



## Association of psychosocial stressors with metabolic syndrome severity among African Americans in the Jackson Heart Study

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### ABSTRACT

**Introduction:** Using Jackson Heart Study (JHS) data, we assessed the association between perceived psychosocial stressors and metabolic syndrome (MetS) severity in African American adults.

**Methods:** Participants included 3870 African American JHS participants aged 21–95 years (63.1% women; mean age 53.8 ± 13.0). Psychosocial stressors assessed included: major life events (MLEs); global stress; and weekly stress inventory. Each stress measure was classified into tertiles (low, medium, and high). Associations of psychosocial stressors with a sex- and race/ethnic-specific MetS severity Z-score were examined after adjustment for demographics and MetS risk factors (i.e., nutrition, physical activity, smoking status, and alcohol consumption). **Results:** Independent of lifestyle factors, participants who reported high (versus low) perceived global stress and MLEs had significantly greater MetS severity ( $p = .0207$  and  $p = .0105$ , respectively). Weekly stress was not associated with MetS severity. Compared to men, women reported significantly higher global stress and MLEs ( $p < 0.0001$ ). A significant interaction between sex and MLEs ( $p = .0456$ ) demonstrated men significantly increased their MetS severity at medium levels of stress, whereas women's MetS severity was significantly increased at high levels of MLEs.

**Conclusions:** In the total sample, higher reported global stress and MLEs were associated with increased risk of MetS severity, while weekly stress was not. Men's and women's stress responses to MLEs were differentially associated with MetS severity, with male MetS severity increasing significantly at lower levels of MLEs relative to women's MetS severity. These data may have implications for targeting stress-related factors in interventions to improve cardiometabolic health in African American adults.

### 1. Introduction

Metabolic syndrome (MetS) is a risk factor for the development of cardiovascular disease (CVD) and type 2 diabetes. Individuals with MetS are twice as likely to develop CVD (Gami et al., 2007; Mottillo et al., 2010) and up to 5 times more likely to develop type 2 diabetes (Ford et al., 2008). Common features of MetS include abdominal adiposity, hypertension, hyperglycemia, and dyslipidemia (Grundy et al., 2005a). In 2012, a nationally representative sample demonstrated the prevalence of MetS in the U.S. was 34.7%, with slightly higher rates among African Americans (AA; 35.5%) than the general population (Aguilar et al., 2015). These rates are consistent with previously published MetS prevalence in the Jackson Heart Study (JHS)

with 28.3–36.4% of participants having MetS (Gurka et al., 2016).

While development of MetS is attributed to known risk factors (e.g., poor diet, physical inactivity, smoking, low education) (Cameron et al., 2004; Irwin et al., 2002), adverse psychosocial factors may also contribute to MetS development and severity. Previously published JHS work indicated AA women with depression had worse MetS severity over an 8-year period relative to AA women who were not depressed (Gurka et al., 2016). Additionally, chronic stress has been identified as a possible risk factor for MetS, as it has been posited that psychosocial stress and neuroendocrine activation exert causal effects on MetS development (Björntorp, 1996; Hjendahl, 2002; Kaur, 2014; Rosmond, 2005). For example, the “Björntorp hypothesis” states that chronic stress can activate the HPA axis, which increases cortisol levels leading

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to an increase in visceral fat deposition, which in turn promotes development of MetS (Björntorp, 1996,2001). Yet, our group and others have demonstrated that AA tend to have less visceral adiposity relative to their non-Hispanic white counterparts (Cardel et al., 2011; Wagner and Heyward, 2000). Thus, there may be additional factors driving development of MetS in AA beyond that of excess visceral adiposity. The “Weathering Hypothesis” suggests that the health of AA deteriorates prematurely relative to non-Hispanic whites as a result of chronic exposure to social and environmental risk factors (Das, 2013; Thorpe et al., 2016). However, limited research has been conducted investigating the influence of psychosocial stressors on MetS outcomes in large samples of AA. Additionally, most research has focused on development or incidence, rather than severity, of MetS resulting from psychosocial stressors.

Thus, this study used JHS data to examine the associations of psychosocial stressors with severity of MetS among AA adults and whether relationships differed by sex. The hypothesis was that AA adults, particularly women, would have a higher MetS severity and that these relationships would be associated with psychosocial stressors.

## 2. Methods

### 2.1. Study population

The JHS is a large, population-based cohort that investigates the etiology of CVD and related risk factors in AA. Between 2000–2004, 5306 participants between the ages of 21–95 were recruited from the Jackson, Mississippi metropolitan area (Taylor et al., 2005). Three clinical examinations were conducted between 2000 and 2013 (exam 1 (baseline): 2000–2004; exam 2: 2005–2008; exam 3: 2009–2013). The Institutional Review Board (IRB) of the University of Mississippi Medical Center, Tougaloo College, and Jackson State University approved the study and all participants provided informed consent. In this cross-sectional study, data were utilized from exam 1 (2000–2004). Exam 1 included collection of baseline information through interviews in home and clinic settings. Questionnaires included inquiries about education, income, and lifestyle elements including physical activity, smoking status, alcohol consumption, and diet (Taylor et al., 2005). Exclusion criteria were presence of diabetes at baseline ( $n = 1233$ ) and missing MetS severity score at exam 1 ( $n = 203$ ), resulting in a sample size of 3870 for this study.

### 2.2. Psychosocial stress measures

Three psychosocial stress measures were included in this study: the Global Perceived Stress Scale (GPSS), Major Life Events (MLEs), and the Weekly Stress Inventory (WSI). The GPSS was given to participants in the baseline clinic examination, MLEs were determined through a telephone interview at the first annual follow-up, and the WSI was given to participants at the end of the baseline clinic examination (Gebreab et al., 2012).

The GPSS, a scale created specifically for the JHS cohort, consists of 8 domains assessing chronic stressors (i.e., employment, relationships, legal and medical issues, racism and discrimination, basic needs, etc.) throughout a 12-month period (Payne et al., 2005). Each domain is assessed using a 4-point scale of options ranging from “not stressful” to “very stressful” (0–3) with total scores varying between 0 and 24 (Payne et al., 2005). This scale was adapted from standardized stress scales including the Survey of Recent Life Experiences (Kohn and Macdonald, 1992), Perceived Stress Scale (Cohen et al., 1983), and Life Events Scale (Sarason et al., 1978). Inter-item reliability was satisfactory (Cronbach’s  $\alpha = 0.72$ ).

MLEs were assessed for the past 12 months through the use of binary responses (yes/no) to an 11-item questionnaire (Holmes and Rahe, 1967). Items assessed include: 1) serious personal illness; 2) being a victim of physical assault; 3) being a victim of robbery/home burglary;

4) losing a loved one to violent behavior; 5) experience of gunfire at home/neighborhood; 6) death of a close friend/relative; 7) major illness/injury of a close friend/relative; 8) moving to a worse residence/neighborhood; 9) losing a job; 10) being forced into retirement when you did not want to; 11) experience of divorce/separation from a spouse. Total points possible range from 0 to 11 with 0 indicating no MLEs were experienced in the past 12 months and 11 indicating that all MLEs listed were experienced in the past 12 months. Cronbach’s alpha was not calculated as this measure is considered an index and not a true scale.

The WSI includes 87 items and was developed to report minor, daily stressful encounters and the magnitude of those encounters over the past week using an 8-point response scale ranging from “not stressful” to “extremely stressful” (0–7) (Brantley et al., 1987). Examples of these minor stressors include financial challenges, work-related tasks, transportation issues, relationships, household responsibilities, and leisure activities. The score was determined by the number of minor stressors encountered (0–87). Cronbach’s alpha was 0.97.

### 2.3. MetS classification and Z-score

At exam 1, MetS was defined using the adult ATP-III criteria (Grundy et al., 2005b). To be classified as having MetS, participants had to meet  $\geq 3$  of the following 5 criteria: concentration of triglycerides  $\geq 1.69$  mmol/L (150 mg/dL), HDL-C  $< 1.04$  mmol/L (40 mg/dL) for men and  $< 1.3$  mmol/L (50 mg/dL) for women, waist circumference  $\geq 102$  cm for men and  $\geq 88$  cm for women, glucose concentration  $\geq 5.55$  mmol/L (100 mg/dL), and systolic BP  $\geq 130$  mmHg or diastolic BP  $\geq 85$  mmHg (Grundy et al., 2005b).

MetS severity Z-score was calculated using formulas previously published (Gurka et al., 2012; Gurka et al., 2014). Briefly, these scores were determined with a confirmatory factor analysis (CFA) of the 5 standard components of MetS (described above (Grundy et al., 2005b)) to determine the weighted contribution of each of these components to a latent MetS “factor” on a sex- and race/ethnicity-specific basis. CFA was conducted on data from the National Health and Nutrition Examination Survey for adults ages 20–64 years (Gurka et al., 2014) divided into 6 sub-groups based on sex and self-identified race/ethnicity including: non-Hispanic white, non-Hispanic black, and Hispanic. For each of these 6 population sub-groups, loading coefficients for the 5 MetS components were determined to load on a single MetS factor and used to generate equations to calculate a standardized MetS severity score for each sub-group (found at <http://mets.health-outcomes-policy.ufl.edu/calculator/>). These MetS severity scores are Z-scores (with 99.75% of values ranging from  $-3$  to  $3$ ) of relative MetS severity on a sex- and race/ethnicity-specific basis, with higher scores indicating worse MetS severity.

### 2.4. Covariates

Self-reported covariate measures included baseline age (continuous), sex, education, and income. Education was categorized by years of schooling completed: less than high school ( $< HS$ ), high school graduate or GED equivalency through 1–3 years of college (HS4-C 1-3), and college graduate or more (C4+ years). Income was divided into 4 categories based on family size, US Census poverty levels, and year of baseline clinic visit (2000–2004): poor (less than federal poverty level), lower-middle (1–1.5 times the federal poverty level), upper-middle (more than 1.5, but less than 3.5 times the federal poverty level), and affluent (3.5 or more times the federal poverty level). Risk factors for development of MetS, including nutrition, physical activity, smoking status, and alcohol consumption were included as covariates. Both physical activity and nutrition status of each participant were classified into tertiles of ideal, intermediate, or poor based on recommendations of the American Heart Association’s Life’s Simple 7 cardiovascular health status metrics (Folsom et al., 2011). With consideration that

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