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Possible Contribution of PTSD to Altered Cortisol Activity in Young Adult Obese African-American Women

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Abstract

Objective—African-Americans have been found to experience increased rates of post-traumatic stress disorder (PTSD), obesity, and flatter diurnal cortisol slopes compared to other demographic groups. Further exploration, however, is needed to understand how PTSD impacts diurnal cortisol activity in obese African-American women. The purpose of the current study is to examine the relationship between salivary cortisol levels and PTSD in a sample of obese young adult African-American women and to examine how depression and insomnia influence the relationship.

Methods—Thirty-four young adult African-American women (mean age=24.0 years; mean BMI=37.4 kg/m², 6/34 of the sample had a score of 40 or above on the PTSD Checklist (PCL) representing clinically significant PTSD) filled out questionnaires assessing PTSD, lifetime exposure to traumatic events, insomnia severity, and depression. A home-based assessment of salivary cortisol was provided upon awakening at 30 min and 1, 3, 6, and 12 h.

Results—There was a significant interaction between PTSD status and diurnal cortisol activity ($p<0.04$). There were trends for higher cortisol levels at awakening ($p<0.051$) and 30 min post-awakening ($p<0.059$) with PTSD. The significance of the interaction between PTSD and cortisol was attenuated by co-varying for depression and insomnia ($p>0.05$).

Conflict of Interest Teletia R. Taylor, Ph.D., Kendra Van Kirk, BA, Denia Tapscott, M.D., Monet Bernard, BS, Juliana Llano, BS, and Thomas A. Mellman, M.D. declare that they have no conflict of interest.

Informed Consent Statement All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 (5). Informed consent was obtained from all patients for being included in the study.

Conclusion—PTSD, influenced by depression and insomnia symptoms, has an impact on diurnal cortisol activity in obese young adult African-American women.

Keywords

Post-traumatic stress disorder; African-Americans; Obesity; Cortisol

Introduction

Post-traumatic stress disorder (PTSD) is a prevalent condition and confers elevated risk for several mental and physical health conditions [1, 2]. African-American women have elevated rates of PTSD as well as associated medical conditions such as obesity [3]. Roberts et al. [4] documented higher rates of lifetime prevalence of PTSD among African-Americans (8.7 %) compared with non-Latino whites (7.4 %) or Asians (4.0 %). Breslau et al. [5] found that women were more than two times as likely as men (30.2 vs. 13 %, respectively) to develop PTSD following a traumatic event.

PTSD has been associated with obesity in African-American women [6]. For example, Mitchell et al. [6] investigated the comorbidity of lifetime PTSD and overweight/ obesity in a population-based African-American urban sample. Data were obtained from 463 African-American male and female participants of the Detroit Neighborhood Health Study. In sex-stratified models, after controlling for demographic variables, PTSD was associated with obesity only among women.

One of the mechanisms by which PTSD can affect physical health, including obesity, is through dysregulated hypothalamic-pituitary-adrenal (HPA) axis functioning [7]. The HPA axis is an important contributor to the human stress response by releasing corticotropin-releasing factor (CRF) from the hypothalamus, which in turn stimulates the secretion of adrenocorticotropin-releasing hormone (ACTH) from the pituitary gland. ACTH, in turn, stimulates the release of cortisol from the adrenal glands and serves as part of a feedback loop to regulate HPA axis activity [7].

Research evaluating HPA axis functioning in PTSD has yielded mixed findings. The most comprehensive studies have assessed male combat veterans and have found low cortisol levels related to increased feedback inhibition in veterans with PTSD compared with normal controls and combat controls [8]. It is not clear to what degree these findings generalize to populations other than male combat veterans with chronic and severe PTSD. In fact, a number of studies of cortisol and PTSD using non-veteran subjects recruited from clinics and the community have failed to confirm low cortisol [9, 10] and some studies demonstrated increased cortisol with PTSD [11]. African-Americans have been found to have flatter diurnal cortisol slopes compared to other demographic groups [12] and, as previously noted, experience increased rates of PTSD [4].

In exploring the association between cortisol and PTSD, it is important to examine other factors contributing to the relationship. For example, depression and sleep disturbance occur commonly with PTSD [13, 14] and both depression and sleep disturbances impact cortisol activity [15, 16]. Moreover, sleep disturbance and depression are associated with obesity in

African-American women. For example, in a convenience sample of 69 obese young adult African-American women, it was reported that BMI was associated with sleep latency [17]. Also, in an analysis of the National Survey of American Life (NSAL), a household mental health survey of adult Black Americans [18], it was reported that for Black Caribbean women, BMI 30 kg/m² and BMI 35 kg/m² were associated with higher odds of 12 months major depressive disorder (MDD). Although non-significant, among African-American women, BMI 30, BMI 35, and BMI 40 kg/m² were all associated with higher odds of 12 months MDD.

Studies linking cortisol with obesity have shown mixed results. Higher waist-to-hip ratios have been associated with lower diurnal cortisol variability [19, 20]. While cortisol awakening response has been positively associated with waist-to-hip ratio and waist circumference [21, 22], others have found an inverse association between awakening and morning cortisols and body mass index (BMI) [23, 24]. Further research is needed to elucidate these relationships. The purpose of the current study is to examine the relationship between salivary cortisol levels and PTSD in a sample of young adult, obese, African-American women. We also sought to examine how depression and insomnia influence the relationship.

Methods

Participants

Recruitment for the study occurred between April 2011 and May 2012. African-American females aged 18 to 35 were recruited via flyers advertising a weight loss intervention study. The flyers were posted around Howard University Hospital, Howard University College of Medicine, and the undergraduate campus in addition to recreation centers, churches, supermarkets, and childcare centers in the nearby community. Exclusion criteria included age <18 or >35, body mass index (BMI) <30, currently on a formal diet, current use of weight loss medications, current alcohol or illicit drug abuse or dependence, use of medications for any psychiatric disorder, diabetes, hypertension, hypercholesterolemia, or use of any other cardiac medications. All participants signed an informed consent form that was approved by the University Institutional Review Board after procedures had been explained and their questions had been answered.

Screening and Evaluation

Participants were screened with questions regarding height and weight, health status, previous/current use of weight loss interventions, and substance abuse/addiction. For screening purposes, BMI was calculated with an online BMI calculator tool using the height and weight verbally provided by participants (actual BMI was determined during the baseline visit).

Procedures

Each participant completed a baseline visit in which height, weight, waist circumference, and BMI were measured at Howard University Hospital's Clinical Research Unit (CRU). The following questionnaires were administered to participants: The PTSD Checklist (PCL)

is a well-validated screening tool for measuring current (experienced within the past month) symptoms of PTSD [25]. A score of 40 or higher indicates clinically relevant PTSD. It was administered in conjunction with the Life Events Checklist (LEC), an inventory of lifetime exposure to traumatic events [26]. Both scales have been used to measure PTSD and exposure to traumatic events in African-American samples [27, 28]. The Patient Health Questionnaire (PHQ-9), a nine-item self-report measure of depression, has been validated in ethnically diverse populations including African-Americans [29] and is widely used in primary care settings [30]. PHQ-9 scores range from 0 to 27, and a score of 10 and above indicates depression of moderate or greater severity. The Insomnia Severity Index (ISI) is a self-report measure that assesses subjective severity of insomnia over a 2-week period [31] and has been used to measure insomnia in African-American female samples [32, 33]. ISI scores range from 0 to 28 and a score above 10 represents clinically significant insomnia symptoms.

A home-based assessment of salivary cortisol was conducted, and participants were instructed to provide saliva in a collection tube upon awakening at 30 min and 1, 3, 6, and 12 h. Sample tubes were returned to the CRU for analysis and storage.

Statistical Analysis

Means, standard deviations, and percentages were calculated to determine group characteristics. Diurnal cortisol responses by PTSD group membership were analyzed with repeated measures analysis of variance (ANOVA) with sample time (awakening, 30 min and 1, 3, 6, and 12 h) as the within-subject factor and PTSD status (equal to or above 40 on the PCL scale, PTSD positive) as the between-subject factor. A separate repeated measures ANOVA was conducted controlling for Insomnia Severity Index scores and PHQ-9 scores.

Results

All of the 34 participants were black, 29 self-identified as African-American, and 5 as West Indian/Caribbean. The mean (standard deviation) (SD) age of the group was 24.0 (4.6) years (range=18–32 years). The mean (SD) BMI of the group was 37.4 (6.3)kg/m². Mean (SD) PCL scores were 30.2 (11.8), and 18 % (6/34) of the sample had a score of 40 or above representing clinically significant PTSD. Based on the Life Event Checklist, the six participants scoring 40 or above on the PCL reported traumatic events that included losing children, being molested as a child, and the traumatic death of a caretaker at age 13. Mean (SD) PHQ-9 scores were 6.0 (5.9) with 18 % (6/34) of the sample meeting the criteria for moderate and greater severity of depression. Mean (SD) ISI scores were 8.1 (5.8) with 41 % (14/34) of the sample meeting the threshold for clinically significant insomnia symptoms.

There was a significant interaction between PTSD status and diurnal cortisol activity ($p < 0.040$). There were trends for higher cortisol levels at awakening ($p < 0.051$) and 30 min post-awakening ($p < 0.059$) with PTSD (see Fig. 1). The significance of the interaction between PTSD and cortisol was attenuated by co-varying for depression and insomnia ($p > 0.05$) (see Fig. 2).

Discussion

Our findings provide preliminary evidence for a relationship between diurnal cortisol and PTSD in young adult, obese, African-American women with trends for higher cortisol activity soon after awakening in participants with PTSD. Johnson et al. [34] found an association of PTSD severity with significantly greater cortisol output the first hour after awakening. As reviewed in the introduction, research evaluating HPA axis functioning in PTSD has yielded mixed results. The most comprehensive studies have assessed male combat veterans and have found low cortisol levels in veterans with PTSD [8]. The fact that we found disparate results from male veteran studies confirms that our sample may differ from male veterans in important ways. It also suggests that more work should be done examining the biology of PTSD in community samples such as ours.

Our study also showed that the association between diurnal cortisol and PTSD status was partially accounted for by insomnia and depression. These findings are not surprising given that sleep disturbance such as trouble falling and staying asleep (insomnia) are common symptoms of PTSD [14], and sleep impairments are known to be associated with alterations in the HPA axis [15]. In addition, research documents a co-occurrence of depression and PTSD [13] as well as elevations in salivary cortisol in patients with MDD [16].

Limitations of the current study include its small sample size and the low number of PTSD respondents. Another limitation is the study only addressed women. As a result, we were not able to determine gender differences pertaining to the effect of PTSD on cortisol. Laudenslager et al. [35] explored diurnal rhythms in salivary cortisol and PTSD in a sample of American-Indian men and women. When stratified by gender, women with a lifetime diagnosis of PTSD had significantly higher mean cortisol levels throughout the day than women without PTSD, but there was no significant association between PTSD and cortisol levels in men. Adding young adult African-American men to a future study would allow for male-female comparisons with respect to biomarkers and PTSD.

Finally, the parent study from which this sample was derived was composed of obese women. Therefore, the generalizability of the findings is limited to this particular anthropometric group. A future investigation could examine similar research questions by comparing a group of non-obese African-American women with and without PTSD to a group of obese African-American women with and without PTSD. One could explore if PTSD is more prevalent in an obese group. This association could be related to disruptions of inhibitory control in PTSD largely mediated by the prefrontal cortex [36]. The capacity of inhibitory control is critical to suppressing food intake in a modern environment characterized by frequent exposure to highly palatable food [37]. Based on these findings, it appears plausible that the neurobiological disruption of inhibitory control associated with PTSD may make one vulnerable to overeating and obesity. Even though evidence indicates significant group differences between African-American women and Caucasian women in their perceptions of their overweight and obese status [38], conducting a comparison among African-American women with and without PTSD and obesity would further elucidate our understanding of the PTSD/cortisol relationship within this ethnic group as well as factors mediating the relationship.

Our findings linking PTSD with cortisol justify the importance of the accurate diagnosis and treatment of PTSD in populations of young adult African-American women. As previously mentioned, the health consequences of PTSD are substantial and can include secondary mental disorders [39], substance use disorders [40], and a range of physical conditions [41]. Effective intervention strategies include cognitive behavioral therapy that has proven to be a useful intervention technique for the treatment of PTSD in a variety of samples including African-American women [42].

In summary, African-Americans in general have been found to experience increased rates of PTSD [4] and flatter diurnal cortisol slopes compared to other demographic groups [12]. Findings of this study provide further evidence that PTSD, influenced by depression and insomnia symptoms, has an impact on diurnal cortisol activity in young adult, obese African-American women that should be confirmed and extended by future research.

Acknowledgments

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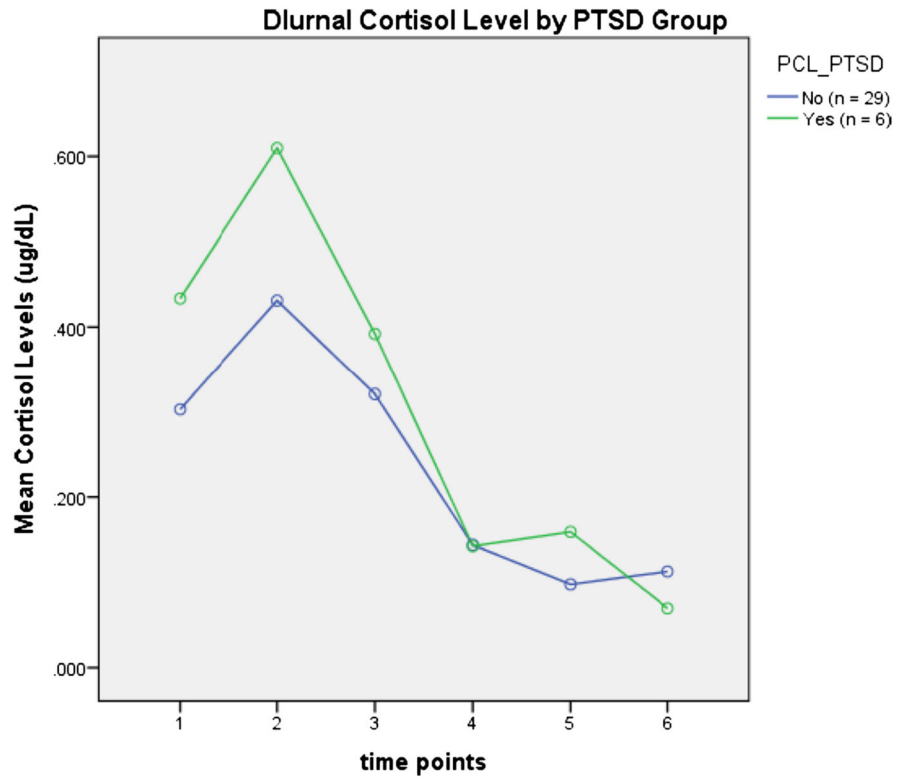


Fig. 1. Time point 1 represents awakening, 2 equals 30 min, 3 equals 1 h, 4 equals 3 h, 5 equals 6 h, and 6 equals 12 h

Diurnal Cortisol levels by PTSD Group Controlling for Depression and Insomnia

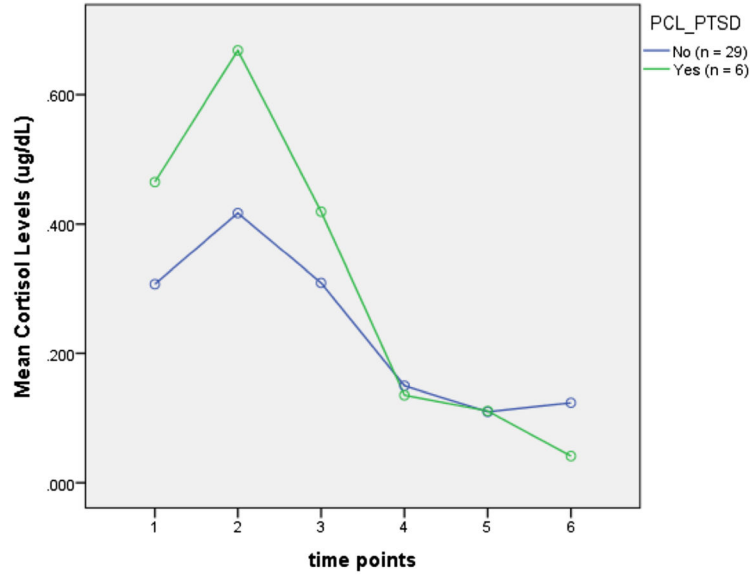


Fig. 2. Time point 1 represents awakening, 2 equals 30 min, 3 equals 1 h, 4 equals 3 h, 5 equals 6 h, and 6 equals 12 h