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Relationships between allostatic load, unhealthy behaviors, and depressive disorder in U.S. adults, 2005–2012 NHANES

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ABSTRACT

Unhealthy behaviors may modify relationships between chronic stress and depression among diverse older adults. We analyzed nationally representative cross-sectional data from participants aged 40–79 years of the 2005–2012 National Health and Nutrition Examination Survey. Unhealthy behaviors included current smoking, excessive/binge drinking, insufficient physical activity, and fair/poor diet. Allostatic load was defined by 10 biomarkers indicating the cumulative physiologic burden of stress. Depressive disorder was assessed using the Patient Health Questionnaire. Multivariable logistic regression examined whether current smoking, excessive/binge drinking, insufficient physical activitiy, and fair/poor diet modified relationships between allostatic load and depressive disorder. Mean age of 12,272 participants was 55.6 years (standard error = 0.19), 51.9% were women, and most had at least a high school education (81.8%). Latinos (11.3%) and African Americans (10.4%) were more likely than Whites (7.1%; $p < 0.001$) to meet depressive disorder criteria. Allostatic load was not associated independently with depressive disorder in any racial/ethnic group and this lack of a relationship did not differ by the extent of unhealthy behaviors. Although Latinos and African Americans report higher levels of depression than Whites, physiological markers of stress do not appear to explain these differences.

1. Introduction

One of the most significant factors that has a longitudinal effect on depression is chronic stress during adulthood (Hammen, 2005; Paykel, 2003). This effect may be exacerbated among racial/ethnic minority adults, as their mental health may suffer due to stress experienced from inequalities in social and economic opportunities as well as environmental conditions.

The prevalence of major depression differs by race/ethnicity. While 4.2–5.6% of African Americans and 3.9–5.3% of Whites report experiencing major depression in the past 12 months, Latinos are affected by major depression at a higher rate (7.9–8.6%) (González et al., 2010; Jimenez et al., 2010). Understanding of the effects of social, economic, and environmental stressors on racial/ethnic health disparities is growing, but remains limited.

The leading behavioral causes of preventable death and disability differ by race/ethnicity (Mokdad et al., 2004). African Americans and Whites are most likely to smoke (Jamal et al., 2016). Obesity is more common among African Americans and Latinos than Whites (Pan et al., 2009). African Americans and Latinos are more likely to drink heavily or in a binge pattern, although alcohol use is most prevalent among Whites (Chartier and Caetano, 2010).

These unhealthy behaviors may influence the relationship between chronic stress and depression (Jackson et al., 2010; Rodriquez et al., 2016). Relationships between substance use or consumption of unhealthy foods and chronic stress have been explained partially by physiological mechanisms (Dallman et al., 2003; Koob et al., 1998; Piazza and Le Moal, 1998; Wadsworth, 2015). Also, chronic stress has been shown to negatively affect levels of physical activity (Lutz et al., 2007).

Jackson and colleagues observed that as chronic stress increased, African Americans who engaged in unhealthy behaviors partially

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avoided a future episode of major depression (Jackson et al., 2010). Other research has shown that among Latino older adults, as chronic stress increased those who engaged in more unhealthy behaviors were more likely to experience significant depressive symptoms in the future. (Rodriquez et al., 2016) A theoretical framework, named the Environmental Affordances model, has been proposed as an explanation of how chronic stress and risk behaviors may interact to affect health.(Mezuk et al., 2013) This framework postulates that engaging in unhealthy behaviors attenuates the effects of stress on depression among African Americans. However, variability in the effects of unhealthy behaviors by race/ethnicity warrants further investigation to understand the biological mechanisms that link chronic stress, unhealthy behaviors, and depression.

Allostatic load has been proposed as a measure of chronic stress using biological indicators and has been found to be associated with mental and physical well-being and all-cause mortality (Schulz et al., 2012; Seeman et al., 1997). Although allostatic load may vary by factors such as age, abdominal fat, and medication use, allostatic load stabilizes in later life and abdominal fat, as well as medication use, is accounted for in the final score (BS, 2000; Geronimus et al., 2006). In the present study, we used data from the National Health and Nutrition Examination Survey (NHANES) to assess whether unhealthy behaviors moderated the relationship between allostatic load and being at-risk for depressive disorder by racial/ethnic group. We hypothesized that engaging in a greater number of unhealthy behaviors (a) attenuated the relationship between allostatic load and being at-risk for depressive disorder for African Americans compared with Whites and (b) amplified the relationship between allostatic load and being at-risk for depressive disorder for Latinos compared with Whites.

2. Methods

2.1. National Health and Nutrition Examination Survey

Data on adult participants aged 40–79 years from four cross-sectional waves of NHANES, 2005–2012, were analyzed in 2016 (Centers for Disease Control and Prevention (CDC) and National Center for Health Statistics (NCHS), n.d.). Older adults were assessed in order to capture the effects of chronic stress over the life course on physiologic markers. NHANES collects data from a nationally representative sample employing a stratified, multistage probability design to assess the health and nutritional status of the U.S. population. Interview data were collected in participants' homes while supplemental health data from physical examinations and blood samples for laboratory testing were collected in mobile examination centers. The number of persons surveyed each year from 2005 to 2012 ranged between 2564 and 3529. Because only publicly available data from NHANES were analyzed and are not considered to involve human subjects, our investigation did not necessitate review by an Institutional Review Board.

2.2. Demographic characteristics

Age, gender, highest level of education (less than high school, high school graduate or equivalent, some college or an associate degree, or college graduate or higher), and race/ethnicity were assessed by self-report in all survey years. Racial/ethnic groups included participants who identified as African American or Black, Latino or Hispanic, and White.

2.3. Depressive disorder

Depressive disorder was assessed using the Patient Health Questionnaire (PHQ-9) (Kroenke et al., 2001). Items asked about the following problems experienced in the last two weeks: little interest or pleasure in doing things; feeling down, depressed, or hopeless; trouble falling or staying asleep – or sleeping too much; feeling tired or having little energy; poor appetite or overeating; feeling bad about yourself – or that you are a failure or have let yourself or your family down; trouble concentrating on things; moving or speaking so slowly that other people could have noticed – or the opposite, being so fidgety or restless that you have been moving around a lot more than usual; and thoughts that you would be better off dead or of hurting yourself in some way. Each PHQ-9 item was scored via ordered response options corresponding to how often the participant had been bothered by each problem during the prior two weeks: not at all (0), several days (1), more than half the days (2), and nearly every day (3). Scores were summed and an indicator variable representing being at-risk for depressive disorder was created with a cut point score of ≥ 10 (Manea et al., 2012).

2.4. Biomarkers of stress and allostatic load

To determine allostatic load, we used ten biological indicators which represent cardiometabolic risk, glucose metabolism, cardiopulmonary functioning, parasympathetic functioning, and inflammation and have been used in past research using NHANES data (Beckie, 2012). These biomarkers included systolic blood pressure, diastolic blood pressure, body mass index (BMI), glycohemoglobin, total cholesterol, high-density lipoprotein (HDL) cholesterol, total/HDL cholesterol ratio, C-reactive protein, albumin, and creatinine clearance.

Allostatic load was calculated as an index of physiologic dysregulation for each participant with each indicator defined as high-, moderate-, or low-risk categories. The following clinically-relevant cut-points were used, respectively: systolic blood pressure: ≥ 150 mmHg, 120 to < 150 mmHg, and < 120 mmHg; diastolic blood pressure: ≥ 90 mmHg, 80 to < 90 mmHg, and < 80 mmHg; body mass index (BMI): ≥ 30 kg/m^3, 25 to < 30 kg/m^3, and 18 to < 25 kg/m^3; glycohemoglobin: $\geq 6.5\%$, 5.7% to $< 6.5\%$, and $< 5.7\%$; total cholesterol: ≥ 240 mg/dL, 200 to < 240 mg/dL, and < 200 mg/dL; HDL cholesterol: < 40 mg/dL, 40 to < 60 mg/dL, and ≥ 60 mg/dL; total/HDL cholesterol ratio: ≥ 6, 5 to < 6, and < 5; C-reactive protein: ≥ 3 mg/L, 1 to < 3 mg/L, and < 1 mg/L; albumin: < 3.0 μg/mL, 3.0 to < 3.8 μg/mL, and ≥ 3.8 μg/mL; and creatinine clearance: < 30 mL/min/1.73 m^2, 30 to < 60 mL/min/1.73 m^2, and ≥ 60 mL/min/1.73 m^2. The highest risk categories for HDL cholesterol, albumin, and creatinine clearance were the categories with the lowest values for each biomarker.

Allostatic load was calculated by assigning one point for the high-risk category, a half point for moderate-risk, and zero points for low-risk. Following previous research, a half point was added to the allostatic load score of participants who reported taking medication for hypertension, diabetes, and/or cholesterol and who had a low-risk value for blood pressure, glycohemoglobin, or lipids (Geronimus et al., 2006). The maximum possible allostatic load score was 10 points.

2.5. Unhealthy behaviors

We assessed the following four unhealthy behaviors: (a) current smoking, (b) excessive and/or binge drinking, (c) not meeting recommendations for moderate or vigorous physical activity per week, and (d) fair or poor overall diet. Current smoking was identified by assessing serum cotinine, a major metabolite of nicotine. Methods for measuring serum cotinine, processing and editing of cotinine data, and laboratory quality assurance and monitoring are documented on the NHANES website (Centers for Disease Control and Prevention (CDC) and National Center for Health Statistics (NCHS), n.d.). The following cut points for serum cotinine were used to determine current smoking: ≥ 5.92 ng/mL for African Americans, ≥ 0.84 ng/mL for Latinos, and ≥ 4.85 ng/mL for Whites (Benowitz et al., 2009).

Participants were asked if they had at least 12 drinks of any type of alcoholic beverage, such as liquor, beer, wine, wine coolers, and others, in any one year or in their lifetime. Among those who responded 'yes', excessive drinking was determined using established criteria: (a) for