The Patterns of Association between Psychosocial Stress and Obesity Differ by Gender in African Americans: The Jackson Heart Study

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Abstract

Objectives: To test the association of three measures of stress (Negative Life Events (NLE), Global Perceived Stress (GPS) and Weekly Stress Inventory (WSI)) with obesity in African American (AA) adults.

Methods: We examined data from 3589 participants from the Jackson Heart Study (JHS). We hypothesized that stress would be positively associated with measures of obesity [Body Mass Index (BMI) and central adiposity, measured by waist circumference (WC)]. Covariates included age, gender, education, family income, and cigarette smoking, and physical activity, type of occupation, marital status, dietary fat intake, and dietary carbohydrate intake. Sex-stratified multiple linear regressions were performed.

Results: The three stress measures were significantly correlated. However, WSI was excluded from the analysis. Men had a lower mean GPS score compared to women. For women, body mass index and mean WC were positively associated with GPS and NLE. In men, GPS and NLE were positively and linearly related to WC although the trend test for GPS was not statistically significant. GPS and NLE individually were positively related with BMI. NLE was positively and significantly associated with BMI. After adjusting for age, both stress measures, GPS and NLE were jointly associated with BMI. After adjusting for the additional covariates, GPS and NLE were jointly associated with BMI. GPS and NLE were associated with WC.

Conclusion: Examining the association of stress on obesity depends on the measurement used to assess stress because variations exist when comparing males and females. Our data indicate that women had higher BMI and larger WC than men.

ABBREVIATIONS

JHS: Jackson Heart Study; AA: African American; WC: Waist Circumference; BMI: Body Mass Index; GPS: Global Perceived Stress; WSI: Weekly Stress Inventory; NLE: Negative Life Events; FFC: Food Frequency Questionnaire; PSS: Psychosocial stress or stress

INTRODUCTION

The prevalence of overweight and obesity has increased worldwide and in the United States (US) over recent decades, regardless of sex, age, and development status of the country, reaching epidemic proportions and exceeding 50% of the adult population in some countries [1,2]. Many believe that obesity, generally assessed by Body Mass Index (BMI), adversely impacts cardiovascular (CV) risk factors and the CV structure and function and contribute to increased risk for cardiovascular disease (CVD) [1]. The likelihood of developing CVD is increased when obesity becomes a factor [2]. However, in spite of the well-chronicled adverse effects of obesity and the increased prevalence of various types of CVD, an obesity paradox regarding prognosis in CVD patients has become a concern because there are some overweight and mildly obese individuals who display less adverse effects than non-obese and overweight individuals with respect to the same CVD abnormalities [1,2].

The epidemic of obesity is accompanied by serious medical, economic, social, and psychological consequences that affect all ages and socioeconomic groups [3]. Since 2009, Mississippi (MS) has had the highest prevalence of obesity among the 50 states [4], with 34.4% of its population in 2011 classified as obese. Obesity is a condition with significant national health burden states [5-8].
Additionally, in 2010, 75.1% of African Americans (compared to 65.2% of Caucasians) residing in MS were classified as overweight or obese [9]. At baseline (2000-2004), the rate of obesity among the cohort of the Jackson Heart Study (JHS) was 53.3%; 60.0% of the female participants and 41.0% of the male participants were obese [10]. The obesity rates of the JHS African American cohort are significantly higher than the national average as well as the Mississippi average for obesity.

Environmental factors are likely greater contributors to the obesity epidemic than genetic factors [11]. Obesity can lead to harmful effects on individuals, contributing to many different physical and mental health outcomes [2]. Even though researchers widely recognize that psychosocial factors are involved in the pathogenesis and progression of cardiovascular disease (CVD), stress is a human condition that has been underestimated as a major contributing risk for the development of CVD. There is evidence that PS has adverse effects on the pathogenesis and progression of CVD [12], and that there is a high prevalence of PS in patients with CVD [1].

Stress (PSS) can initiate disease processes and reaction to environmental stimuli and exposures that result in behavioral, physiologic, or psychological changes that place some people at risk for developing disease [13-14]. PSS is associated with obesity-related behaviors [15-17] such as increased plasma cortisol, engagement in poor dietary practices, and inadequate physical activity. PSS can also affect bio-behavioral processes that lead to obesity and eventually to cardiovascular disease (CVD) and the development and progression of atherosclerosis [3,18-21]. Given the suggested association between PSS and obesity and the high rates of obesity among the JHS cohort [13-17], it is important to examine the association between psychosocial PSS and measures of obesity.

Increases in plasma cortisol levels have been associated with an increased risk for central adiposity [22,23]. PSS occurs more often in certain ethnic groups who are predisposed to stressors such as low-paying jobs, crime, pollution, noise, social isolation, and poverty. Lakey and Cohen suggested that social support can protect people from the adverse effects of PSS [24]. However, minority groups (particularly African Americans) experience these stressors without adequate support more often than whites. Little research has been conducted to investigate the direct effects of PSS on obesity. Most stress-related studies have focused on the relationship between stress and cortisol secretion, which is known to impact central adiposity. Roberts et al. found that change in cortisol levels is a biological consequence of stress, and that stress might increase caloric intake or influence the choice of foods inadvertently or as a deliberate coping strategy [25]. Various factors related to increased adiposity can generate cortisol release, which can trigger behaviors that lead to weight gain [26].

While the relationship between CVD outcomes and related risk factors, such as hypertension and type 2 diabetes has been well documented, the association between PSS and obesity has been studied less frequently [27,28]. Thus, the objective of this cross sectional study was to test the association of three measures of PSS (Negative Life Events (NLE), Global Perceived Stress (GPS) and Weekly Stress Inventory (WSI)) used in the JHS with obesity in a sample of African American (AA) adults from the JHS. We hypothesized PSS would be positively associated with measures of obesity, such as Body Mass Index (BMI) and central adiposity. Based on Thurston et al., we tested our hypotheses stratified based on men and women [29].

**MATERIALS AND METHODS**

**Study population**

Data from the baseline examination (2000-2004) of the JHS were used in this study. The JHS is the largest single-site, population-based cohort study of CVD among AAs in the U.S. The study population consists of non-institutionalized AA adults aged 21-95 residing in the Jackson, MS metropolitan statistical area (MSA) [30]. Participants were recruited from urban and rural areas in the tri-county region, Hinds Madison, and Rankin Counties [31]. The final JHS cohort included 5,301 participants (mean age = 55.6, SD = 12.7, 63.3% women), equivalent to 7% of all AAs aged 21-95 residing in the Jackson MSA [32]. Details of the study design and recruitment protocol have been described elsewhere [33-36]. This study was based on an analytic sample size (n = 3589) that was derived after excluding missing data for the measures of obesity (BMI and WC), the covariates, and the PSS measures (GPS and NLE). Details of WSI were not included in the analysis but briefly discussed because it will have further reduced the analytic sample to 2078. Hence, analytic sample for this paper was n = 3589.

**Primary outcome measures**

The two primary outcome measures of obesity were: BMI and WC. BMI was measured as weight in kilograms divided height in meters squared. Participant’s weight was measured using a zero balance scale. Participant’s height was obtained using the Frankfort Plane for measuring body height. WC was measured to the nearest centimeter at the umbilicus using an anthropometric tape that should be snug, but not so tight as to compress tissue.

Because BMI does not accurately measure adiposity and may perform differentially across ethnic groups [37], we used WC as a measure of central adiposity. Central obesity may also increase the risk of morbid obesity and can be a predictor of mortality [38].

**Independent variables**

**Measures of stress and life events:** The measures of stress and life events that were examined in this study were: Global Perceived Stress (GPS), the Weekly Stress Inventory (WSI), and Negative Life Events (NLE). Brief descriptions of each of the measures are as follows: GPS was measured using an 8-item scale assessing perceived stress across eight life domains (e.g., Family Environment Scale, Occupational Stress Inventory, Work Environment Scale, etc.). Each of the eight items of GPS was categorized as not stressful, mildly stressful, moderately stressful and very stressful.

The NLE survey used in the JHS was adapted from the Holmes and Rahe Life Changes Scale [39]. The NLE, an 11-item questionnaire, administrated by telephone interview at the annual follow-up post Examination 1, assessed stress-related occurrences in the last 12 months by requesting responses of “yes” or “no”. The items included: (1) experiencing serious
personal illness; (2) being a victim of physical assault; (3) being a victim of a robbery or home burglary; (4) losing a loved one due to violence; (5) experiencing gunfire at home/neighborhood; (6) having a close friend/relative die; (7) having a close friend/relative experience major illness/injury; (8) moving to a worse residence/neighborhood; (9) losing a job; (10) being forced to retire when didn't want to; (11) experiencing divorce/separation from spouse. NLE was used as a categorical variable.

Although the analysis for this paper focused on two of the three PSS measures (GPS and NLE), a brief description of the WSI is provided since it is mentioned and briefly discussed in the context of GPS and NLE. The reason the WSI was excluded in the in-depth analysis for this paper was because it would have further reduced the analytic sample by 151, resulting in an analytic sample which would be 39.2% of the full cohort. The WSI, which measures minor stressful life events over the past week, was administered in Examination 1 during the Home Induction Interview (HII). This 87-item questionnaire was developed by Jones and Brantley (1989) to assess minor discrete experiences of PSS across life domains such as: work tasks, relationships, finances, transportation, household tasks and responsibilities, leisure time activities, and others [40].

Covariates

Behavioral risk factors/ Potential moderating factors: Covariates included age in years, gender, education (less than high school, high school, some college, or Bachelor degree plus), family income (low, lower middle, upper middle, affluent), cigarette smoking (current smoker, former smoker, or never smoked), physical activity (active living, work, home and garden, and sport and exercise indexes) [41], type of occupation (1=low, 3=moderate, 5=high; based on the Department of Labor Occupational Codes and consistent with the KPAS [42], marital status (married, widowed, divorced, separated and never-married), dietary fat intake (grams), and dietary carbohydrate intake (grams). Dietary fat and dietary carbohydrate intake were measured from the initial short Food Frequency Questionnaire (FFQ) assessed in JHS Exam One [43]. Cigarette smoking, low physical activity, and dietary fat intake were considered as potential covariates because they have been linked with PSS. In the in-depth analysis for this paper was because it would have further reduced the analytic sample by 151, resulting in an analytic sample which would be 39.2% of the full cohort. The WSI, which measures minor stressful life events over the past week, was administered in Examination 1 during the Home Induction Interview (HII). This 87-item questionnaire was developed by Jones and Brantley (1989) to assess minor discrete experiences of PSS across life domains such as: work tasks, relationships, finances, transportation, household tasks and responsibilities, leisure time activities, and others [40].

Statistical analysis

Descriptive statistics were used to describe the sample characteristics. For categorical measures, percentages and sample sizes were reported. Given the degree of missing data in the various measures, especially for the three PSS measures, the analytic sample was compared to the full cohort (n = 5301) including all of the covariates listed above. These analyses were designed to assess how representative the final analytic sample is in comparison to the full cohort. Gender was tested for its moderating effect on PSS relative to obesity. Given that gender was a significant moderator, sex-stratified multiple linear regressions were performed to assess the association between PSS and the measures of obesity. The PSS measures were considered individually and jointly, and served as independent variables. In separate models, adjusted linear regression was used to examine the relationships between PSS and obesity, measured by overall adiposity (BMI) and central adiposity (WC) and attenuation by covariates. In the additional linear regression models, the association was also simultaneously adjusted for all relevant confounders. Cortisol was not treated as a covariate in the linear models since it is a marker for stress; and therefore, adjusting for it might result in over-adjusting for the effect of PSS as measured by GPS and NLE. Statistical significance was determined at p < .05. All analyses were conducted using SAS 9.3 statistical software (SAS Institute, Cary NC).

RESULTS AND DISCUSSION

Table (1) provides a summary of the characteristics of the analytic samples (participants providing measures of GPS and NLE). Household income, smoking status, consumption of alcohol, dietary total fat intake, dietary fiber intake, energy, and cortisol levels, and BMI varied by gender. Men had a lower mean stress score measured by GPS compared to the women (4.4 vs. 5.6). The mean (SD) age of the sample was 54.4 (12.7) years and nearly two-thirds (63.2%) were women. The distributions of the social economic status indicators (education, income and occupation) were diverse suggesting that the study sample had representation of As ranging from low to high SES. The three PSS measures (GPS, NLE, and WSI) were all significantly correlated. The pair-wise correlations between the three PSS measures are as follows: for GPS and NLE, r = 0.238 (p < 0.0001); GPS and WSI, r = 0.400 (p < 0.0001); and NLE and WSI, r = 0.205 (p < 0.0001) (Data not shown).

Sex-specific and age-adjusted linear trend analysis of the obesity measures (BMI and WC) across quartiles of the PSS measures are displayed in Table (2). For women, BMI and mean WC were positively associated with GPS and NLE. In men, only GPS and NLE were positively and approximately linearly related to WC although the trend test for GPS was not statistically significant at the 0.05 level.

Table (3) shows the sex-specific associations of the two obesity measures before and after adjusting for age and behavioral risk factors by the PSS measures, individually and combined. For GPS and NLE, individually and combined, the following significant findings were obtained.

PSS and BMI and WC associations in women

Both GPS and NLE individually were positively related to BMI; higher levels of GPS and NLE were associated with higher BMI. When GPS and NLE were combined in the model, the associations remain significant. GPS is more strongly associated with BMI.

Global Perceived Stress (GPS): Though GPS was positively and significantly associated with BMI (β = 0.643, p < .0001), this association remained significant but attenuated after adjusting for age (β = 0.481, p = 0.0037) and then adjusting for the remaining covariates (education, family income, cigarette smoking, physical activity, type of occupation, marital status, menopause status (women only), current female hormone use (women only), dietary energy, dietary fat intake, and dietary carbohydrate intake) (β = 0.519, p = 0.0028, fully adjusted model). GPS was positively and significantly associated with WC (β = 0.869; p = 0.0126); this association remained significant and suppressed after adjusting for age (β = 1.356, p = 0.0002); however, it was also attenuated in the fully adjusted model (β = 1.235, p = 0.0012).
The combined effect of GPS (β = 0.560; p = 0.0005) and NLE (β = 0.361; p = 0.0256) suggested that jointly both factors were positively and significantly associated with BMI for women. After adjusting for age, both PSS measures, GPS (β = 0.383; p = 0.0245) and NLE (β = 0.393; p = 0.0151) were jointly associated with BMI; however the unadjusted associations were attenuated with age. After adjusting for the additional covariates (in the fully adjusted model), both PSS measures, GPS (β = 0.435; p = 0.0144) and NLE (β = 0.362; p = 0.0264), were jointly associated with BMI, with GPS serving as a suppression factor, whereas NLE was an attenuating factor in the association. In assessing the joint effect of the two PSS measures, GPS (β = 0.683; p = 0.0561) and NLE (β = 0.808; p = 0.0237) on WC, the data suggest that GPS was not significantly associated; however NLE was. When age was accounted for in the model, both PSS measures, GPS (β = 1.177; p = 0.0017) and NLE (β = 0.719; p = 0.0438) were significantly associated with WC. However, for the fully adjusted model, GPS (β = 0.110; p = 0.0045) was significantly associated with WC, but the association between NLE and WC (β = 0.540; p = 0.1313) was significantly attenuated, rendering the prior association to be non-significant.

### PSS and BMI and WC associations in men

Though GPS and NLE were not associated with BMI, individually and combined, individually, GPS and NLE were associated with WC. However, when combined, GPS, but not NLE, was significantly associated with WC for men. For men the independent positive association between GPS (β = 0.440; p = 0.0101) and BMI was significantly weakened after adjusting for age (β = 0.225; p = 0.2076). However, the association was further strengthened in the fully adjusted model (β = 0.388; p = 0.0313). Unlike GPS, NLE was not significantly associated with BMI for men in all three models. The joint effect of GPS and NLE on BMI suggests that both factors were not significantly associated with

### Table 2: Age-Adjusted Mean of Measures of Stress by Obesity and Sex Expressed in Quartiles.

<table>
<thead>
<tr>
<th>Stress Measures</th>
<th>BMI (kg/m²) mean ±sd</th>
<th>WC (cm) mean ±sd</th>
<th>BMI (kg/m²) Mean ±sd</th>
<th>WC (cm) mean ±sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS (n = 3583)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>32.7±7.7</td>
<td>100.2±16.9</td>
<td>29.4±6.3</td>
<td>99.8±15.9</td>
</tr>
<tr>
<td>Q2</td>
<td>32.2±7.5</td>
<td>98.5±16.5</td>
<td>30.2±6.2</td>
<td>101.5±15.4</td>
</tr>
<tr>
<td>Q3</td>
<td>33.0±7.5</td>
<td>100.3±16.5</td>
<td>29.7±6.4</td>
<td>101.7±15.5</td>
</tr>
<tr>
<td>Q4</td>
<td>33.8±7.6</td>
<td>102.9±16.8</td>
<td>33.8±5.5</td>
<td>102.0±15.8</td>
</tr>
<tr>
<td>P for trend</td>
<td>0.0018</td>
<td>0.0011</td>
<td>0.5289</td>
<td>0.1009</td>
</tr>
<tr>
<td>NLE (n = 3583)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Q1</td>
<td>32.4±7.5</td>
<td>99.6±16.5</td>
<td>29.3±6.2</td>
<td>99.6±15.4</td>
</tr>
<tr>
<td>Q2</td>
<td>32.7±7.5</td>
<td>100.2±16.5</td>
<td>29.9±6.2</td>
<td>101.0±15.4</td>
</tr>
<tr>
<td>Q3</td>
<td>33.1±7.5</td>
<td>100.5±16.5</td>
<td>30.5±6.2</td>
<td>103.4±15.4</td>
</tr>
<tr>
<td>Q4</td>
<td>33.7±7.5</td>
<td>102.0±16.5</td>
<td>29.8±6.2</td>
<td>101.6±15.4</td>
</tr>
<tr>
<td>P for trend</td>
<td>0.0046</td>
<td>0.0309</td>
<td>0.1397</td>
<td>0.0306</td>
</tr>
</tbody>
</table>

GPS = Global Perceived Stress; NLE = Negative Life Events; BMI= Body Mass Index; WC = Waist Circumference; PSS = Perceived Stress Scale; Impact = mean burden of weekly stressful events.
Table 3: Sex, Age, and Multivariable-Adjusted Association of Stress (GPS & NLE) and Obesity Measures (BMI & WC).

<table>
<thead>
<tr>
<th>Models</th>
<th>BMI (kg/m²)</th>
<th>WC (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>β (p)</td>
<td>β (p)</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPS</td>
<td>0.643 (&lt;.001)</td>
<td>0.086 (.0126)</td>
</tr>
<tr>
<td>NLE</td>
<td>--</td>
<td>0.965 (.0055)</td>
</tr>
<tr>
<td>GPS + age</td>
<td>0.481 (.0037)</td>
<td>1.356 (.0002)</td>
</tr>
<tr>
<td>NLE + age</td>
<td>--</td>
<td>0.984 (.0046)</td>
</tr>
<tr>
<td>GPS + NLE</td>
<td>0.560 (.0005)</td>
<td>0.808 (.0237)</td>
</tr>
<tr>
<td>GPS + NLE + age</td>
<td>0.383 (.0245)</td>
<td>0.719 (.0438)</td>
</tr>
<tr>
<td>GPS + NLE + age + Covariates</td>
<td>0.519 (.0028)</td>
<td>1.235 (.0012)</td>
</tr>
<tr>
<td>NLE + age + Covariates</td>
<td>--</td>
<td>0.759 (.0303)</td>
</tr>
<tr>
<td>GPS + NLE + age + Covariates</td>
<td>0.435 (.0144)</td>
<td>1.109 (.0045)</td>
</tr>
<tr>
<td><strong>Men</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPS</td>
<td>0.440 (.0101)</td>
<td>0.641 (.1312)</td>
</tr>
<tr>
<td>NLE</td>
<td>--</td>
<td>0.913 (.0315)</td>
</tr>
<tr>
<td>GPS + age</td>
<td>0.225 (.076)</td>
<td>0.908 (.0419)</td>
</tr>
<tr>
<td>NLE + age</td>
<td>--</td>
<td>0.918 (.0306)</td>
</tr>
<tr>
<td>GPS + NLE</td>
<td>0.398 (.0234)</td>
<td>0.809 (.0636)</td>
</tr>
<tr>
<td>GPS + NLE + age</td>
<td>0.168 (.3610)</td>
<td>0.756 (.0835)</td>
</tr>
<tr>
<td>GPS + NLE + age + Covariates</td>
<td>0.308 (.0313)</td>
<td>1.202 (.0077)</td>
</tr>
<tr>
<td>NLE + age + Covariates</td>
<td>--</td>
<td>0.962 (.0246)</td>
</tr>
<tr>
<td>GPS + NLE + age + Covariates</td>
<td>0.331 (.0722)</td>
<td>1.034 (.0249)</td>
</tr>
</tbody>
</table>

BMI = Global Perceived Stress; NLE = Negative Life Events; BMI = Body Mass Index; and WC = Waist Circumference; Covariates: education, family income, cigarette smoking, physical activity, type of occupation, marital status, menopause status (women only), current female hormone use (women only), dietary energy (Kcal), dietary fat intake (grams), and dietary carbohydrate intake (grams).

BMI for men; (GPS: β = 0.331; p = 0.0722; NLE: β = 0.257; p = 0.1419). A similar pattern of association between GPS and BMI was observed between GPS and WC. The unadjusted association (β = 0.641; p = 0.1312) was not significant, but the analysis was significant after adjusting for age (β = 0.908; p = 0.0419). The fully adjusted model (β = 1.202; p = 0.0077) was significant. NLE (β = 0.962; p = 0.0246) was significantly and positively associated with WC for men in the fully adjusted model; however, it was not for the unadjusted and age-adjusted models. Based on the model evaluating the joint association of GPS and NLE with WC, NLE was not statistically significant; however, GPS (β =1.034; p = 0.0249) was significantly associated with WC in the fully adjusted model.

DISCUSSION

We envisioned that this PSS investigation would make a unique contribution to understanding the relationship between PSS and the two important obesity measures, BMI and WC in an African American population. This study tested the following hypotheses: 1) PSS would be positively associated with BMI; and 2) PSS would be positively associated with central adiposity as measured by WC. Stress is a phenomenon occurring between an individual and the environment, and it can result in long-term consequences, including obesity and cardiovascular disease, which have been rapidly increasing in the state of Mississippi. Stress creates a biochemical, psychosomatic condition that promotes overweight and obesity because it fuels weight gain and fat deposition. There was a higher prevalence of central obesity in the females in the JHS cohort, and central obesity has been shown to be associated with PSS [46,47]. The results of this study revealed that women are more likely to experience PSS than men. Consistent with previous research [48,49], the prevalence of abdominal obesity may also be linked to PSS in the African American males in the JHS because, in males, PSS, as measured by GPS and NLE, was positively and approximately linearly related to WC.

PSS can have an effect on the risk for obesity because of its impact on many bio-behavioral processes. PSS inhibits positive health behaviors, ultimately affecting one’s risk for being overweight and/or obese [41]. This is because many people respond to high levels of PSS by consuming foods containing high calories, sugar, and fat, while consuming fewer portions of vegetables [42,50,51]. The focus of this study was on the association of PSS on BMI and WC, two measures used to classify obesity and the risk of fat accumulation [52]. In a study involving a population of sedentary, mostly non-Hispanic white workers in metropolitan Seattle, the researchers determined that higher levels of perceived stress were associated with fewer servings of fruit and vegetables and greater consumption of fast food meals that could influence their weight status [18]. They concluded that the eating patterns of women who are overweight or obese...
are influenced by PSS. However, for that sample, BMI was not associated with perceived stress, as was found in this study in this group of African Americans males in the JHS.

Selecting the best measure of PSS and overweight and obesity in populations is an issue that has engendered much debate. Some researchers believe that BMI is a weak predictor of weight-related health problems among some racial and ethnic groups, such as AA and Hispanic-American women [53]. The results of this study illustrate that the association of PSS on obesity may vary depending on how PSS is measured, and these variations may manifest themselves differently in males and females. In addition, the influence of PSS on obesity may vary depending on types of obesity measures used. In the women, both GPS and NLE unadjusted were significantly related to BMI, even though GPS was more strongly related to BMI than NLE. In AA women in the JHS, GPS is a stronger predictor of BMI than NLE. In the males, GPS unadjusted, and not NLE, was significantly related to BMI. When GPS and NLE are combined in the model, the associations remain significant, even though GPS is more strongly associated with BMI. In females, when the effects of GPS are adjusted for age, higher levels of GPS were significantly associated with higher BMI, even though the relationship was attenuated. In males, when the effects of GPS were adjusted for age, GPS was not associated with BMI. In females, when the effects of NLE are adjusted for age, higher levels of NLE were significantly associated with higher BMI, and in males, when the effects of NLE were adjusted for age, NLE was not associated with BMI. These findings suggest that, for females, GPS is a stronger predictor of BMI than NLE, and GPS is a stronger predictor of BMI in females than in males in African Americans in the JHS.

For both males and females, when the effects of GPS are adjusted for age plus covariates, higher levels of GPS were significantly associated with higher BMI. In females, when the effects of NLE are adjusted for age plus covariates, higher levels of NLE were significantly associated with higher BMI, while in males, NLE was not associated with BMI. When the effects of GPS and NLE combined in the full model are adjusted for age plus covariates, higher levels of GPS and NLE were significantly associated with higher BMI, while in males, GPS and NLE were not associated with BMI.

Some studies have reported that WC is superior to BMI in predicting cardiovascular disease risk [54]. Elevated levels of blood cortisol intensify central fat deposition. Cortisol is a stress hormone, and the experience of chronic stress can quickly increase visceral fat accumulation [55]. As seen in this study, predicting the association of PSS on obesity depends to a large extent on the measurement used to assess PSS because variations exist when comparing males and females on the PSS measures and on the obesity measures. Our data indicate that women had higher BMI and larger WC than men. For women, there was a positive linear trend for mean BMI and mean WC. In females, both GPS and NLE were individually related to WC, while in males, NLE, and not GPS, was individually related to WC; in females, higher levels of GPS and NLE were significantly associated with higher WC, and in males, higher levels of NLE were significantly associated with higher WC. So, for females, NLE is a stronger predictor of WC than GPS, even though both measures of PSS are predictive of WC. For African American males, NLE is the best predictor of PSS.

For both AA males and females, when the effects of GPS and NLE were adjusted for age, higher levels of GPS and NLE were significantly associated with higher WC. For males and females, when the effects of GPS were adjusted for age plus covariates, higher levels of GPS were significantly associated with higher WC. In males, higher levels of NLE were significantly associated with higher WC. In males and females, when the effects of GPS and NLE were combined in the full model and adjusted for age plus covariates, higher levels of GPS were significantly associated with higher WC. This study provides evidence that supports the belief that PSS inhibits positive health behaviors and facilitates biochemical breakdowns that subsequently accelerate the risk for the development of overweight and obesity.

STUDY LIMITATIONS & STRENGTHS

Our findings must be interpreted in light of some limitations. This is a cross-sectional study that examined data collected in Exam 1 of the JHS. The JHS sample was limited to non-institutionalized adults and was not designed to be a nationally representative sample. Given the sampling frame of the JHS cohort, findings from the study might not generalize to all AAs. In addition, being obese can cause PSS in individuals, and it was impossible to adjust for the built-in connection between these two factors. Although, every attempt was made to account for multicollinearity in the prescreening of the data, it is possible that estimates of the parameters of interest may not be biased. In this study, we did not consider cardiorespiratory fitness, which was recognized as more important than body composition for predicting prognosis of CVD [1,2,12]. The strength of this study is that it provides extensive data on psychosocial stressors and obesity measures on 3589 AA adults of varied socioeconomic status which makes it possible to draw conclusions on the association of PSS on obesity among AAs.

CONCLUSION

Implications of study findings

PSS may contribute to behavioral and biomedical changes that could contribute to obesity. However, the warning signals may be manifested in males and females in different ways, and, therefore, could be a challenge when developing and implementing prevention and intervention strategies to combat the obesity epidemic. The questions of interest for intervention and prevention purposes are: (1) which measure of PSS is more predictive of obesity that can potentially lead to severe disease burden, and (2) which measure of obesity is more related to various PSS measures.

The findings of this study suggest that there is an association between measures of PSS and obesity outcomes such as WC. It is understood that calculation of BMI does not discriminate between fat content and lean-mass [56] and standardized criteria for abdominal obesity are more clearly defined for WC [57]. Understanding this information is vital for designing PSS intervention and management strategies that could be developed to support obesity prevention efforts [18]. Since obesity is a common occurrence in individuals who experience long-term chronic PSS, it is important to concentrate efforts on finding ways to identify and prevent this growing problem as a means to effectively improving health status.
Evidence from this study supports this assertion that PSS and obesity are linked. What is the best measure of human responses to PSS and life’s stressors and which measure of obesity and overweight are the best predictors of health risks are questions that require additional exploration. To contribute to the narrative in the fight against obesity and overweight, longitudinal studies are needed to examine the impact of stress management techniques on obesity and overweight prevention.

The degree and length of time of existence of obesity influences CVD prognosis, highlighting the need for prevention and intervention strategies that can delay obesity onset. Strategies to prevent obesity could have CV health benefits and should start in early childhood [2]. Also, the introduction of stress management training as a secondary strategy for the prevention of CVD is supported by recent evidence [1]. Therefore, greater emphasis should be placed on intervention to combat PSS among communities [12].

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