Distribution Agreement

In presenting this thesis or dissertation as a partial fulfillment of the requirements for an advanced degree from Emory University, I hereby grant to Emory University and its agents the non-exclusive license to archive, make accessible, and display my thesis or dissertation in whole or in part in all forms of media, now or hereafter known, including display on the world wide web. I understand that I may select some access restrictions as part of the online submission of this thesis or dissertation. I retain all ownership rights to the copyright of the thesis or dissertation. I also retain the right to use in future works (such as articles or books) all or part of this thesis or dissertation.

Signature:

_____ _____

Miriam Van Dyke Date

Reports of Experiences of Socioeconomic Status Discrimination and Sleep Quality in African-American and White Adults

By

Miriam Van Dyke
Degree to be awarded: MPH

Department of Epidemiology

_____

Tené T. Lewis, Ph.D
Committee Chair

Reports of Experiences of Socioeconomic Status Discrimination and Sleep Quality in African-American and White Adults

By

Miriam Van Dyke

B.S.
University of Alabama at Birmingham
2013

Thesis Committee Chair: Tené T. Lewis, Ph.D

An abstract of
A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Epidemiology
2013

Abstract

Reports of Socioeconomic Status Discrimination and Subjective Sleep Quality in African-American and White Adults

By Miriam Van Dyke

Research on reports of discrimination and risk for chronic diseases has grown, but much of this work has 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. We examined the cross-sectional association between self-reports of SES discrimination and subjective sleep quality, an emerging risk factor for poor health. We also examined whether associations varied by SES or race – given well-documented black-white disparities in sleep quality.

Participants were 425 African-American and White adults (67.5% female, 50.6% African-American, 55.3% college educated) aged 30-65 from the Morehouse & Emory Team Up to eliminate Cardiovascular Health Disparities (META-HEALTH) study. Self-reports of SES discrimination were assessed with a modified Experiences of Discrimination Scale and subjective sleep complaints were assessed with the Pittsburgh Sleep Quality Index. SES and race-stratified linear regression analyses were conducted to examine the association between reports of SES discrimination and subjective sleep quality after controlling for demographics, self-reports of racial and gender discrimination, financial and general stress, BMI, and depressive symptoms.

Compared to Whites, African-Americans reported higher levels of both SES and racial discrimination (p-values <0.0001), but not gender discrimination ($p>0.1$). In race-stratified models, self-reports of SES discrimination were significantly associated with subjective sleep quality in African-Americans after adjusting for demographics ($\beta=1.58$, $p<0.01$). The association remained significant after adjustment for other forms of discrimination (neither of which were significantly associated with sleep quality), BMI, and stress ($\beta=1.49$, $p<0.01$); but was reduced to marginal significance after adjusting for depressive symptoms ($p=0.06$). No significant associations were observed in Whites ($p>0.1$). No consistent patterns emerged in SES-stratified models.

Findings suggest that self-reports of SES discrimination may be an important risk factor for subjective sleep quality among African-Americans.

Reports of Experiences of Socioeconomic Status Discrimination and Sleep Quality in African-American and White Adults

By

Miriam Van Dyke

B.S.
University of Alabama at Birmingham
2013

Thesis Committee Chair: Tené T. Lewis, Ph.D

A thesis submitted to the Faculty of the
Rollins School of Public Health of Emory University
in partial fulfillment of the requirements for the degree of
Master of Public Health
in Epidemiology
2013

Table of Contents

Chapter I: Background

According to the Centers for Disease Control and Prevention (CDC), "insufficient sleep is a public health epidemic[1]." Data from the 2009 Behavioral Risk Factor Surveillance System (BRFSS) survey suggests that over 35% of 74,571 adult respondents from 12 U.S. states reported having less than 7 hours of sleep per day[2]. The National Department of Transportation estimates that nearly 1,550 deaths and 40,000 injuries that occur annually in the U.S. can be attributed to drowsy driving[3]. Beyond the association of poor sleep with motor vehicle accidents[4], poor sleep has also been associated with important overall indicators of health, including increased mortality [5-8] and mental and physical health[9]. More specifically, poor sleep has been associated with an increased risk of obesity[10,11], lowered immune function, stroke[12], diabetes[11,13], heart disease, cancer [14], hypertension[11,15,16], cardiovascular disease[11,17,18], and mental health disorders[19].

In the United States, certain groups bear a disproportionate burden of adverse sleep outcomes., A recent review of studies examining racial disparities in sleep revealed that African-Americans are more likely to experience adverse sleep outcomes including "poorer sleep continuity and quality, excessively short or long sleep duration, greater sleep variability, and greater risk for sleep apnea" than their White counterparts[20]. Similarly, individuals with a low socioeconomic status (SES) (defined by income, occupation, or education) and those that report financial strain have been found to be more likely to have a poor quality of sleep than those with a high SES[9,21-23]

Although race may be highly confounded with SES in the United States[24,25], research suggests that racial disparities in sleep are not completely due to SES[26]. In fact, at least one study has found that African-Americans from *higher* SES backgrounds

actually have worse sleep than African-Americans from lower SES backgrounds[26]. In a nationally representative sample of 41,088 African-American and White adults from the National Health Interview Survey, Jackson, et al found that with increasing occupational prestige, the prevalence of short sleep decreased among Whites, but increased among African-Americans. Thus, the racial disparity in sleep was smallest for those working in a manufacturing/construction occupation (PR=1.14) and largest among those holding professional occupations (PR=1.44)[26].

Several researchers have hypothesized that discrimination may be one possible explanation for these racial disparities in sleep, particularly at the highest level of SES. . Discrimination, defined as "the practice of unfairly treating a person or group of people differently from other people or groups of people[27]," has been conceptualized as a form of chronic stress that might impact a range of health outcomes. Across studies, reports of discrimination have been associated with various health conditions, including hypertension, atherosclerosis, obesity[28,29], breast cancer, asthma, -- all conditions where poor sleep may also play a role[11,30].

A number of studies have found positive associations between reports of discrimination and sleep. In 2013, Lewis, et al[31], published findings examining the association between reports of discrimination overall and sleep in 368 African-American, White, and Chinese women from the Study of Women's Health Across the Nation Sleep Study. Although the measurement of discrimination was not specific to any one form of discrimination (e.g. race, SES or gender), the findings provided some documentation that chronic feelings of discrimination over time may significantly influence not only objective, polysomnography-assessed sleep, but also subjective sleep outcomes, regardless of race and after adjustment for depressive symptoms.

In contrast, Grandner, et al utilized cross-sectional data from a group of 7,148 adults from Michigan and Wisconsin to examine the association between experiences of racism, measured by one question in the 2006 BRFSS in regards to seeking healthcare, and self-reported sleep disturbance[32]. After adjustment for covariates that included demographics and depressed mood, investigators found a significant association between experiences of racism in seeking healthcare and sleep disturbance among Whites, but not African-Americans. These findings are interesting in that reports of experiences of racism were only significant in Whites and not in African-Americans, where Whites may not necessarily be considered the "minority" in the United States. It is important to note that because African-Americans in the sample were more likely to experience perceived discrimination, authors speculated the non-significant stratified results in African-Americans may be attributed to a lack of power. Further it is also important to note that the discrimination measurement only included healthcare as a setting, where it may be that African-Americans may be more likely to experience discrimination more often than Whites in other settings/situations not queried.

More recent research examining linkages between discrimination and sleep suggest that experiences of discrimination may impact sleep outcomes independent of other psychosocial stressors[33]. In a cross-sectional study conducted by Slopen and Williams with a sample of nearly 3,000 Black, Hispanic, and White adults, results revealed that discrimination, both racial and non-racial, was associated with sleep duration and difficulties independent of SES and other psychosocial stressors, and that racial/ethnic disparities were eliminated after adjustment for experiences of discrimination. Although Slopen and Williams only utilized two open ended questions to

measure sleep duration and sleep difficulties, their measurement of race-based discrimination was relatively comprehensive as they utilized both a Major Experiences of discrimination scale and an everyday discrimination scale to capture not only one-time discriminatory events that may be considered acute, but also more chronic discriminatory experiences that may occur on a daily basis. Overall, Slopen and Williams found that the association between experiences of racial discrimination and sleep was independent of other psychosocial stressors that included acute events, childhood adversity, financial, community, employment, relationships, etc.

Although the literature on discrimination and sleep has evolved over time, there are some limitations that should be addressed in future research[34]. For example, studies of discrimination and sleep quality should consider including other forms of discrimination besides only reports of overall or racial discrimination. Although Slopen and Williams looked at "nonracial" discrimination in their 2014 study[33], clearer definitions are needed to distinguish different types of discrimination (e.g. based on gender, weight, religious affiliation, sexual orientation, SES, etc.) and the independent effects of each type of discrimination on sleep and other health outcomes in general. SES discrimination may be particularly important to consider as SES has been a consistently powerful determinant of health in U.S. society[35] and may actually gain greater significance in future decades as income inequality increases. Understanding the role of SES-related stressors like SES discrimination, in the context of race, and racial discrimination may be particularly important.

Chapter II: Manuscript

"Reports of Experiences of Socioeconomic Status Discrimination and Sleep Quality in African-American and White Adults"

Introduction

In the United States (U.S.) there are substantial disparities in health[36-38], education[39], employment[40], and prosecution by the judicial system[36] that disproportionately impact racial/ethnic minorities and persons of lower socioeconomic status (SES)[41]. These disparities have led many to conclude that certain groups in the U.S. have different life experiences in comparison to others[36,42]. Discrimination, or "the practice of unfairly treating a person or group of people differently from other people or groups of people[27]," may be a part of these differential life experiences.[43,44] Self-reported experiences of discrimination are conceptualized as a form of psychosocial stress[33] that may impact health through stress-related mechanisms[45,46], including cortisol secretions, inflammation[47], and deregulated blood pressure[48]. Reports of discrimination have been associated with important clinical endpoints such as breast cancer[49], cardiovascular disease[28], depression[50], hypertension[51], and obesity[52,53]. Many of these diseases are considered chronic conditions, which as a whole are responsible for 75% of the U.S. health care spending according to a 2012 Institute of Medicine Report[54].

The majority of research on discrimination and health has focused on racial discrimination or overall mistreatment[29,45], but other forms of discrimination, specifically

socioeconomic (SES) discrimination, may also be important to consider based on the well-documented association between SES and health[35,41,55,56]. SES has been a consistently powerful determinant of health in U.S. society and may actually gain greater significance in future decades as income inequality increases. According to a report by the Congressional Budget Office in 2011, income for the top 1% grew by 275 percent in comparison to a growth in income of 18% for the bottom 20% of Americans[57].

However, SES is shaped by race[25]. For example, in 2010, on average, Whites made twice as much in income and had attained six times as much wealth than African-Americans [58]. Further, research suggests that SES factors may operate differentially in African-Americans compared to Whites, particularly in relation to health [59]. In a study examining the association between race, education, and weight change in 2,019 African-American and White women from the SWAN study, differential effects for the impact of educational attainment on BMI were observed for Whites in comparison to African-Americans. Among White women, educational attainment was associated with lower BMI as education level increased, whereas in African-American women, the "protective" effect of educational attainment was not observed [60]. In another example, a longitudinal study examining change in inflammation levels and educational attainment 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 fibrogen levels over the 15-year follow-up. However, educational attainment was not associated with a beneficial effect on the change in fibrogen levels over time in African-Americans[61]. These results suggest that educational attainment in the U.S. may be more beneficial for Whites in comparison to African-Americans.

Results from these studies in addition to others[24,61-64] suggest that the impact of SES processes on health may differ by race. However, most of these studies have focused on the impact of actual SES indicators. Limited research has been done examining the effect of SES-related stressors, particularly SES discrimination, on health in the context of race. Research suggests that certain racial groups, such as African-Americans, may be more vulnerable to the health effects of SES-related stressors when compared to Whites, because they have access to fewer economic, cultural, and social resources to help cope with stress from negative events related to socioeconomic status[65-67].

Thus, the current study was designed to examine the independent effects of SES discrimination on sleep quality in an urban cohort of African-American and White middle-aged adults by race. To date, we are aware of only one other study that has examined the association between SES discrimination and any indicator of health[68]. In a nationally representative sample of 1,659 individuals in the United States, Ren, et al[68] examined associations among reports of SES discrimination, racial discrimination and three different self-reported outcomes: depressive symptoms, general health status, and mental health status[68] They 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 confounds, including financial stress[21,33,59] and gender discrimination. The need to examine discrimination within the "larger social context of the multiple stressful exposures within which it is embedded" has been recommended in recent work[29,33,59]; thus, we are examining SES discrimination in the context of other specific stressors related to socioeconomic status (i.e. financial

stress) as well as other forms of discriminatory stress (i.e. both racial and gender discrimination).

Sleep quality, an emerging risk factor in chronic health outcomes, has been associated with obesity[30], stroke, cancer, and mortality[14]. Racial and socioeconomic disparities in sleep quality have been well-documented[20,69-71]. Individuals of a low SES and those that report financial strain have been found to be more likely to have poor quality sleep than those with a high SES[9,21-23] Moreover, a recent review of studies examining racial disparities in sleep revealed that African-Americans are more likely to experience adverse sleep outcomes including "poorer sleep continuity and quality, excessively short or long sleep duration, greater sleep variability, and greater risk for sleep apnea" in comparison to their White counterparts[20]. The review also highlighted the need for further research on the mechanisms helping to explain the persistent racial disparities in sleep[20].

Studies suggest that psychosocial stressors, such as both racial and non-specific discrimination may be a risk factor for adverse sleep quality[31-33,72,73], and may help to explain racial disparities observed in sleep quality[33]. However it is currently unknown whether discrimination based on SES is associated with sleep quality, independent of race, SES, and other types of discrimination. Based on previous research, we hypothesized that self-reported experiences of SES discrimination would be associated with worse subjective sleep quality, independent of other psychosocial stressors, including financial stress and both racial and gender discrimination. This hypothesis was tested in both race-stratified and SES-stratified statistical models, because of prior research noting the differential impact of SES-related processes on African-Americans

compared to Whites and the potential salience of SES discrimination as a stressor for lower-SES individuals.[20,22,69,71,74].

Methods

Participants

Participants were a subset of 470 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 was a two-stage cross-sectional study of randomly sampled African-American and White males and females ages 30-65 from the Metropolitan Atlanta, Georgia area. During the first stage from March 2006 to October 2009, data for this study was collected from participants residing in four distinct Metropolitan Atlanta counties. Participants were selected using random digit dialing methodology stratified by county median income to ensure the inclusion of an adequate representation of individuals from varying levels of SES backgrounds.

Sampling methodology for META-HEALTH was similar to that used for the behavioral risk factor surveillance system (BRFSS), which is the standard for area sample designs. Sample telephone numbers were selected in 100-series telephone banks containing one or more listed households. Before a party was deemed as "unreachable," nine calls were placed. Calls to the selected numbers were placed at different times and days so that a total of three day attempts, three night attempts, and three weekend attempts were made.

The META-HEALTH study aimed to examine psychosocial, cultural, and biological factors, of cardiovascular health outcomes in African-Americans and Whites. A total of 3,391 participants completed phone interviews in the first stage of the study, and of those, 753 participated in the second stage of the study, which included an extended interview and clinical exam including anthropometrics and the assessment of biomarkers at either Emory or Morehouse Schools of Medicine. Data on subjective sleep quality were available for 470 participants. A total of 45 participants were excluded due to missing or incomplete information on the subjective sleep quality or experiences of SES discrimination scale. 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 informed consent was received from all study participants.

Reports of Discrimination

Experiences of discrimination based on SES, race, or gender, respectively were measured using a modified version of the Experiences of Discrimination Scale[75].This scale has been widely used in African-American and White study populations[68,75-77]and has been shown to have high levels of validity and reliability[75]. 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 situations and settings. Examples of the situations and settings included: "at school, getting a job, at work, at home, receiving medical care, or 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. Prior studies have shown that the seven situations and settings measured in the scale capture the same underlying construct and yield a high internal reliability[68]. Because responses to the discrimination questions were highly skewed, with the majority of participants reporting "never" or only one experience of discrimination, a dichotomous ever/never variable was created for each type of discrimination. [78].

Subjective Sleep Quality

Subjective sleep quality was measured with the Pittsburgh Sleep Quality Index (PSQI)[79], 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. Total scores on the PSQI ranges from 0-21, with higher scores suggesting lower quality sleep and more sleep complaints. The measure has been widely used across study populations and has been found to have good validity and high test-retest reliability[80]. Scores of 5 and greater on the PSQI indicate poor sleep quality[79].

Demographics

Age in years, race (non-Hispanic African-American, non-Hispanic White), and gender (male, female) 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[81]. For education, a dichotomous variable defined by the self-reported completion of a college education was

created. Those who reported completing at least a college education were considered to be high SES, and those not reporting the completion of a college education were considered to be low SES.

Covariates

Covariates including body mass index (BMI), depressive symptoms, financial stress and perceived stress, were selected based on previous literature identifying them as conceptual or empirical covariates of discrimination and/or sleep[31-33,73,82]. BMI was calculated utilizing measured height and weight (BMI= weight (kg)/ height (m^2)), assessed during the clinic visit, and was modeled continuously in all analyses. . Depressive symptoms were assessed using the Beck Depression Inventory-II (BDI-II)[83], a questionnaire consisting of 21 groups of statements examining 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. The BDI-II has been validated in various populations[84] and was modeled continuously.

Perceived stress was assessed via the Perceived Stress Scale, a valid and reliable 14-item scale measuring global feelings of stress [85], with scores ranging from 0 to 50. 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. The three questions assessing financial stress were summed to create a continuous measure with a range of 0-3. Both perceived stress and financial stress were modeled continuously in analyses.

Statistical Analysis

T-tests and Chi-squared analyses were conducted to characterize study variables by race in our sample. Race-specific correlation analyses were conducted to examine the bivariate associations between each covariate and reports of SES discrimination or sleep quality, respectively. Race-stratified and SES-stratified analyses were conducted using adjusted multiple linear and logistic regression models to examine the association between reports of SES discrimination and subjective sleep quality among the two racial and two SES groups. Models examined the association between reports of SES discrimination and sleep quality after adjustment 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. The two-way interaction between race and SES discrimination was assessed in non-stratified linear and logistic regression models including all covariates. 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. Multicollinearity was examined by assessing condition indices (CIs) and variance decomposition proportions (VDPs). All analyses were conducted using the SAS software version 9.4 (SAS®Institute, Inc., Cary,NC,USA).

Results

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 ($p<0.0001$) and more likely to report SES and racial discrimination overall and in a greater number of settings ($p<0.0001$). African-Americans also reported worse subjective sleep quality ($p=0.0008$), had higher BMIs ($p<0.0001$) and were more likely to report financial stress ($p<0.0001$) than their White counterparts. Reports of gender discrimination, depressive symptoms and perceived stress were similar in African-Americans and Whites ($p>0.05$).

In both African-Americans and Whites, reports of SES discrimination were positively correlated with subjective sleep quality (Pearson coefficients: 0.20-0.23) (Tables 2a and 2b) and were weakly to moderately correlated with perceived stress, financial stress and depressive symptoms (Pearson coefficients: 0.18-0.36). Racial discrimination, gender discrimination, and depressive symptoms were weakly to moderately positively correlated with sleep quality (Pearson coefficients: 0.16-0.46) in both races. . Racial and gender discrimination were moderately correlated with SES discrimination in both races (Pearson coefficients: 0.47-0.64) (Table 2a, 2b).

Race, Reports of SES Discrimination, and Sleep

In race-stratified, multivariable linear regression models presented in Table 3, self-reports of SES discrimination were significantly associated with subjective sleep quality in African-Americans after adjustment for age, gender and education ($\beta=1.58$, $p<0.01$). The association remained significant after adjustment for racial discrimination

and gender discrimination, BMI, financial stress, and perceived stress (β=1.49, $p<0.01$). After further adjustment for depressive symptoms, the association was reduced to marginal significance (β=1.04, $p=0.06$). No significant association for reports of SES discrimination and sleep quality was observed in Whites in linear models after adjustment for demographics and other forms of discrimination ($p>0.1$) (Table 3). Among the covariates adjusted for in race-stratified linear models, only perceived stress ($p=0.0154$) and depressive symptoms ($p<0.0001$) were significantly associated with subjective sleep quality in the final fully adjusted model for African-Americans (Table 4). Tests for multicollinearity in linear regression models were non-significant with CIs of < 30 and no two pairs of VDPs >0.5 in final models.

In race-stratified, adjusted logistic regression models (Table 5), African-Americans reporting SES discrimination had a significantly larger odds of experiencing poor sleep quality (PSQI scores greater than 4) than African-Americans not reporting SES discrimination (OR=2.32, 95% CI=1.14-4.72). No significant associations were observed within Whites (OR=0.60, 95% CI= 0.28-1.29) (Table 5). The fully adjusted association between SES discrimination and poor sleep quality in logistic regression models for African-Americans and Whites is graphically depicted in Figure 1. Two-way interactions between race and SES discrimination in fully-adjusted, non-stratified logistic and linear regression models were non-significant.

SES, Reports of SES Discrimination, and Sleep

No consistent patterns emerged in SES-stratified linear and logistic regression models. Reports of SES discrimination were significantly associated with subjective sleep quality in linear regression models for low SES participants after adjusting for

demographics (β=1.21, p=0.03), but were attenuated once other types of discrimination, BMI, financial and perceived stress, and depressive symptoms were controlled for (β=0.68, p>0.05). For high SES participants, reports of SES discrimination were significantly associated with subjective sleep quality in linear models after adjusting for demographics (β=1.39, p<0.01), but were non-significant once other types of discrimination, BMI, financial and perceived stress, and depressive symptoms were considered (β=0.24, p>0.05).

Reports of SES discrimination were not significantly associated with poor sleep quality in unadjusted (OR=1.50, 95% CI=0.82, 2.76) or fully adjusted logistic regression models (OR=1.17, 95% CI= 0.52, 2.64) among low SES participants. However, similar to results from linear regression models, for high SES participants, reports of SES discrimination were significantly associated with poor sleep quality (OR= 1.76, 95% CI= 1.02, 3.05) until other forms of discrimination, BMI, financial stress, perceived stress, and depressive symptoms were considered (OR= 1.24, 95% CI= 0.64, 2.40).

Discussion

In this population-based cohort of African-American and White Adults, reports of SES discrimination were associated with poor sleep among African-Americans, but not Whites. Thus, consistent with research on other SES indicators[64] and SES-related stressors[86], our results suggest that African-Americans may be more vulnerable to the effects of SES-discrimination on health than their White counterparts. We found that African-Americans, regardless of SES, were significantly more likely to report SES

discrimination, and reported SES discrimination in more settings and situations than Whites (Supplemental Table 1). Consequently, educational attainment appeared to be protective against SES discrimination for Whites, but not for African-Americans.

This is consistent with prior work, which argues that middle-class African-Americans may be unable to exercise privileges associated with higher SES due to their race[87-89]. It is also possible that SES discrimination may be more salient for African-Americans than Whites because even at similar levels of education, African-Americans have less wealth and fewer financial resources than their White counterparts[58,64]. Thus, even the college-educated African-Americans in our sample may be more vulnerable to SES-related stressors than college-educated Whites.

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 in itself may be an important form of discrimination to consider as a psychosocial stressor in future studies. Further, because racial discrimination was not significant in models including SES discrimination for African-Americans, it is possible that SES discrimination may arguably be a more important form of discrimination to consider than racial discrimination in African-Americans, in line with some theories on the declining significance of race[90,91]. However, this is likely not true, because our overall findings were not independent of race (i.e. reports of SES discrimination were significantly associated with poor sleep among African-Americans, but not Whites).

Other possible explanations for our observation that SES discrimination was more strongly associated with poor sleep quality than racial discrimination relate to the very

strong confound between race and SES in United States society. Because race and class are highly correlated, 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. Thus, 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 experiencing discrimination, but are misattributing experiences of racial discrimination to SES discrimination. Prior research [92] suggests that attributes of discrimination may be confused when study participants hold multiple statuses (i.e. African-American and low SES), where in our study it may be possible that African-Americans reporting SES discrimination are attributing mistreatment to SES discrimination even when it could be at least partially due to racial discrimination. The considerably 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.

It is noteworthy that college educated African-Americans reported just as much SES-related discrimination as their less-educated counterparts, and more SES discrimination than college-educated Whites. While information on childhood SES was not available in this cohort, childhood SES may be an important factor to consider in the context of this study. 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[93]. 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[67,93] . SES during childhood could confound the association between reports of ever experiencing SES discrimination and sleep quality as evidence already suggests that childhood SES is associated with sleep outcomes[94].

Although interaction terms between race and SES discrimination were not significant in full, non-stratified models, given our descriptive findings among high-SES African-Americans we conducted exploratory regression models (Supplemental Tables 3,4,5) 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 was done because results from prior studies suggest that discrimination may have a stronger impact on health among higher-SES African-Americans[95,96]. Consistent with these prior studies, a significant effect for reports of SES discrimination on sleep quality emerged for high SES African-Americans in our cohort in exploratory analyses, although it was attenuated once depressive symptoms were controlled for (Supplemental Table 5). Otherwise, no consistent findings were observed in linear and logistic regression models stratified by SES for African-Americans and Whites separately.

This study had several 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[29]. The measurement of sleep quality, the outcome in our study, was also based on self-reports. Although there is evidence in the discrimination and sleep literature that both objective and subjective forms of sleep quality will provide similar results[31], the use of an

objective measure, such as polysomnography, or actigraphy is preferred. Secondly,, only 425 of the 753 participants in the second-stage of the study had information on reports of SES discrimination and subjective sleep quality. Although those with missing information were not significantly different from our analytic sample on most covariates, they were significantly more likely to report depressive symptoms. As a result, our analytic sample may have been slightly healthier than the overall sample. Third, the cross-sectional nature of our study limits the ability of causal inference of the effect of reports of experiences of SES discrimination on sleep quality. Finally, although the META-HEALTH study sample is population-based and consists of a cohort that is nearly half African-American, with a high prevalence of higher-SES African-Americans --a group that is historically known to have low participation in research[97], 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.

To our knowledge, this is the first epidemiological 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 experiences of SES discrimination were independently associated with reports of poor sleep quality in African-Americans, but not Whites. Although replication is needed, our findings expand upon the current discrimination and sleep literature by incorporating SES discrimination as a factor associated with adverse sleep quality independent of other forms of discrimination, such as gender and racial discrimination. In addition to the replication of our study, further examination of the association of reports of SES

discrimination and other health outcomes in diverse populations over time and with consideration of other forms of discrimination and psychosocial stressors, and work and living environment factors is warranted.

Our findings provide a potential intersection not largely researched between the established literature on SES as a determinant of health and the growing literature on discrimination and health. As the United States continues to strive to "create social and physical environments that promote good health for all" by 2020[98], reports of discrimination as it relates to socioeconomic status in the context of race may be an important psychosocial construct and SES-related stressor to consider in public health research and policy.

Chapter III. Public Health Implications, Possible Future Directions

As interactions and societal structures surrounding race and class in society continue to evolve, discrimination as a psychosocial stressor associated with health outcomes will most likely remain highly relevant. Although recent controversial cases, such as the Trayvon Martin case[99], the Eric Garner case[100], and the Michael Brown case[101] – all unarmed African-American men killed without penalty by police officers or other citizens who felt threatened-- brought great disruption and division to the U.S. population along racial lines, these controversies also highlighted for many the importance of discrimination and psychological stress based on race and SES. The ongoing public significance of these topics has brought them to the forefront of public health research and practice. Further, with the recent economic recession, housing market

crash, continuous constraints on the job market, and the growing problem of income inequality in the U.S., where some of these issues may be more salient for marginalized groups of the population[102], the inclusion of psychological stressors (i.e. SES discrimination) which can be shaped by the continuously changing social climate and economic environment in public health research, intervention, and policy is critically important.

Psychosocial experiences, such as experiences of discrimination, are believed to be an important contributor to the differential experiences of many of those impacted by disparate health outcomes in the United States. A continuous focus on improving health disparities by race and social class in the U.S. may prove to be effective in decreasing the growing costs of healthcare in the United States[102]. With the continuous commitment of the U.S. government and other organizations to addressing institutional discriminatory practices in housing, healthcare, and employment, which are all social constructs that influence health patterns, through policy, there is a further need to address other forms of discrimination, such as internalized and interpersonal discrimination. Public health research and interventions based on personally-mediated and internalized forms of discrimination are also needed.

Additionally, because most discrimination and health research has solely focused on racial and overall discrimination, there is a need for more research focused on other types of discrimination (i.e. SES-based, gender based, sexual orientation-based, weight-based, etc.) and the pathways and mechanisms (i.e. perceived stress, depressive symptoms, etc.) in which they impact health. It will be of particular importance to consider the role of these other types of discrimination in persons of different genders,

nationalities, sexual orientations, religious affiliations, class backgrounds, ages, and race/ethnicities. This type of research will allow for the identification of potential interventions (i.e. social support, counseling, etc.) that may be fundamental for mitigating adverse health effects associated with discrimination.

For SES- related discrimination in particular, the complexity of this specific type of discrimination in the context of race in the U.S. and the current lack of research examining SES discrimination and the effects of other SES-related stressors on health is of particular concern. It is quite possible that the importance of SES-related stressors as determinants of health may grow in the near future for the overall general population, although the magnitude of their importance will likely be determined by race. Future research examining social disadvantage and characteristics of place in relation to health should consider the role of SES discrimination as a potentially pervasive psychosocial stressor in the day to day lives of disadvantaged individuals. Prospective studies with racially and ethnically diverse, nationally representative samples with varying levels of socioeconomic status from different structural environments are warranted to help further examine the interplay between race, SES, SES discrimination, and health.

Tables

Table 1. META-HEALTH Participant Characteristics by Race

	African-American (n=215)	**Whites (n=210)**	***p*[a]**
Age	49.3 (9.6)	51.6 (9.4)	0.02
Female (%)	69.8	65.2	0.32
College education (%)	39.5	71.6	<.01
Experiences of discrimination			
Socioeconomic			
Ever (%)	52.1	31.9	<.01
Situation frequency	1.5 (2.0)	0.71 (1.4)	<.01
Racial			
Ever (%)	71.5	41.4	<.01
Situation frequency	2.6 (2.2)	0.8 (1.2)	<.01
Gender			
Ever (%)	56.1	56.2	0.98
Situation frequency	1.4 (1.6)	1.3 (1.5)	0.18
Depressive symptoms	6.7 (6.8)	6.5 (6.9)	0.63
BMI (kg/m^2)[b]	31.5 (8.1)	28.2 (6.6)	<.01
Perceived stress	21 (7.8)	20.4 (7.4)	0.55
Financial stress	1.5 (1.2)	0.85 (1.1)	<.01
Subjective sleep quality (PSQI)-continuous	6.3 (3.8)	5.1 (3.1)	0.01
Poor sleep quality (PSQI) - dichotomous (%)	62.8	49.1	0.01

Note. Values are mean with standard deviation in parentheses
[a]*p* values from T-Tests and Chi-square tests of racial differences
PSQI= Pittsburgh Sleep Quality Index
BMI= Body Mass Index
[b]BMI= weight (in kg)/height (in m^2)

Table 2a. Correlation Analyses in Whites in the META-HEALTH Study (N=205)

	BMI	Age	Depressive Symptoms	Financial Stress	Perceived Stress	SES Discrimination[a]	Racial Discrimination[a]	Gender Discrimination[a]	Subjective Sleep Quality
BMI	1	0.14	0.28***	0.18*	0.04	0.13	0.13	0.01	0.06
Age		1	0.05	-0.1	-0.08	0.05	0.06	0.08	0.05
Depressive Symptoms			1	0.27***	0.52***	0.24***	0.13	0.09	0.46***
Financial Stress				1	0.41***	0.36***	0.21**	0.22**	0.12
Perceived Stress					1	0.19**	0.12	0.13	0.28***
SES Discrimination[a]						1	0.58***	0.47***	0.20**
Racial Discrimination[a]							1	0.45***	0.18*
Gender Discrimination[a]								1	0.08
Subjective Sleep Quality									1

Note. [a]Discrimination is continuous and indicates number of settings and situations where type of discrimination is reported

P<0.05*

P<0.01**

P<0.001***

Table 2b. Correlation Analyses in African-Americans in the META-HEALTH Study (N=206)

	BMI	Age	Depressive Symptoms	Financial Stress	Perceived Stress	SES Discrimination[a]	Racial Discrimination[a]	Gender Discrimination[a]	Subjective Sleep Quality
BMI	1	0.01	0.16*	0.01	0.07	0.05	0.05	0.03	0.07
Age		1	-0.05	-0.01	-0.01	-0.02	0.01	0.04	-0.01
Depressive Symptoms			1	0.27***	0.46***	0.27***	0.18**	0.21**	0.42***
Financial Stress				1	0.34***	0.18**	0.13	0.22**	0.19**
Perceived Stress					1	0.25***	0.19**	0.25***	0.34***
SES Discrimination[a]						1	0.64***	0.57***	0.23**
Racial Discrimination[a]							1	0.60***	0.17*
Gender Discrimination[a]								1	0.16*
Subjective Sleep Quality									1

Note. [a]Discrimination is continuous and indicates number of settings and situations where type of discrimination is reported

P<0.05*

P<0.01**

P<0.001***

Table 3. Association of SES Discrimination and Subjective Sleep Quality by Race in the META-HEALTH Study using Linear Regression Models

Race-Stratified Models	African-American Participants			White Participants		
	PSQI	P-value	N	PSQI	P-value	N
	Estimate (SE)			Estimate (SE)		
Model 1						
SES Discrimination	1.57 (0.51)	0.0021	215	1.02 (0.46)	0.0283	210
Model 2						
SES Discrimination	1.58 (0.51)	0.0021	215	0.94 (0.46)	0.0435	208
Model 3						
SES Discrimination	1.46 (0.59)	0.0142	213	0.27 (0.50)	0.5938	208
Model 4						
SES Discrimination	1.49 (0.57)	0.0092	207	0.20 (0.51)	0.6985	205
Model 5						
SES Discrimination	1.04 (0.56)	0.0622	206	-0.21 (0.48)	0.6579	205

Model 1: SES Discrimination

Model 2: Model 1 + Age, Gender, and Education

Model 3: Model 2+ Gender and Race Discrimination

Model 4: Model 3+ BMI, Financial Stress and Perceived Stress

Model 5: Model 4+ Depressive Symptoms

Table 4. Association of SES Discrimination and Subjective Sleep Quality in African-Americans in the META-HEALTH Study: Full Adjusted Linear Regression Models

	African-Americans (N=206)	
	PSQI Beta-estimate (SE)	P-value
SES Discrimination	1.04 (0.56)	0.06
College	-0.07 (0.53)	0.90
Age	0.01 (0.025)	0.86
Gender	0.41 (0.53)	0.44
Racial Discrimination	0.04 (0.64)	0.95
Gender Discrimination	-0.32 (0.56)	0.57
BMI (kg/m^2)	-0.01 (0.03)	0.95
Perceived Stress	0.09 (0.04)	0.02
Financial Stress	0.09 (0.23)	0.71
Depressive Symptoms (BDI-II)	0.17 (0.04)	<.01

Table 5. Association of SES Discrimination and Poor Sleep Quality by Race in the META-HEALTH Study using Logistic Regression Models

Race-Stratified Models	African-American Participants				White Participants			
	PSQI				PSQI			
	OR	LL 95% CI	UL 95% CI	N	OR	LL 95% CI	UL 95% CI	N
Model 1								
SES Discrimination	2.37	1.35	4.18	215	1.11	0.62	1.97	210
Model 2								
SES Discrimination	2.39	1.35	4.24	215	1.03	0.57	1.87	208
Model 3								
SES Discrimination	2.68	1.38	5.19	213	0.77	0.40	1.50	208
Model 4								
SES Discrimination	2.68	1.34	5.37	207	0.76	0.37	1.55	205
Model 5								
SES Discrimination	2.32	1.14	4.72	206	0.60	0.28	1.29	205

Model 1: SES Discrimination

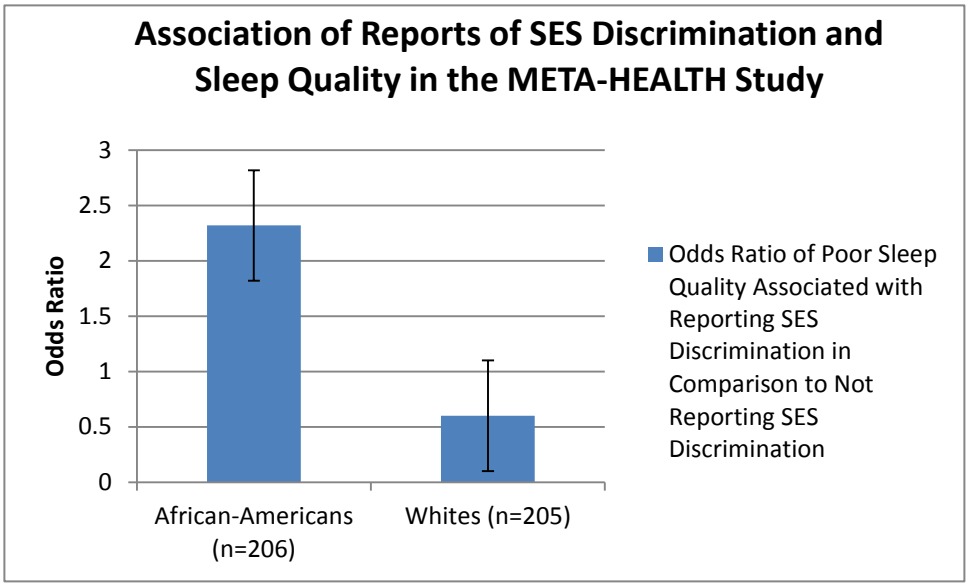
Model 2: Model 1 + Age, Gender, and Education

Model 3: Model 2+ Gender and Race Discrimination

Model 4: Model 3+ BMI, Financial Stress and Perceived Stress

Model 5: Model 4+ Depressive Symptoms

Figure 1. Fully Adjusted Association between SES Discrimination and Poor Sleep Quality in Logistic Regression Models for African-Americans and Whites in the META-HEALTH Study



Supplemental Tables

Supplemental Table 1. Situations and Settings of Reports of SES Discrimination by SES and Race in the META-HEALTH study.

Ever experienced SES discrimination (%)	High SES African-Americans (n=85)	High SES Whites (n=149)	P-value[a]	Low SES African-Americans (n=130)	Low SES Whites (n=59)	P-value[a]
At school	19	17	0.72	19	26	0.34
Getting a job	20	7	0.01	21	17	0.69
At work	25	11	0.01	23	10	0.05
Getting housing	19	5	0.02	22	10	0.07
Getting medical care	17	6	0.01	12	14	0.82
From police or in courts	18	2	<0.01	22	7	0.01
On street or in public setting	33	11	<0.01	32	19	0.08

[a]Fisher's exact test between races within SES strata with alpha=0.05

Supplemental Table 2. Situations and Settings of Reports of SES Discrimination by SES and Race in the META-HEALTH study.

Ever experienced SES discrimination (%)	Low SES African-Americans (n=130)	High SES African-Americans (n=85)	P-value[a]	Low SES Whites (n=59)	High SES Whites (n=149)	P-value[a]
At school	19	19	1.0	26	17	0.17
Getting a job	21	20	1.0	17	7	0.07
At work	23	25	0.87	10	11	1.0
Getting housing	22	19	0.61	10	5	0.23
Getting medical care	12	17	0.42	14	6	0.09
From police or in courts	22	18	0.60	7	2	0.11
On street or in public setting	32	33	0.88	19	11	0.17

[a]Fisher's exact test among between SES strata within races with alpha=0.05

Supplemental Table 3. META-HEALTH Participant Characteristics by Race and SES

	African-Americans		Whites	
	No College (n=130)	College (n=85)	No College (n=59)	College (n=149)
Age	50.4 (10.1)	47.6 (8.7)	52.6 (9.6)	51.1 (9.4)
Female (%)	66.9	74.1	66.1	65.8
Experiences of Discrimination				
Racial,%	67.7	77.4	45.8	38.9
Socioeconomic,%	51.5	52.9	35.6	30.9
Gender,%	50.8	64.3	55.9	56.4
Depressive symptoms	7.5 (7.2)	5.6 (6.2)	7.4 (6.6)	6.2 (7.0)
BMI[a] (kg/m^2)	31.9 (8.9)	30.8 (6.8)	29.8 (7.8)	27.4 (6.0)
Perceived stress	22.1 (8.5)	19.3 (6.4)	21.3 (7.4)	20.2 (7.4)
Financial stress	1.8 (1.1)	1.1 (1.1)	1.0 (1.2)	0.8 (1.1)
Subjective sleep quality (PSQI)	6.5 (3.9)	5.8 (3.6)	5.7 (3.3)	5.0 (3.0)
Poor sleep quality (PSQI) - dichotomous (%)	66.9	56.5	62.7	44.3

Note. Values are mean with standard deviation in parentheses
PSQI= Pittsburgh Sleep Quality Index
BMI= Body Mass Index
[a]BMI= weight (in kg)/height (in m^2)

Supplemental Table 4. Association of SES Discrimination and Subjective Sleep Quality by SES and Race in the META-HEALTH Study using Linear Regression Models

	High SES African-Americans			Low SES African-Americans			High SES Whites			Low SES Whites		
	PSQI			PSQI			PSQI			PSQI		
	Estimate (SE)	P-Value	N	Estimate (SE)	P-Value	N	Estimate (SE)	P-Value	N	Estimate (SE)	P-Value	N
Model 1												
SES Discrimination	2.12 (0.74)	0.01	85	1.23 (0.67)	0.07	130	0.92 (0.54)	0.09	149	1.02 (0.91)	0.27	59
Model 2												
SES Discrimination	2.06 (0.76)	0.01	85	1.25 (0.69)	0.07	130	0.91 (0.54)	0.09	149	0.85 (0.90)	0.35	59
Model 3												
SES Discrimination	2.13 (0.91)	0.02	83	1.08 (0.80)	0.18	130	0.42 (0.57)	0.46	149	-0.03 (1.13)	0.98	59
Model 4												
SES Discrimination	1.66 (0.90)	0.07	83	1.42 (0.77)	0.07	124	0.26 (0.56)	0.65	146	0.38 (1.12)	0.75	59
Model 5												
SES Discrimination	0.92 (0.85)	0.28	82	1.05 (0.76)	0.17	124	-0.14 (0.54)	0.80	146	-0.05(1.12)	0.97	59

Model 1: SES Discrimination
Model 2: Model 1 + Age and Gender
Model 3: Model 2+ Gender and Race Discrimination
Model 4: Model 3+ BMI, Financial Stress and Perceived Stress
Model 5: Model 4+ Depressive Symptoms

Supplemental Table 5. Association of SES Discrimination and Poor Sleep Quality by SES and Race in the META-HEALTH Study using Logistic Regression Models

	High SES African-Americans				Low SES African-Americans				High SES Whites				Low SES Whites			
	PSQI				PSQI				PSQI				PSQI			
	OR	LL 95% CI	UL 95% CI	N	OR	LL 95% CI	UL 95% CI	N	OR	LL 95% CI	UL 95% CI	N	OR	LL 95% CI	UL 95% CI	N
Model 1																
SES Discrimination	3.00	1.23	7.30	85	2.07	0.98	4.35	130	1.23	0.61	2.47	149	0.69	0.23	2.07	59
Model 2																
SES Discrimination	3.07	1.23	7.62	85	2.02	0.95	4.29	130	1.24	0.62	2.50	149	0.64	0.20	2.04	59
Model 3																
SES Discrimination	3.94	1.32	11.78	83	2.22	0.94	5.27	130	1.02	0.48	2.17	149	0.28	0.05	1.15	59
Model 4																
SES Discrimination	3.57	1.17	10.91	83	2.54	1.00	6.45	124	1.01	0.45	2.28	146	0.25	0.04	1.52	59
Model 5																
SES Discrimination	2.82	0.90	8.84	82	2.27	0.87	5.90	124	0.85	0.36	2.01	146	0.18	0.03	1.32	59

Model 1: SES Discrimination
Model 2: Model 1 + Age and Gender
Model 3: Model 2+ Gender and Race Discrimination
Model 4: Model 3+ BMI, Financial Stress and Perceived Stress
Model 5: Model 4+ Depressive Symptoms

References

1. Prevention CfDCa. Insufficient Sleep is a Public Health Epidemic. Web site. http://www.cdc.gov/features/dssleep/. Published Updated.
2. Prevention CfDCa. *Unhealthy Sleep-Related Behaviors-12 States, 2009*2011.
3. US Department of Transportation NHTSA, National Center on Sleep Disorders Research, National Heart Lung and Blood Institute. Drowsy driving and automobile crashes. Web site. http://www.nhtsa.gov/people/injury/drowsy_driving1/Drowsy.html. Published Updated Accessed April 6, 2015.
4. Connor J, Norton R, Ameratunga S, et al. Driver sleepiness and risk of serious injury to car occupants: population based case control study. *BMJ.* May 2002;324(7346):1125.
5. Cappuccio FP, D'Elia L, Strazzullo P, Miller MA. Sleep duration and all-cause mortality: a systematic review and meta-analysis of prospective studies. *Sleep.* May 2010;33(5):585-592.
6. Patel SR, Ayas NT, Malhotra MR, et al. A prospective study of sleep duration and mortality risk in women. *Sleep.* May 2004;27(3):440-444.
7. Gallicchio L, Kalesan B. Sleep duration and mortality: a systematic review and meta-analysis. *J Sleep Res.* Jun 2009;18(2):148-158.
8. Kripke DF, Garfinkel L, Wingard DL, Klauber MR, Marler MR. Mortality associated with sleep duration and insomnia. *Arch Gen Psychiatry.* Feb 2002;59(2):131-136.
9. Moore PJ, Adler NE, Williams DR, Jackson JS. Socioeconomic status and health: the role of sleep. *Psychosom Med.* 2002 Mar-Apr 2002;64(2):337-344.
10. Jean-Louis G, Williams NJ, Sarpong D, et al. Associations between inadequate sleep and obesity in the US adult population: analysis of the national health interview survey (1977-2009). *BMC Public Health.* Mar 2014;14(1):290.
11. Buxton OM, Marcelli E. Short and long sleep are positively associated with obesity, diabetes, hypertension, and cardiovascular disease among adults in the United States. *Soc Sci Med.* Sep 2010;71(5):1027-1036.
12. Qureshi AI, Giles WH, Croft JB, Bliwise DL. Habitual sleep patterns and risk for stroke and coronary heart disease: a 10-year follow-up from NHANES I. *Neurology.* Apr 1997;48(4):904-911.
13. Ayas NT, White DP, Al-Delaimy WK, et al. A prospective study of self-reported sleep duration and incident diabetes in women. *Diabetes Care.* Feb 2003;26(2):380-384.
14. Marshall NS, Wong KK, Cullen SR, Knuiman MW, Grunstein RR. 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.* Apr 2014;10(4):355-362.
15. Sands-Lincoln M, Grandner M, Whinnery J, Keenan BT, Jackson N, Gurubhagavatula I. The association between obstructive sleep apnea and hypertension by race/ethnicity in a nationally representative sample. *J Clin Hypertens (Greenwich).* Aug 2013;15(8):593-599.
16. Gottlieb DJ, Redline S, Nieto FJ, et al. Association of usual sleep duration with hypertension: the Sleep Heart Health Study. *Sleep.* Aug 2006;29(8):1009-1014.
17. Ayas NT, White DP, Manson JE, et al. A prospective study of sleep duration and coronary heart disease in women. *Arch Intern Med.* Jan 2003;163(2):205-209.

18. Jackson CL, Redline S, Emmons KM. Sleep as a potential fundamental contributor to disparities in cardiovascular health. *Annu Rev Public Health.* Mar 2015;36:417-440.

19. Ford DE, Cooper-Patrick L. Sleep disturbances and mood disorders: an epidemiologic perspective. *Depress Anxiety.* 2001;14(1):3-6.

20. Petrov M, Lichstein K. Difference between sleep in black and white adults: an update and future directions. *Sleep Medicine.* 2015.

21. Hall M, Buysse DJ, Nofzinger EA, et al. Financial strain is a significant correlate of sleep continuity disturbances in late-life. *Biol Psychol.* Feb 2008;77(2):217-222.

22. Friedman EM, Love GD, Rosenkranz MA, et al. Socioeconomic status predicts objective and subjective sleep quality in aging women. *Psychosom Med.* 2007 Sep-Oct 2007;69(7):682-691.

23. Patel NP, Grandner MA, Xie D, Branas CC, Gooneratne N. "Sleep disparity" in the population: poor sleep quality is strongly associated with poverty and ethnicity. *BMC Public Health.* 2010;10:475.

24. Braveman PA, Heck K, Egerter S, et al. The Role of Socioeconomic Factors in Black-White Disparities in Preterm Birth. *Am J Public Health.* Sep 2014:e1-e9.

25. Braveman P. The question is not: "is race or class more important?". *J Epidemiol Community Health.* Dec 2005;59(12):1029.

26. Jackson CL, Redline S, Kawachi I, Williams MA, Hu FB. Racial disparities in short sleep duration by occupation and industry. *Am J Epidemiol.* Nov 2013;178(9):1442-1451.

27. Merriam-Webster. Discrimination. Web site. http://www.merriam-webster.com/dictionary/discrimination. Published 2015. Updated.

28. Lewis TT, Williams DR, Tamene M, Clark CR. Self-Reported Experiences of Discrimination and Cardiovascular Disease. *Curr Cardiovasc Risk Rep.* Jan 2014;8(1):365.

29. Lewis TT, Cogburn CD, Williams DR. Self-Reported Experiences of Discrimination and Health: Scientific Advances, Ongoing Controversies, and Emerging Issues. *Annu Rev Clin Psychol.* Jan 2015.

30. Gangwisch JE, Malaspina D, Boden-Albala B, Heymsfield SB. Inadequate sleep as a risk factor for obesity: analyses of the NHANES I. *Sleep.* Oct 2005;28(10):1289-1296.

31. Lewis TT, Troxel WM, Kravitz HM, Bromberger JT, Matthews KA, Hall MH. Chronic exposure to everyday discrimination and sleep in a multiethnic sample of middle-aged women. *Health Psychol.* Jul 2013;32(7):810-819.

32. Grandner MA, Hale L, Jackson N, Patel NP, Gooneratne NS, Troxel WM. Perceived racial discrimination as an independent predictor of sleep disturbance and daytime fatigue. *Behav Sleep Med.* Oct 2012;10(4):235-249.

33. Slopen N, Williams DR. Discrimination, other psychosocial stressors, and self-reported sleep duration and difficulties. *Sleep.* Jan 2014;37(1):147-156.

34. Slopen N, Lewis TT, Williams DR. Discrimination and sleep: a systematic review. *Sleep Med.* Jan 2015.

35. Adler NE, Boyce T, Chesney MA, et al. Socioeconomic status and health. The challenge of the gradient. *Am Psychol.* Jan 1994;49(1):15-24.

36. Watch HR. *Submission to the Committee on the Elimination of Racial Discrimination: During its Consideration of the Seventh to Ninth Periodic Reports of the United States of America: CERD 85th Session*2014.

37. Feagin J, Bennefield Z. Systemic racism and U.S. health care. *Soc Sci Med.* Feb 2014;103:7-14.

38. Williams DR, Jackson PB. Social sources of racial disparities in health. *Health Aff (Millwood).* 2005 Mar-Apr 2005;24(2):325-334.

39. Farkas G. Racial Disparities and Discrimination in Education: What do we know, how do we know it, and what do we need to know? *Teacher's College Record.* 2003;105(6):1119-1146.

40. Center PR. Black Unemployment rate is consistently twice that of Whites. Web site. http://www.pewresearch.org/fact-tank/2013/08/21/through-good-times-and-bad-black-unemployment-is-consistently-double-that-of-whites/. Published 2013. Updated.

41. Adler NE, Newman K. Socioeconomic disparities in health: pathways and policies. *Health Aff (Millwood).* 2002 Mar-Apr 2002;21(2):60-76.

42. Becker G. *The Economics of Discrimination*: University of Chicago Press; 2010.

43. Molina LE, Phillips NL, Sidanius J. National and Ethnic Identity in the Face of Discrimination: Ethnic Minority and Majority Perspectives. *Cultur Divers Ethnic Minor Psychol.* Sep 2014.

44. Sennett R, Cobb J. The Hidden Injuries of Class: W. W. Norton & Company; 1972.

45. Pascoe EA, Smart Richman L. Perceived discrimination and health: a meta-analytic review. *Psychol Bull.* Jul 2009;135(4):531-554.

46. Clark R, Anderson NB, Clark VR, Williams DR. Racism as a stressor for African Americans. A biopsychosocial model. *Am Psychol.* Oct 1999;54(10):805-816.

47. Lewis TT, Aiello AE, Leurgans S, Kelly J, Barnes LL. Self-reported experiences of everyday discrimination are associated with elevated C-reactive protein levels in older African-American adults. *Brain Behav Immun.* Mar 2010;24(3):438-443.

48. Din-Dzietham R, Nembhard WN, Collins R, Davis SK. Perceived stress following race-based discrimination at work is associated with hypertension in African-Americans. The metro Atlanta heart disease study, 1999-2001. *Soc Sci Med.* Feb 2004;58(3):449-461.

49. Taylor TR, Williams CD, Makambi KH, et al. Racial discrimination and breast cancer incidence in US Black women: the Black Women's Health Study. *Am J Epidemiol.* Jul 2007;166(1):46-54.

50. Schulz AJ, Gravlee CC, Williams DR, Israel BA, Mentz G, Rowe Z. Discrimination, symptoms of depression, and self-rated health among african american women in detroit: results from a longitudinal analysis. *Am J Public Health.* Jul 2006;96(7):1265-1270.

51. Williams DR, Neighbors H. Racism, discrimination and hypertension: evidence and needed research. *Ethn Dis.* 2001;11(4):800-816.

52. Hunte HE. Association between perceived interpersonal everyday discrimination and waist circumference over a 9-year period in the Midlife Development in the United States cohort study. *Am J Epidemiol.* Jun 2011;173(11):1232-1239.

53. Lewis TT, Kravitz HM, Janssen I, Powell LH. Self-reported experiences of discrimination and visceral fat in middle-aged African-American and Caucasian women. *Am J Epidemiol.* Jun 2011;173(11):1223-1231.

54. Medicine Io. *Living Well with Chronic Illness*2012.

55. Feinstein JS. The relationship between socioeconomic status and health: a review of the literature. *Milbank Q.* 1993;71(2):279-322.

56. Adler NE, Stewart J. Preface to the biology of disadvantage: socioeconomic status and health. *Ann N Y Acad Sci.* Feb 2010;1186:1-4.

57. Office CB. Trends in the Distribution of Household Income

Between 1979 and 20072011.

58. McKernan S-M, Ratcliffe C, Steuerle CE, Zhang S. Less than Equal: Racial Disparities in Wealth Accumulation2013.

59. Williams DR, Mohammed SA. Discrimination and racial disparities in health: evidence and needed research. *J Behav Med.* Feb 2009;32(1):20-47.

60. Lewis TT, Everson-Rose SA, Sternfeld B, Karavolos K, Wesley D, Powell LH. Race, education, and weight change in a biracial sample of women at midlife. *Arch Intern Med.* Mar 2005;165(5):545-551.

61. Fuller-Rowell TE, Curtis DS, Doan SN, Coe CL. Racial disparities in the health benefits of educational attainment: a study of inflammatory trajectories among African American and white adults. *Psychosom Med.* Jan 2015;77(1):33-40.

62. Braveman P, Cubbin C, Marchi K, Egerter S, Chavez G. Measuring socioeconomic status/position in studies of racial/ethnic disparities: maternal and infant health. *Public Health Rep.* 2001 Sep-Oct 2001;116(5):449-463.

63. Braveman PA, Cubbin C, Egerter S, et al. Socioeconomic status in health research: one size does not fit all. *JAMA.* Dec 2005;294(22):2879-2888.

64. LaVeist TA. Disentangling race and socioeconomic status: a key to understanding health inequalities. *J Urban Health.* Jun 2005;82(2 Suppl 3):iii26-34.

65. Myers HF. Ethnicity- and socio-economic status-related stresses in context: an integrative review and conceptual model. *J Behav Med.* Feb 2009;32(1):9-19.

66. Keene DE, Lynch JF, Baker AC. Fragile health and fragile wealth: mortgage strain among African American homeowners. *Soc Sci Med.* Oct 2014;118:119-126.

67. Hardaway CR, McLoyd VC. 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.* Feb 2009;38(2):242-256.

68. Ren XS, Amick BC, Williams DR. Racial/ethnic disparities in health: the interplay between discrimination and socioeconomic status. *Ethn Dis.* 1999 Spring-Summer 1999;9(2):151-165.

69. Chen X, Wang R, Zee P, et al. Racial/Ethnic Differences in Sleep Disturbances: The Multi-Ethnic Study of Atherosclerosis (MESA). *Sleep.* Nov 2014.

70. Piccolo RS, Yang M, Bliwise DL, Yaggi HK, Araujo AB. Racial and socioeconomic disparities in sleep and chronic disease: results of a longitudinal investigation. *Ethn Dis.* 2013;23(4):499-507.

71. Lichstein K, Durrence HH, Riedel B, Taylor D, Bush A. *Epidemiology of Sleep: Age, Gender, and Ethnicity*. New Jersey, United States2004.

72. Thomas KS, Bardwell WA, Ancoli-Israel S, Dimsdale JE. The toll of ethnic discrimination on sleep architecture and fatigue. *Health Psychol.* Sep 2006;25(5):635-642.

73. Tomfohr L, Pung MA, Edwards KM, Dimsdale JE. Racial differences in sleep architecture: the role of ethnic discrimination. *Biol Psychol.* Jan 2012;89(1):34-38.

74. Lauderdale DS, Knutson KL, Yan LL, et al. Objectively measured sleep characteristics among early-middle-aged adults: the CARDIA study. *Am J Epidemiol.* Jul 2006;164(1):5-16.

75. Krieger N, Smith K, Naishadham D, Hartman C, Barbeau EM. Experiences of discrimination: validity and reliability of a self-report measure for population health research on racism and health. *Soc Sci Med.* Oct 2005;61(7):1576-1596.

76. Krieger N, Kosheleva A, Waterman PD, Chen JT, Koenen K. Racial discrimination, psychological distress, and self-rated health among US-born and foreign-born Black Americans. *Am J Public Health.* Sep 2011;101(9):1704-1713.

77. Dailey AB, Kasl SV, Holford TR, Lewis TT, Jones BA. Neighborhood- and individual-level socioeconomic variation in perceptions of racial discrimination. *Ethn Health.* Apr 2010;15(2):145-163.

78. Hunte HE, Williams DR. The association between perceived discrimination and obesity in a population-based multiracial and multiethnic adult sample. *Am J Public Health.* Jul 2009;99(7):1285-1292.

79. Buysse DJ, Reynolds CF, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res.* May 1989;28(2):193-213.

80. Backhaus J, Junghanns K, Broocks A, Riemann D, Hohagen F. Test-retest reliability and validity of the Pittsburgh Sleep Quality Index in primary insomnia. *J Psychosom Res.* Sep 2002;53(3):737-740.

81. Krieger N, Williams DR, Moss NE. Measuring social class in US public health research: concepts, methodologies, and guidelines. *Annu Rev Public Health.* 1997;18:341-378.

82. Hall MH, Matthews KA, Kravitz HM, et al. Race and financial strain are independent correlates of sleep in midlife women: the SWAN sleep study. *Sleep.* Jan 2009;32(1):73-82.

83. BECK AT, WARD CH, MENDELSON M, MOCK J, ERBAUGH J. An inventory for measuring depression. *Arch Gen Psychiatry.* Jun 1961;4:561-571.

84. Richter P, Werner J, Heerlein A, Kraus A, Sauer H. On the validity of the Beck Depression Inventory. A review. *Psychopathology.* 1998;31(3):160-168.

85. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav.* Dec 1983;24(4):385-396.

86. Szanton SL, Allen JK, Thorpe RJ, Seeman T, Bandeen-Roche K, Fried LP. Effect of financial strain on mortality in community-dwelling older women. *J Gerontol B Psychol Sci Soc Sci.* Nov 2008;63(6):S369-374.

87. Jackson P, Williams D. *The Intersection of Race, Gender, and SES: : health paradoxes. In Gender, Race, Class, & Health: Intersectional Approaches*. San Francisco, CA: Jossey-Bass.

88. Feagin J, Sikes M. *Living with Racism. The Black Middle-Class Experience*: Beacon Press Books; 1994.

89. Cose E. *The Rage of a Privileged Class.*: Harper Collins; 1993.

90. Wilson WJ. The Declining Significance of Race: Revisited & Revised. Vol 1402011:55-69.

91. Sakamoto A, Wu HH, Tzeng JM. The declining significance of race among American men during the latter half of the twentieth century. *Demography.* Feb 2000;37(1):41-51.

92. Levin S, Sinclair S, Veniegas RC, Taylor PL. Perceived discrimination in the context of multiple group memberships. *Psychol Sci.* Nov 2002;13(6):557-560.

93. Heflin CM, Patillo M. Poverty in the family: Race, Siblings, and Socioeconomic Heterogeneity. *Social Science Research.* 2006;35(4):804-822.

94. Tomfohr LM, Ancoli-Israel S, Dimsdale JE. Childhood socioeconomic status and race are associated with adult sleep. *Behav Sleep Med.* 2010;8(4):219-230.

95. Fuller-Rowell TE, Doan SN, Eccles JS. Differential effects of perceived discrimination on the diurnal cortisol rhythm of African Americans and Whites. *Psychoneuroendocrinology.* Jan 2012;37(1):107-118.

96. Krieger N, Sidney S. Racial discrimination and blood pressure: the CARDIA Study of young black and white adults. *Am J Public Health.* Oct 1996;86(10):1370-1378.

97. Rencher WC, Wolf LE. Redressing past wrongs: changing the common rule to increase minority voices in research. *Am J Public Health.* Dec 2013;103(12):2136-2140.

98. Promotion OoDPaH. Healthy People 2020: Social Determinants of Health. Web site. http://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-health. Published Updated.

99. CNN. Trayvon Martin Shoot Fast Facts. Web site. http://www.cnn.com/2013/06/05/us/trayvon-martin-shooting-fast-facts/. Published Updated Accessed April 7, 2015.

100. CNN. Officer in Eric Garner case: I never used chokehold. Web site. http://www.cnn.com/2014/12/10/justice/new-york-pantaleo-nypd-interview/. Published Updated Accessed April 7, 2015.

101. CNN. What happened when Michael met Officer Darren Wilson. Web site. http://www.cnn.com/interactive/2014/08/us/ferguson-brown-timeline/. Published Updated Accessed April 7, 2015.

102. Services USDoHaH. *HHS Action Plan to Reduce Racial and Health Disparities*.