality Index.

**Results:** In logistic regression models adjusted for age, gender, and education, reports of SES discrimination were associated with poor sleep quality among African-Americans ( $OR = 2.39$  95%  $CI = 1.35, 4.24$ ), but not Whites ( $OR = 1.03$ , 95%  $CI = 0.57, 1.87$ ), and the race  $\times$  SES discrimination interaction was significant at  $p = 0.04$ . After additional adjustments for reports of racial and gender discrimination, other psychosocial stressors, body mass index and depressive symptoms, SES discrimination remained a significant predictor of poor sleep among African-Americans, but not Whites. In contrast to findings by race, SES discrimination and sleep associations did not significantly differ by SES.

**Conclusion:** Findings suggest that reports of SES discrimination may be an important risk factor for subjective sleep quality among African-Americans and support the need to consider the health impact of SES-related stressors in the context of race.

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## 1. Introduction

In the United States (U.S.) there are substantial disparities in health (Feagin and Bennefield, 2014) that disproportionately impact African-Americans and persons of lower socioeconomic status (SES) (Adler and Newman, 2002). These disparities have led many to conclude that these groups may have different life experiences in comparison to others. Research suggests that

discrimination, or “the practice of unfairly treating a person or group of people differently from other people or groups of people (Merriam-Webster, 2015),” may be a part of these differential life experiences (Sennett and Cobb, 1972). Self-reported experiences of discrimination are conceptualized as a form of psychosocial stress (Slopen and Williams, 2014) and have been associated with important and costly pre-clinical and clinical endpoints such as breast cancer (Taylor et al., 2007), depression (Schulz et al., 2006), cardiovascular disease (Lewis et al., 2014), asthma (Coogan et al., 2014), and obesity (Hunte and Williams, 2009; Lewis et al., 2011).

The majority of research on discrimination and health has focused on racial discrimination or overall mistreatment (Lewis et al., 2015), but other forms of discrimination, specifically discrimination on the basis of SES, may also be important to consider given the well-documented association between SES and

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health (Adler and Stewart, 2010). SES has been a consistently powerful determinant of health in U.S. society historically and may gain greater significance in future decades as income inequality increases (Congressional Budget Office, 2011).

However, SES is related to race (Braveman, 2005). In 2010, Whites earned twice as much in income and had accumulated six times as much wealth, on average, than their African-American counterparts (McKernan et al., 2013). Further, research suggests that SES factors may operate differentially in African-Americans compared to Whites, particularly in relation to health (Williams and Mohammed, 2009). In a study examining the association between race, education, and weight change in 2,019 African-American and White women from the Study of Women's Health Across the Nation (SWAN), educational attainment was associated with lower body mass index (BMI) as education level increased among White women, whereas in African-American women, the “protective” effect of educational attainment on BMI was not observed (Lewis et al., 2005). A more recent longitudinal study examining educational attainment and change in inflammation levels among 2,670 African-American and White young adults, aged 18–30 years, found that each additional year of education reported in Whites was associated with a 7-mg/dl lower increase in fibrinogen levels over the 15-year follow-up. However, educational attainment was not associated with a lower rate of increase in fibrinogen levels over time in African-Americans (Fuller-Rowell et al., 2015).

Results from these studies in addition to others (Braveman et al., 2014; LaVeist, 2005) suggest that the impact of SES processes on health may differ by race. However, most of this research has focused on actual SES indicators. Few studies have examined the effect of SES-related stressors, particularly SES discrimination, on health in the context of race. Research suggests that African-Americans may be more vulnerable to the health effects of SES-related stressors as compared to Whites, because they have access to fewer economic, cultural, and social resources to cope with stress from negative SES-related events (Hardaway and McLoyd, 2009; Keene et al., 2014).

Thus, the current study was designed to examine the independent effects of SES discrimination on sleep quality in a cohort of African-American and White middle-aged adults. To date, we are aware of only one other study that has examined the association between SES discrimination and any indicator of health. In a nationally representative sample of 1659 individuals in the United States, Ren, et al. (Ren et al., 1999) found independent associations between SES discrimination, racial discrimination and each of their three outcomes: depressive symptoms, general health status, and mental health status. However, their cohort was predominantly White (86.3%), and they did not control for important confounders (Hall et al., 2008; Slopen and Williams, 2014), including financial stress, overall stress, and gender discrimination.

Sleep quality, our outcome of interest, is an emerging risk factor for chronic disease, that has been associated with an increased risk of obesity (Buxton and Marcelli, 2010; Jean-Louis et al., 2014), stroke (Qureshi et al., 1997), diabetes (Ayas et al., 2003), cancer (Marshall et al., 2014), cardiovascular disease (Jackson et al., 2015), and mortality (Gallicchio and Kalesan, 2009). According to the Centers for Disease Control and Prevention (CDC), the lack of quality sleep has become a “public health epidemic (Centers for Disease Control and Prevention).” Across studies, African-Americans and lower SES individuals have poorer quality sleep than Whites and higher SES individuals, respectively (Chen et al., 2015; Patel et al., 2010; Petrov and Lichstein, 2015; Piccolo et al., 2013). Additionally, studies suggest that psychosocial stressors—including both racial and overall discrimination—may be a risk factor for adverse sleep outcomes (Lewis et al., 2013; Slopen and

Williams, 2014; Thomas et al., 2006; Tomfohr et al., 2012; Vaughn et al., 2015). However, it is currently unknown whether discrimination based on SES is independently associated with sleep quality.

Based on previous research, we hypothesized that self-reported experiences of SES discrimination would be independently associated with worse subjective sleep quality. The need to examine discrimination within the “larger social context of the multiple stressful exposures within which it is embedded” (Williams and Mohammed, 2009) has been recommended in recent work (Lewis et al., 2015); thus, we examined whether this association was independent of other stressors (i.e. perceived stress), stressors related to socioeconomic status (i.e. financial stress) as well as other forms of discriminatory stress (i.e. both racial and gender discrimination).

## 2. Methods

### 2.1. Participants

Participants were a subset of 469 non-Hispanic African-American and White adults from the Morehouse & Emory Team up to Eliminate Cardiovascular Health Disparities (META-HEALTH) Study. The META-HEALTH study aimed to examine psychosocial, cultural, and biological correlates of cardiovascular health and was a two-stage cross-sectional study of randomly sampled African-American and White males and females ages 30–65. Participants were selected from four distinct Metropolitan Atlanta, GA counties, stratified by county median income to ensure the inclusion of an adequate representation of individuals from varying levels of SES backgrounds. During the first stage, from March 2006 to October 2009, a total of 3,391 participants were contacted using random digit dialing methodology and completed phone interviews. Of these, 469 participated in the second stage of the study, which included an extended interview (with sleep assessment) and a clinical exam. In total, 44 participants were excluded due to missing information on experiences of SES discrimination and/or subjective sleep quality. Our final analytic sample of 425 included 215 African-Americans and 210 Whites, and was 67.5% female. An additional 14 participants were excluded due to missing data on covariates during analyses. This study was approved by the Emory and Morehouse institutional review boards and all participants provided written informed consent.

### 2.2. Reports of discrimination

Experiences of SES-discrimination were measured using a previously modified version of the Experiences of Discrimination Scale (Krieger et al., 2005). Participants were asked if they had ever “been prevented from doing something”, or “been hassled or made to feel inferior” because of their SES, in seven different settings: at school, getting a job, at work, getting housing, getting medical care, from the police or in the courts on the street or in a public setting. Two additional questionnaires asked about experiences of discrimination in the same seven scenarios, but inquired whether experiences could be attributed to race, or gender, respectively. The Experiences of Discrimination scale has been widely used in both African-American and White study populations and has demonstrated high levels of validity and reliability (Krieger et al., 2005). In the current cohort, discrimination scores were highly skewed, with most participants reporting no or only one experience of discrimination; thus, a dichotomous ever/never variable was created for each type of discrimination (Hunte and Williams, 2009).

### 2.3. Subjective sleep quality

Subjective sleep quality was measured with the Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989), a 19-item questionnaire that measures aspects of sleep over the preceding month. Questions inquire about sleep duration, sleep disturbance, sleep latency (time spent falling asleep), dysfunction during the day due to sleepiness (i.e. trouble staying awake while driving), sleep efficiency (time in bed spent asleep), and sleep medication use. Composite scores on the PSQI range from 0 to 21, with higher scores indicating lower quality sleep and more sleep complaints. The PSQI has been widely used across study populations with good validity and high test-retest reliability (Backhaus et al., 2002). Scores of 5 and greater on the PSQI indicate poor sleep quality (Buysse et al., 1989).

### 2.4. Demographics

Age in years, race (non-Hispanic African-American, non-Hispanic White), and gender were all assessed via self-report. Education was used as an indicator of SES because it remains fairly constant throughout adulthood, is believed to be a major determinant of SES, and is less likely than other measures of SES (e.g. income, wealth) to have a large amount of missing values (Krieger et al., 1997). Education was self-reported, and a dichotomous college education/no college education variable was created based upon the distribution of education in the sample. Those who reported completing at least a college education were considered to be in the high SES category, and those not reporting the completion of a college education were considered to be in the low SES category.

### 2.5. Covariates

Covariates including BMI, depressive symptoms, financial stress and perceived stress were selected based on previous literature identifying them as conceptual or empirical correlates of discrimination and/or sleep (Hall et al., 2008; Slopen and Williams, 2014; Tomfohr et al., 2012). BMI was calculated utilizing measured height and weight ( $BMI = \text{weight (kg)}/\text{height (m}^2\text{)}$ ) and was assessed during the clinic visit. Depressive symptoms were assessed with the Beck Depression Inventory-II (BDI-II) (Beck et al., 1961), a 21-item questionnaire assessing depressive symptoms in the past two weeks. The question assessing sleep quality in the BDI-II was removed for the purposes of these analyses and a composite BDI-II score was calculated by summing the remaining questions with a potential range of 0–60.

Perceived stress was assessed via the Perceived Stress Scale, a valid and reliable 14-item scale measuring global feelings of stress (Cohen et al., 1983), with possible scores ranging from 0 to 56. Financial stress was measured using three questions examining stress related to paying for food, medical care, or bills. Those reporting financial stress once in a while, fairly often, or very often were given a score of 1 for each respective question, and responses were summed to create an ordinal measure ranging from 0 to 3.

### 2.6. Statistical analysis

Descriptive and correlation analyses were conducted to characterize study variables by race in our sample. Race- and SES-stratified regression analyses were conducted to examine the association between reports of SES discrimination and subjective sleep quality. We ran stratified models based on prior research noting the differential impact of SES-related processes on African-Americans compared to Whites (Fuller-Rowell et al., 2015;

LaVeist, 2005; Lewis et al., 2005) and the potential salience of SES discrimination as a stressor for lower SES individuals (Lauderdale et al., 2006; Myers, 2009). Logistic regression models were used to model subjective sleep quality as a dichotomous outcome, and linear regression models were used to model continuous subjective sleep quality scores. Models were adjusted for age, gender (Step 1), reports of racial and gender discrimination (Step 2), BMI, perceived stress, financial stress (Step 3), and depressive symptoms (Step 4). In addition to those covariates, education was adjusted for in race-stratified models, and race was adjusted for in SES-stratified models in Step 1. We also formally tested for race  $\times$  SES discrimination and SES  $\times$  SES discrimination interactions in minimally and fully adjusted non-stratified logistic and linear models. Finally, because participants reporting SES discrimination may be more likely to also report other forms of discrimination (i.e. racial or gender discrimination), we tested for multicollinearity. All analyses were conducted using SAS software version 9.4 (SAS Institute, Inc., Cary, NC, USA). An alpha level of 0.05 was used for all analyses.

## 3. Results

### 3.1. Participant characteristics

Descriptive statistics of the analytic sample are presented in Table 1. In comparison to Whites, African-Americans were younger ( $p = 0.02$ ), less likely to be college educated ( $p < 0.01$ ) and more likely to report SES and racial discrimination overall and in a greater number of settings ( $p < 0.01$ ). African-Americans also reported worse subjective sleep quality ( $p < 0.01$ ), had a higher BMI ( $p < 0.01$ ) and were more likely to report financial stress ( $p < 0.01$ ) than their White counterparts. In correlation analyses (Supplementary Tables 1 and 2), racial and gender discrimination were moderately correlated with SES discrimination in both races ( $r_s = 0.29$  to  $0.46$ ; all  $p$ -values  $< 0.001$ ).

**Table 1**

Selected demographic and psychosocial characteristics of African-American and White adults ( $N = 425$ ) by race in the META-HEALTH study.

Characteristic	African-Americans ( $N = 215$ )		Whites ( $N = 210$ )		$p$
	%	Mean (SD)	%	Mean (SD)	
Age		49.3 (9.6)		51.6 (9.4)	0.02
Female	69.8		65.2		0.32
College education	39.5		71.6		<0.01
Experiences of discrimination					
Socioeconomic					
Ever	52.1		31.9		<0.01
Number of Settings		1.5 (2.0)		0.71 (1.4)	<0.01
Racial					
Ever	71.5		41.4		<0.01
Number of Settings		2.6 (2.2)		0.8 (1.2)	<0.01
Gender					
Ever	56.1		56.2		0.98
Number of Settings		1.4 (1.6)		1.3 (1.5)	0.18
Depressive symptoms		6.7 (6.8)		6.5 (6.9)	0.63
Body Mass Index ( $\text{kg}/\text{m}^2$ )		31.5 (8.1)		28.2 (6.6)	<0.01
Perceived stress		21 (7.8)		20.4 (7.4)	0.55
Financial stress		1.5 (1.2)		0.85 (1.1)	<0.01
Subjective sleep quality		6.3 (3.8)		5.1 (3.1)	<0.01
Poor sleep quality <sup>a</sup>	62.8		49.1		<0.01

Note.  $p$ -values result from  $t$ -tests and Chi-square tests for racial differences. META-HEALTH = Morehouse & Emory Team up to Eliminate Cardiovascular Health Disparities; SD = Standard deviation.

<sup>a</sup> Poor Sleep Quality = Scores of 5 and greater on the Pittsburgh Sleep Quality Index.

### 3.2. Primary analyses

In race-stratified, fully-adjusted logistic regression models (Table 2), African-Americans reporting SES discrimination were significantly more likely to have poor sleep quality (PSQI scores 5 and greater) than African-Americans not reporting SES discrimination ( $OR = 2.32$ , 95% Confidence Interval  $[CI] = 1.14–4.72$ ). However, no significant association between reports of SES discrimination and sleep quality was observed within Whites ( $OR = 0.60$ , 95%  $CI = 0.28–1.29$ ) (Table 2). The race  $\times$  SES discrimination interaction was significant in the age, gender and education adjusted model ( $p = 0.04$ ), but was reduced to marginal significance in the fully-adjusted model ( $p = 0.06$ ). In fully adjusted, race-stratified models, the only other significant covariate in the final logistic models for African-Americans was depressive symptoms. None of the other stress-related variables (including racial discrimination) were significant for African-Americans (Table 3). For Whites, only education and depressive symptoms were significant covariates in the final logistic model (Table 3).

Results from race-stratified, linear regression models with subjective sleep quality as a continuous variable were similar to those observed in logistic models. Self-reported SES discrimination was significantly associated with worse subjective sleep quality in African-Americans after adjustment for age, gender and education ( $b = 1.58$ ,  $p < 0.01$ ). The association remained significant after adjustment for racial and gender discrimination, BMI, financial stress, and perceived stress ( $b = 1.49$ ,  $p < 0.01$ ). After further adjustment for depressive symptoms, the association was reduced to marginal significance ( $b = 1.04$ ,  $p = 0.06$ ). Again, no significant association between reports of SES discrimination and sleep quality was observed in Whites in linear models after adjustment for demographics and other forms of discrimination ( $b = 0.27$ ,  $p = 0.59$ ); the race  $\times$  SES discrimination interaction term, however, was not significant ( $p = 0.24$ ).

No consistent or significant associations emerged in SES-stratified logistic or linear regression models (data available upon request), and the SES  $\times$  SES discrimination interaction was not significant in non-stratified, fully-adjusted logistic or linear regression models ( $p = 0.74$ ,  $p = 0.90$ ), respectively. Multicollinearity was not observed.

**Table 3**

Fully adjusted logistic regression model examining the Association between SES discrimination and subjective sleep quality<sup>a</sup> stratified by race.

Predictor	African-Americans (N = 206)	Whites (N = 205)
	OR, 95% CI	OR, 95% CI
SES Discrimination	2.32 (1.14, 4.72)	0.60 (0.28, 1.29)
Education (College)	0.83 (0.42, 1.63)	0.41 (0.20, 0.83)
Age	1.00 (0.96, 1.03)	0.99 (0.96, 1.03)
Gender	0.93 (0.46, 1.87)	1.19 (0.57, 2.49)
Racial Discrimination	0.68 (0.30, 1.57)	1.42 (0.70, 2.90)
Gender Discrimination	0.77 (0.37, 1.60)	1.50 (0.69, 3.10)
Body Mass Index <sup>b</sup>	1.00 (0.96, 1.03)	0.97 (0.92, 1.02)
Perceived Stress	1.04 (0.99, 1.09)	1.03 (0.98, 1.09)
Financial Stress	1.17 (0.87, 1.57)	0.82 (0.59, 1.15)
Depressive Symptoms	1.08 (1.01, 1.15)	1.16 (1.08, 1.24)

Abbreviations: CI = Confidence Interval; META-HEALTH = Morehouse & Emory Team up to Eliminate Cardiovascular Health Disparities; OR = Odds Ratio; SES = Socioeconomic status.

<sup>a</sup> Poor Sleep Quality = Scores of 5 and greater on the Pittsburgh Sleep Quality Index.

<sup>b</sup> Body Mass Index = weight (in kg)/height (in m<sup>2</sup>).

### 3.3. Exploratory analyses

Given our significant findings for SES discrimination among African-Americans only, we ran exploratory descriptive analyses to better understand racial differences in SES discrimination (Supplementary Table 3). These analyses were stratified by SES, in order to determine whether the low-SES African-Americans were driving the elevated reports of SES discrimination among this group. In comparison to Whites without a college degree, African-Americans without a college degree were significantly more likely to report SES discrimination in only 1 out of 7 settings, with 3 additional settings reaching marginal significance. However, among college-educated participants, African-Americans were significantly more likely to report SES discrimination than their White counterparts in 6 out of 7 settings (Supplementary Table 3).

## 4. Discussion

In this population-based cohort of African-American and White Adults, reports of SES discrimination were independently associated with poor sleep quality among African-Americans, but not

**Table 2**  
Logistic regression models examining Association between SES discrimination and poor subjective sleep quality<sup>a</sup> by race among African-American and White adults in the META-HEALTH study.

Model	African-Americans		Whites	
	OR, 95% CI	N	OR, 95% CI	N
<b>Model 1</b>				
SES Discrimination	2.37 (1.35, 4.18)	215	1.11 (0.62, 1.97)	210
Crude association, no adjustments				
<b>Model 2</b>				
SES Discrimination	2.39 (1.35, 4.24)	215	1.03 (0.57, 1.87)	208
Adjusted for age, gender, and education				
<b>Model 3</b>				
SES Discrimination	2.68 (1.38, 5.19)	213	0.77 (0.40, 1.50)	208
Adjusted for model 2 covariates + racial and gender discrimination				
<b>Model 4</b>				
SES Discrimination	2.68 (1.34, 5.37)	207	0.76 (0.37, 1.55)	205
Adjusted for model 3 covariates + body mass index, financial stress, and perceived stress				
<b>Model 5</b>				
SES Discrimination	2.32 (1.14, 4.72)	206	0.60 (0.28, 1.29)	205
Adjusted for model 4 covariates + depressive symptoms				

Abbreviations: CI = Confidence Interval; META-HEALTH = Morehouse & Emory Team up to Eliminate Cardiovascular Health Disparities; OR = Odds Ratio; SES = Socioeconomic status.

<sup>a</sup> Poor Sleep Quality = Scores of 5 and greater on the Pittsburgh Sleep Quality Index.



Whites—even after controlling for important confounding factors. Thus, consistent with research on other SES-related stressors (Szanton et al., 2008), our results suggest that African-Americans may be more vulnerable to the effects of SES-discrimination on health than their White counterparts. In descriptive analyses, we found that African-Americans, regardless of SES, were significantly more likely to report SES discrimination and reported SES discrimination in more settings than Whites. Consequently, educational attainment appeared to be protective against reports of SES discrimination for Whites, but not African-Americans.

This is in line with prior work, which argues that middle-class African-Americans may be less likely to benefit from higher SES due to their race (Cose, 1993; Feagin and Sikes, 1994; Jackson and Williams, 2006). In a recent study of 41,088 African-American and White adults from the National Health Interview Survey, Jackson and colleagues (Jackson et al., 2013) found that with increasing occupational prestige, the prevalence of short sleep decreased among Whites, but increased among African-Americans, such that African-Americans from higher SES backgrounds had worse sleep than African-Americans from lower SES backgrounds. Although not the primary focus of our analyses, we observed similar findings. In race-stratified logistic regression models, education was protective against poor sleep in Whites, but was not significantly associated with poor sleep in African-Americans. Thus, SES discrimination was a stronger correlate of poor sleep than actual SES in our sample for African-Americans.

It is unclear why the association between SES discrimination and sleep was stronger than the association between racial discrimination and sleep for African-Americans in our cohort. One possible explanation relates to the very strong link between race and SES in U.S. society. Because race and class are highly correlated (Braveman, 2005), it is possible that even high SES African-Americans are frequently assumed to be lower SES and thus experience (and are impacted by) SES discrimination in a range of contexts more frequently than their White counterparts. Therefore, these individuals would actually be experiencing SES-related discrimination (e.g. in stores and restaurants), but the assumptions underlying the perception of them as low SES would be primarily driven by their race.

Similarly, it is also possible that African-Americans are actually experiencing racial discrimination, but are misattributing these experiences of racial discrimination to SES. Prior research (Levin et al., 2002) suggests that attributes of discrimination may be confused when study participants hold multiple statuses (i.e., African-American and perceived or actual low SES), so it is possible that the African-Americans reporting SES discrimination in our cohort are attributing mistreatment to SES discrimination even when it could be partially due to racial discrimination. The moderate to strong correlation between reports of racial and SES discrimination in this study provide some support for this concept, suggesting that SES discrimination and racial discrimination may be interconnected. Yet, our finding that reports of SES discrimination were significantly associated with sleep quality in African-Americans independent of reports of racial discrimination suggests that SES discrimination may be an important form of discrimination to consider in future studies.

In exploratory analyses, we found that college educated African-Americans reported more SES discrimination than college-educated Whites. It is possible that SES discrimination is more salient for African-Americans compared to Whites because even at similar levels of education and occupational prestige, African-Americans have less wealth and fewer financial resources than their White counterparts (LaVeist, 2005; McKernan et al., 2013). Childhood SES may also play a role. Heflin and Patillo found that African-Americans who were considered to be middle-class were

four times more likely to have come from a poor background than their White middle-class counterparts (Heflin and Patillo, 2006). Thus, it may be that the college-educated African-Americans reporting SES discrimination in this study were more likely to come from a low SES childhood background in comparison to college-educated Whites (Hardaway and McLoyd, 2009). While information on childhood SES was not available in this cohort, childhood SES may be an important confounding factor to consider in the context of our study as evidence suggests that childhood SES is associated with sleep outcomes (Tomfohr et al., 2010).

Given our exploratory descriptive findings among high SES African-Americans, we also conducted exploratory regression models stratified by high and low SES for African-Americans and Whites, separately, to further examine associations among race, SES, SES discrimination and sleep quality. This analysis was done because results from at least one prior study suggest that discrimination may have a differential impact on health among higher SES African-Americans (Fuller-Rowell et al., 2012). Consistent with this notion, a significant association between reports of SES discrimination and sleep quality emerged for high SES African-Americans in our cohort in exploratory analyses, although it was attenuated once depressive symptoms were controlled for. Reports of both racial and overall discrimination have been consistently associated with depressive symptoms in prior studies (Barnes et al., 2004; Lewis et al., 2013). Thus, some have argued that individuals with symptoms of depression may simply be over-reporting discrimination. However, prospective studies have found that discrimination typically precedes depressive symptoms (Brody et al., 2006; Brown et al., 2000; Schulz et al., 2006). However, because these analyses were largely exploratory in nature, these results should be interpreted with some caution. Additional research is needed to fully understand the associations among SES discrimination, depressive symptoms, and physical health outcomes among college-educated African-American adults.

#### 4.1. Limitations

First, while it is the most widely used methodology for assessing discrimination, our primary exposure, reports of discrimination, was self-reported which may need to be considered when interpreting results (Lewis et al., 2015). Sleep quality was also self-reported. Although there is evidence in the sleep literature that objective and subjective forms of sleep quality are similarly correlated with discrimination (Lewis et al., 2013), the use of objective measures, such as polysomnography, or actigraphy, is preferred. Further, the PSQI does not measure regular sleep schedules. Research suggests that a regular sleep schedule may be important for health (Buysse, 2014), and future studies should consider the association between discrimination and sleep timing and regularity. Second, the cross-sectional nature of our study limits the ability of causal inference of the effect of reports of SES discrimination on sleep quality. Further, reports of discrimination involved “ever” reporting discrimination, while self-reports of sleep reflected the past month; thus, the temporal dynamics around this cross-sectional association are unclear. Third, since our sample was relatively small, there may have been low power for detecting interactions between race or SES and reports of SES discrimination in our study. Finally, although the META-HEALTH study sample is population-based and consists of a cohort that is nearly half African-American, it is comprised of only non-Hispanic African-Americans and Whites from four counties in Georgia. This potentially weakens the ability to generalize the results of this study to other racial/ethnic groups and populations in other geographic locations.

## 5. Conclusions

To our knowledge, this is the first study to examine the association between reports of SES discrimination and sleep quality. In this sample of non-Hispanic African-American and White men and women from a population based cohort, reports of SES discrimination were independently associated with reports of poor sleep quality in African-Americans, but not Whites. These findings add to the growing literature documenting the effects of SES-related stressors on health among African-Americans (Simons et al., 2016). Additionally, although replication is needed, our findings expand upon the current discrimination and sleep literature by incorporating SES discrimination as a factor independently associated with adverse sleep quality. Thus, SES discrimination—particularly in the context of race—may be an important psychosocial construct and SES-related stressor to consider in future public health research and policy.

## Acknowledgments

This study was supported by the following funding: NIH/NHLBI 1 U01 HL79214-01; NIH/NHLBI 1 U01 HL079156-01; M01-RR00039; NIH/NCRR 5P20RR11104; NIH/NCRR 5U54RR022814. TT Lewis was supported by NIH/NHLBI K01HL92591. V Vaccarino was supported by NIH/NHLBI K24 HL077506. We would like to thank the META-HEALTH study participants and staff.

## Appendix A. Supplementary data

Supplementary data related to this article can be found at <http://dx.doi.org/10.1016/j.socscimed.2016.02.012>.

## References

- Adler, N.E., Newman, K., 2002. Socioeconomic disparities in health: pathways and policies. *Health Aff. (Millwood)* 21 (2), 60–76.
- Adler, N.E., Stewart, J., 2010. Preface to the biology of disadvantage: socioeconomic status and health. *Ann. N. Y. Acad. Sci.* 1186, 1–4. <http://dx.doi.org/10.1111/j.1749-6632.2009.05385.x>.
- Ayas, N.T., White, D.P., Al-Delaimy, W.K., Manson, J.E., Stampfer, M.J., Speizer, F.E., Hu, F.B., 2003. A prospective study of self-reported sleep duration and incident diabetes in women. *Diabetes Care* 26 (2), 380–384.
- Backhaus, J., Junghanns, K., Broocks, A., Riemann, D., Hohagen, F., 2002. Test-retest reliability and validity of the Pittsburgh Sleep Quality Index in primary insomnia. *J. Psychosom. Res.* 53 (3), 737–740.
- Barnes, L.L., Mendes De Leon, C.F., Wilson, R.S., Bienias, J.L., Bennett, D.A., Evans, D.A., 2004. Racial differences in perceived discrimination in a community population of older blacks and whites. *J. Aging Health* 16 (3), 315–337. <http://dx.doi.org/10.1177/0898264304264202>.
- Beck, A., Ward, C., Mendelson, M., Mock, J., Erbaugh, J., 1961. An inventory for measuring depression. *Arch. Gen. Psychiatry* 4, 561–571.
- Braveman, P., 2005. The question is not: “is race or class more important?”. *J. Epidemiol. Community Health* 59 (12), 1029.
- Braveman, P., Heck, K., Egerter, S., Marchi, K.S., Dominguez, T.P., Cubbin, C., Curtis, M., 2014. The role of socioeconomic factors in black-white disparities in preterm birth. *Am. J. Public Health* e1–e9. <http://dx.doi.org/10.2105/AJPH.2014.302008>.
- Brody, G.H., Chen, Y.F., Murry, V.M., Ge, X., Simons, R.L., Gibbons, F.X., Cutrona, C.E., 2006. Perceived discrimination and the adjustment of African American youths: a five-year longitudinal analysis with contextual moderation effects. *Child. Dev.* 77 (5), 1170–1189. <http://dx.doi.org/10.1111/j.1467-8624.2006.00927.x>.
- Brown, T., Williams, D., Jackson, J., Neighbors, H., Torres, M., Sellers, S., Brown, K., 2000. Being black and feeling blue: the mental health consequences of racial discrimination. *Race Soc.* 2 (2), 117–131.
- Buxton, O.M., Marcelli, E., 2010. Short and long sleep are positively associated with obesity, diabetes, hypertension, and cardiovascular disease among adults in the United States. *Soc. Sci. Med.* 71 (5), 1027–1036. <http://dx.doi.org/10.1016/j.socscimed.2010.05.041>.
- Buyse, D.J., 2014. Sleep health: can we define it? Does it matter? *Sleep* 37 (1), 9–17. <http://dx.doi.org/10.5665/sleep.3298>.
- Buyse, D.J., Reynolds, C.F., Monk, T.H., Berman, S.R., Kupfer, D.J., 1989. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res.* 28 (2), 193–213.
- Centers for Disease Control and Prevention. Insufficient Sleep is a Public Health Epidemic. from: <http://www.cdc.gov/features/dssleep/>.
- Chen, X., Wang, R., Zee, P., Lutsey, P.L., Javaheri, S., Alcántara, C., Redline, S., 2015. Racial/ethnic differences in sleep disturbances: the multi-ethnic study of atherosclerosis (MESA). *Sleep* 38 (6), 877–888. <http://dx.doi.org/10.5665/sleep.4732>.
- Cohen, S., Kamarck, T., Mermelstein, R., 1983. A global measure of perceived stress. *J. Health Soc. Behav.* 24 (4), 385–396.
- Congressional Budget Office, 2011. Trends in the Distribution of Household Income between 1979 and 2007.
- Coogan, P.F., Yu, J., O'Connor, G.T., Brown, T.A., Cozier, Y.C., Palmer, J.R., Rosenberg, L., 2014. Experiences of racism and the incidence of adult-onset asthma in the Black Women's Health Study. *Chest* 145 (3), 480–485. <http://dx.doi.org/10.1378/chest.13-0665>.
- Cose, E., 1993. *The Rage of a Privileged Class*. Harper Collins.
- Feagin, J., Bennefield, Z., 2014. Systemic racism and U.S. health care. *Soc. Sci. Med.* 103, 7–14. <http://dx.doi.org/10.1016/j.socscimed.2013.09.006>.
- Feagin, J., Sikes, M., 1994. *Living with Racism. The Black Middle-class Experience*. Beacon Press Books.
- Fuller-Rowell, T.E., Curtis, D.S., Doan, S.N., Coe, C.L., 2015. Racial disparities in the health benefits of educational attainment: a study of inflammatory trajectories among African American and white adults. *Psychosom. Med.* 77 (1), 33–40. <http://dx.doi.org/10.1097/PSY.0000000000000128>.
- Fuller-Rowell, T.E., Doan, S.N., Eccles, J.S., 2012. Differential effects of perceived discrimination on the diurnal cortisol rhythm of African Americans and Whites. *Psychoneuroendocrinology* 37 (1), 107–118. <http://dx.doi.org/10.1016/j.psyneuen.2011.05.011>.
- Gallicchio, L., Kalesan, B., 2009. Sleep duration and mortality: a systematic review and meta-analysis. *J. Sleep. Res.* 18 (2), 148–158. <http://dx.doi.org/10.1111/j.1365-2869.2008.00732.x>.
- Hall, M., Buysse, D.J., Nofzinger, E.A., Reynolds, C.F., Thompson, W., Mazumdar, S., Monk, T.H., 2008. Financial strain is a significant correlate of sleep continuity disturbances in late-life. *Biol. Psychol.* 77 (2), 217–222. <http://dx.doi.org/10.1016/j.biopsycho.2007.10.012>.
- Hardaway, C.R., McLoyd, V.C., 2009. Escaping poverty and securing middle class status: how race and socioeconomic status shape mobility prospects for African Americans during the transition to adulthood. *J. Youth Adolesc.* 38 (2), 242–256. <http://dx.doi.org/10.1007/s10964-008-9354-z>.
- Heflin, C.M., Patillo, M., 2006. Poverty in the family: race, siblings, and socioeconomic heterogeneity. *Soc. Sci. Res.* 35 (4), 804–822.
- Hunte, H.E., Williams, D.R., 2009. The association between perceived discrimination and obesity in a population-based multiracial and multiethnic adult sample. *Am. J. Public Health* 99 (7), 1285–1292. <http://dx.doi.org/10.2105/AJPH.2007.128090>.
- Jackson, C.L., Redline, S., Emmons, K.M., 2015. Sleep as a potential fundamental contributor to disparities in cardiovascular health. *Annu. Rev. Public Health* 36, 417–440. <http://dx.doi.org/10.1146/annurev-publhealth-031914-122838>.
- Jackson, C.L., Redline, S., Kawachi, I., Williams, M.A., Hu, F.B., 2013. Racial disparities in short sleep duration by occupation and industry. *Am. J. Epidemiol.* 178 (9), 1442–1451. <http://dx.doi.org/10.1093/aje/kwt159>.
- Jackson, P.B., Williams, D., 2006. *The intersection of race, gender, and SES: health paradoxes. In: Gender, Race, Class, & Health: Intersectional Approaches*. Jossey-Bass, San Francisco, CA.
- Jean-Louis, G., Williams, N.J., Sarpong, D., Pandey, A., Youngstedt, S., Zizi, F., Ogedegbe, G., 2014. Associations between inadequate sleep and obesity in the US adult population: analysis of the national health interview survey (1977–2009). *BMC Public Health* 14 (1), 290. <http://dx.doi.org/10.1186/1471-2458-14-290>.
- Keene, D.E., Lynch, J.F., Baker, A.C., 2014. Fragile health and fragile wealth: mortgage strain among African American homeowners. *Soc. Sci. Med.* 118, 119–126. <http://dx.doi.org/10.1016/j.socscimed.2014.07.063>.
- Krieger, N., Smith, K., Naishadham, D., Hartman, C., Barbeau, E.M., 2005. Experiences of discrimination: validity and reliability of a self-report measure for population health research on racism and health. *Soc. Sci. Med.* 61 (7), 1576–1596. <http://dx.doi.org/10.1016/j.socscimed.2005.03.006>.
- Krieger, N., Williams, D.R., Moss, N.E., 1997. Measuring social class in US public health research: concepts, methodologies, and guidelines. *Annu. Rev. Public Health* 18, 341–378. <http://dx.doi.org/10.1146/annurev.publhealth.18.1.341>.
- Lauderdale, D.S., Knutson, K.L., Yan, L.L., Rathouz, P.J., Hulley, S.B., Sidney, S., Liu, K., 2006. Objectively measured sleep characteristics among early-middle-aged adults: the CARDIA study. *Am. J. Epidemiol.* 164 (1), 5–16. <http://dx.doi.org/10.1093/aje/kwj199>.
- LaVeist, T.A., 2005. Disentangling race and socioeconomic status: a key to understanding health inequalities. *J. Urban Health* 82 (2 Suppl. 3), iii26–iii34. <http://dx.doi.org/10.1093/jurban/jti061>.
- Levin, S., Sinclair, S., Veniegas, R.C., Taylor, P.L., 2002. Perceived discrimination in the context of multiple group memberships. *Psychol. Sci.* 13 (6), 557–560.
- Lewis, T.T., Cogburn, C.D., Williams, D.R., 2015. Self-reported experiences of discrimination and health: scientific advances, ongoing controversies, and emerging issues. *Annu. Rev. Clin. Psychol.* <http://dx.doi.org/10.1146/annurev-clinpsy-032814-112728>.
- Lewis, T.T., Everson-Rose, S.A., Sternfeld, B., Karavolos, K., Wesley, D., Powell, L.H., 2005. Race, education, and weight change in a biracial sample of women at midlife. *Arch. Intern. Med.* 165 (5), 545–551. <http://dx.doi.org/10.1001/archinte.165.5.545>.
- Lewis, T.T., Kravitz, H.M., Janssen, I., Powell, L.H., 2011. Self-reported experiences of

- discrimination and visceral fat in middle-aged African-American and Caucasian women. *Am. J. Epidemiol.* 173 (11), 1223–1231. <http://dx.doi.org/10.1093/aje/kwq466>.
- Lewis, T.T., Troxel, W.M., Kravitz, H.M., Bromberger, J.T., Matthews, K.A., Hall, M.H., 2013. Chronic exposure to everyday discrimination and sleep in a multiethnic sample of middle-aged women. *Health Psychol.* 32 (7), 810–819. <http://dx.doi.org/10.1037/a0029938>.
- Lewis, T.T., Williams, D.R., Tamene, M., Clark, C.R., 2014. Self-reported experiences of discrimination and cardiovascular disease. *Curr. Cardiovasc Risk Rep.* 8 (1), 365. <http://dx.doi.org/10.1007/s12170-013-0365-2>.
- Marshall, N.S., Wong, K.K., Cullen, S.R., Knutman, M.W., Grunstein, R.R., 2014. Sleep apnea and 20-year follow-up for all-cause mortality, stroke, and cancer incidence and mortality in the busselton health study cohort. *J. Clin. Sleep. Med.* 10 (4), 355–362. <http://dx.doi.org/10.5664/jcsm.3600>.
- McKernan, S.-M., Ratcliffe, C., Steuerle, C.E., Zhang, S., 2013. Less than Equal: Racial Disparities in Wealth Accumulation.
- Merriam-Webster, 2015. Discrimination, from. <http://www.merriam-webster.com/dictionary/discrimination>.
- Myers, H.F., 2009. Ethnicity- and socio-economic status-related stresses in context: an integrative review and conceptual model. *J. Behav. Med.* 32 (1), 9–19. <http://dx.doi.org/10.1007/s10865-008-9181-4>.
- Patel, N.P., Grandner, M.A., Xie, D., Branas, C.C., Gooneratne, N., 2010. Sleep disparity" in the population: poor sleep quality is strongly associated with poverty and ethnicity. *BMC Public Health* 10, 475. <http://dx.doi.org/10.1186/1471-2458-10-475>.
- Petrov, M., Lichstein, K., 2015. Difference between sleep in black and white adults: an update and future directions. *Sleep. Med.* <http://dx.doi.org/doi:10.1016/j.sleep.2015.01.011>.
- Piccolo, R.S., Yang, M., Bliwise, D.L., Yaggi, H.K., Araujo, A.B., 2013. Racial and socioeconomic disparities in sleep and chronic disease: results of a longitudinal investigation. *Ethn. Dis.* 23 (4), 499–507.
- Qureshi, A.I., Giles, W.H., Croft, J.B., Bliwise, D.L., 1997. Habitual sleep patterns and risk for stroke and coronary heart disease: a 10-year follow-up from NHANES I. *Neurology* 48 (4), 904–911.
- Ren, X.S., Amick, B.C., Williams, D.R., 1999. Racial/ethnic disparities in health: the interplay between discrimination and socioeconomic status. *Ethn. Dis.* 9 (2), 151–165.
- Schulz, A.J., Gravelle, C.C., Williams, D.R., Israel, B.A., Mentz, G., Rowe, Z., 2006. Discrimination, symptoms of depression, and self-rated health among african american women in detroit: results from a longitudinal analysis. *Am. J. Public Health* 96 (7), 1265–1270. <http://dx.doi.org/10.2105/AJPH.2005.064543>.
- Sennett, R., Cobb, J., 1972. *The Hidden Injuries of Class*. W. W. Norton & Company.
- Simons, R., Lei, M., Beach, S., Philibert, R., Cutrona, C., Gibbons, F., Barr, A., 2016. Economic hardship and biological weathering: the epigenetics of aging in a US sample of black women. *Soc. Sci. Med.* 150, 192–200. <http://dx.doi.org/10.1016/j.socscimed.2015.12.001>.
- Slopen, N., Williams, D.R., 2014. Discrimination, other psychosocial stressors, and self-reported sleep duration and difficulties. *Sleep* 37 (1), 147–156. <http://dx.doi.org/10.5665/sleep.3326>.
- Szanton, S.L., Allen, J.K., Thorpe, R.J., Seeman, T., Bandeen-Roche, K., Fried, L.P., 2008. Effect of financial strain on mortality in community-dwelling older women. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 63 (6), S369–S374.
- Taylor, T.R., Williams, C.D., Makambi, K.H., Mouton, C., Harrell, J.P., Cozier, Y., Adams-Campbell, L.L., 2007. Racial discrimination and breast cancer incidence in US black women: the black Women's health study. *Am. J. Epidemiol.* 166 (1), 46–54. <http://dx.doi.org/10.1093/aje/kwm056>.
- Thomas, K.S., Bardwell, W.A., Ancoli-Israel, S., Dimsdale, J.E., 2006. The toll of ethnic discrimination on sleep architecture and fatigue. *Health Psychol.* 25 (5), 635–642. <http://dx.doi.org/10.1037/0278-6133.25.5.635>.
- Tomfohr, L.M., Ancoli-Israel, S., Dimsdale, J., 2010. Childhood socioeconomic status and race are associated with adult sleep. *Behav. Sleep. Med.* 8 (4), 219–230. <http://dx.doi.org/10.1080/15402002.2010.509236>.
- Tomfohr, L.M., Pung, Edwards, Dimsdale, 2012. Racial differences in sleep architecture: the role of ethnic discrimination. *Biol. Psychol.* 89 (1), 34–38. <http://dx.doi.org/10.1016/j.biopsycho.2011.09.002>.
- Vaughn, M., Salas-Wright, C., White, N., Kremer, K., 2015. Poor sleep and reactive aggression in a nationally representative sample of African-American adults. *J. Psychiatric Res.* (66–67), 54–59.
- Williams, D.R., Mohammed, S.A., 2009. Discrimination and racial disparities in health: evidence and needed research. *J. Behav. Med.* 32 (1), 20–47. <http://dx.doi.org/10.1007/s10865-008-9185-0>.