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The Cortisol Awakening Response as a Function of PTSD Severity and Abuse Chronicity in Sheltered Battered Women

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Abstract

Although intimate partner violence (IPV) is a significant social problem associated with severe psychiatric problems, most notably PTSD, only a handful of studies has examined PTSD and associated physiological factors in battered women. Further, no research to date has investigated impact of abuse chronicity on HPA functioning. The present study examined the impact of PTSD severity and abuse chronicity on the cortisol awakening response in a sample of 52 sheltered battered women. Results suggest that IPV-related PTSD and abuse chronicity have opposite effects on waking salivary cortisol curves in battered women. PTSD severity was associated with significantly greater cortisol output the first hour after awakening, while more chronic abuse was associated with lower total cortisol output in the first hour after awakening. Implications of findings and suggestions for future research are discussed.

Keywords

PTSD; cortisol; HPA axis; intimate partner violence; battered women

Large-scale surveys conducted by the US Department of Justice suggest that as many as 22 to 29% of women report histories of physical abuse by intimate partners and that approximately 1.5 million women are raped and/or physically assaulted by a current or former partner at least once annually (Bachman & Saltzman, 1995; Tjaden & Thoennes, 2000). Battered women may comprise one of the largest traumatized populations in North America (Council on Scientific Affairs, 1992). Intimate partner violence (IPV) is often a chronic traumatic stressor, in that it typically involves prolonged and repeated episodes of physical, sexual, and emotional abuse that significantly disrupt a victim's sense of safety and security. As interpersonal abuse is associated with increased risk for developing posttraumatic stress disorder (PTSD; Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995; Breslau, Kessler, Chilcoat, Schultz, Davis, & Andreski, 1998), PTSD is cited as one of the most frequent difficulties faced by battered women (Golding, 1999; Jones, Hughes, & Unterstaller, 2001). Further, battered women in shelters tend

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to experience greater severity of abuse and related injury (Saunders, 1994), and higher rates of PTSD (Jones et al., 2001) than battered women who never seek shelter. Battered women in shelters also provide a unique population of inquiry, in that the nature of their trauma is both recent and chronic. Unlike other trauma victims, sheltered battered women's trauma has often lasted many years and their fear for their safety and lack of resources is directly related to their need to seek shelter. However, research examining PTSD and associated physiological factors in battered women has been sparse at best. Given the unique characteristics of IPV, it is unclear if existing research on the biological correlates of PTSD would generalize to battered women in shelters. This study sought to extend the literature on the psychophysiology of trauma and PTSD by investigating the impact of PTSD severity and abuse chronicity on the cortisol awakening response in battered women in shelters.

Research suggests that PTSD may be associated with dysregulation of the hypothalamic pituitary-adrenal (HPA) axis. However, the exact nature and direction of these alterations is unclear. Research investigating association between PTSD and 24-hour urinary cortisol levels has found both lower (e.g., Yehuda, Boissoneau, Mason, Giller, 1993; Yehuda, Boissoneau, Lowy, Giller, 1995) and higher (e.g., Lemieux & Coe, 1995; Rasmussen et al., 2001) cortisol output in PTSD patients compared to controls. Possible explanations for inconsistent findings include frequency, severity, and recency of the traumatic event, gender, menopausal status, inpatient versus outpatient status, and disease comorbidities (Yehuda, 2002a, 2000b; Rasmussen, Vythilingam, Morgan, 2003).

Multiple methods have been implemented to assess cortisol levels in patients with PTSD, with most studies relying on 24-hour urinary cortisol levels (e.g., Yehuda et al., 1993; Lemieux & Coe, 1995; Yehuda et al., 1995; Rasmussen et al., 2001) or low-dose dexamethasone suppression tests (e.g., Stein, Yehuda, Koverola, & Hanna, 1997; Griffin, Resick, & Yehuda, 2005). However, recent research suggests that the cortisol response to awakening can serve as a useful index of the dynamic activity of the HPA axis (Pruessner et al., 1997; Wust et al., 2000). Wust et al. (2000) reported that approximately 75% of people demonstrate a mean cortisol increase of about 50% within the first 30 minutes after awakening. Furthermore, the cortisol awakening response is believed to be a robust phenomenon, in that it is not significantly impacted by many of the confounding variables that may impact other indexes of HPA axis functioning (e.g., age, oral contraceptive use, habitual smoking). Only a handful of studies has investigated the cortisol awakening response as it relates to PTSD. This research has consistently found PTSD to be associated with lower cortisol output during the first hour after waking (Lauc, Zvonar, Vuksic-Mihaljevic, & Flogel, 2004; Neylan et al., 2005; Wessa, Rohleder, Kirschbaum, & Flor, 2006). However, no studies to date have specifically investigated this response in victims of IPV.

Similar to research conducted with other trauma populations, research investigating cortisol abnormalities in victims of IPV is also mixed. Griffin et al. (2005) found battered women with PTSD to have lower early morning plasma cortisol levels than battered women without PTSD or normal healthy controls. Additionally, they found PTSD to be associated with hypersuppression of cortisol following administration of 0.5 mg dexamethasone. However, Inslicht et al. (2006) found that battered women with lifetime PTSD to have significantly higher salivary cortisol levels throughout the day than battered women without lifetime PTSD. Still other studies investigating the relationship between cortisol levels and PTSD in battered women found negative relationships between presence of IPV and morning cortisol levels but no relationship between PTSD and morning cortisol levels (Seedat, Stein, Kennedy, & Hauger, 2003; Pico-Alfonso, Garcia-Linares, Celda-Navarro, Herbert, & Martinez, 2004), suggesting that HPA alterations were a consequence of the abuse and not PTSD symptoms.

Considering paucity of research investigating HPA abnormalities in victims of IPV, and prior mixed findings, we sought to extend the literature on cortisol alterations associated with PTSD in several ways. First, in this study we investigated the cortisol awakening response as a function of IPV-related PTSD severity in a sample of recently abused battered women in shelters. Second, we also explored whether abuse chronicity, a variable whose relationship to cortisol output has yet to be explored, significantly impacted the cortisol awakening response in battered women.

Methods

The present study is part of a larger investigation evaluating efficacy of a brief treatment program for battered women with PTSD in shelters (Johnson & Zlotnick, 2006), and includes baseline data from treatment-seeking shelter residents who were assessed for inclusion in an ongoing randomized trial of that treatment program. Participants were recruited from two shelters from within the same shelter system over 1.5 years. All shelter residents who reported that their abuse was from an intimate partner were eligible for the current study. Shelter staff provided residents with brochures advertising the research and instructed residents to contact research staff for more information. After receiving a description of the study, interested participants were scheduled for a baseline interview. Of the shelter residents who contacted the research line but were never enrolled in the study, 36 left the shelter prior to their scheduled interview, 12 were not in shelter as a result of violence from an intimate partner, 6 never scheduled an interview, and one participant refused to provide a saliva sample, resulting in a final sample of 91 participants who provided waking saliva samples. All baseline interviews were completed by trained graduate students in psychology or counseling under the direct supervision of a licensed psychologist. Interview training included detailed instruction, practice interviews, and observation of interviews. Measures relevant to the current study are described below.

Measures

Descriptive Variables

Information on IPV, trauma history, and Axis I comorbidity was collected with standardized measures. IPV in the month prior to shelter admission was obtained from the Revised Conflict Tactic Scales (CTS2; Straus, Hamby, McCoy, & Sugarman, 1996). Diagnostic comorbidity to PTSD was assessed with the mood, substance, and anxiety modules of the Structured Clinical Interview for DSM-IV-TR Axis I Disorders (SCID; First, Gibbon, Spitzer, & Williams, 2002). Participants' prior trauma history was assessed with the Trauma History Questionnaire (THQ; Green, 1996).

Study Variables

Salivary Cortisol

Prior to the baseline interview, participants were provided verbal and written instructions on saliva collection. Using the Salivette sampling device (Sarstedt, Newton, NC), four saliva samples were collected in the first hour after waking to estimate participants' cortisol response to awakening (Wust et al., 2000). The first sample was collected immediately upon waking. The latter three samples were taken at 30, 45, and 60 minutes after waking. Participants were instructed not to eat, drink, or brush their teeth prior to sampling, as well as to refrain from smoking while samples were being collected. Information for these behaviors, medications, as well as wake time and timing of each sample was collected to assess adherence to sampling instructions and possible confounding variables. Participants were instructed to store the samples in the shelter freezer until they could be collected by research staff. Saliva samples

were then stored at -80°C until assay. Saliva samples were processed at the Center for Psychobiology and Psychosomatic Research (Trier, Germany) using a time-resolved immunoassay with fluorescence detection (DELPIA: Dressendorfer, Kirschbaum, Rohede, Stahl, & Strasburger, 1992).

PTSD Severity

The Clinician Administered PTSD Scale (CAPS; Blake et al., 1990) is a semi-structured interview that assesses the diagnostic criteria of PTSD, including the frequency and severity of PTSD re-experiencing, avoidance, and arousal symptoms during the prior week. The CAPS is one of the most-widely used interviews to assess PTSD and has established reliability and validity (Weathers, Keane, & Davidson, 2001). Current PTSD was assessed for the abusive relationship that led to participants' shelter admission, as well as for their most severe prior traumatic event. Inter-rater reliability was calculated for PTSD diagnosis for 17 randomly selected interviews ($kappa = .82$). The present analyses focus on the continuous measure of CAPS total symptom severity scores.

Abuse Chronicity

An item was added to the CTS-2 asking participants the duration (i.e., number of months) of the abusive relationship that led to their shelter admission. Length of this index abusive relationship is used in the present study as an indicator of the chronicity of the abusive relationship.

Depression Severity

The Beck Depression Inventory (BDI; Beck et al., 1961) was used to assess severity of depression symptoms. The BDI is a 21-item self-report measure of characteristic attitudes and symptoms of depression with established reliability and validity.

Statistical Analyses

Data from 16 participants were not used in analyses as a result of at least one saliva sample being insufficient for cortisol assay. All participants who reported steroid use, smoked during the first hour after waking and/or had a discrepancy between their wake time and time of waking sample in excess of 30 minutes were removed from analyses. Additionally, to eliminate any potential confound with PTSD from other traumatic events, participants who met diagnostic criteria for PTSD from another traumatic event, but did not meet criteria for IPV-related PTSD were excluded from all analyses (see Figure 1). Thus, data from 52 participants were used in all analyses.

Estimates of participants' overall salivary cortisol secretion during the first hour after waking were derived through two formulas articulated by Pruessner et al. (2003): area under the curve with respect to increase (AUC_I) and area under the curve with respect to ground (AUC_G). According to Pruessner et al. (2003), AUC_I is more reflective of the sensitivity of the HPA axis and cortisol changes over time, while AUC_G is more reflective of total cortisol output or overall cortisol intensity.

First, correlational analyses were conducted to determine if AUC_I or AUC_G were significantly related to any potential confounds for waking cortisol levels suggested by prior research (see Wust et al., 2000). Next, a series of hierarchical regression analyses controlling for age and depression severity¹ was run with both AUC_I and AUC_G as outcome variables and either PTSD severity or abuse chronicity as the predictor variables in the final step of the regression. We

¹Analyses were run with and without depression severity as a covariate and led to similar findings except where noted.

controlled for age because it served as a potential confound for the length of the abusive relationship (i.e., abuse chronicity) and depression severity because of the overlapping symptoms between PTSD and depression. Finally, in cases where both PTSD and abuse chronicity predicted AUC variables, additional hierarchical regression analyses were conducted to determine the relative contribution of PTSD versus chronicity in predicting cortisol levels.

Results

Descriptive Analyses

Of the 52 participants used in analyses, 32 (61.5%) met criteria for IPV-related PTSD. Average participant age was 34.29 ($SD = 9.50$). Ethnic and racial composition was as follows: 48% African American, 10% Hispanic, 29% White, and 13% another ethnicity. Most participants were living with or married to their abuser before entering the shelter (73%), completed at least high-school or the equivalent (79%), and were unemployed (85%). Average length of shelter stay prior to data collection was 15 days.

Of the 52 participants, 96% reported psychological aggression, 87% physical aggression, 62% sexual coercion, and 75% an IPV-related injury within the month prior to shelter admission, while 92% of participants reported at least one traumatic event prior to their current IPV. Additionally, 54% met criteria for Major Depression, 56% a lifetime substance use disorder, 44% another anxiety disorder, and 6% Bipolar Disorder. Correlational analyses found that AUC_I and AUC_G did not significantly relate to number of hours of sleep the night prior to saliva collection, psychotropic medication status, smoking status, caffeine and food consumption, ethnicity, presence of substance use disorder, or length of shelter stay (p 's $> .05$). Thus, none of these variables was controlled for in remaining analyses.

The Impact of PTSD Severity and Chronicity on the Cortisol Awakening Response

Table 1 displays correlations among study variables. Regression analyses revealed that PTSD positively and significantly predicted AUC_G (F change = 4.88, $p < .05$) but not AUC_I ($p > .05$)² above and beyond age and depression severity. Saliva levels at each data point were graphed as a function of PTSD diagnostic status (see Figure 2) to pictorially represent the relationship between PTSD and waking salivary cortisol curves. Similar regression analyses with abuse chronicity as the predictor variable revealed that chronicity significantly and negatively predicted AUC_G (F change = 6.03, $p < .05$), but not AUC_I ($p > .05$). A median split (38 months) was used to graph waking cortisol levels as a function of abuse chronicity (see Figure 3).

Because AUC_G appeared to relate differently to PTSD severity and abuse chronicity, further analyses were run to clarify the nature of these relationships. PTSD severity and abuse chronicity did not significantly correlate (see Table 1) and there was no significant interaction between PTSD severity and abuse chronicity for AUC_G ($p > .05$). Because PTSD severity and abuse chronicity were not significantly related and the two variables didn't interact, final hierarchical regressions for AUC_G were conducted with both PTSD severity and abuse chronicity in the models in order to determine if the two variables had effects independent of one another. After controlling for abuse chronicity, the positive impact of PTSD severity was not statistically significant ($p = .055$) for AUC_G (see Table 2). However, while controlling for PTSD severity, abuse chronicity significantly and negatively predicted AUC_G (see Table 2).

²PTSD severity did however, predict AUC_I when not controlling for depression severity (F Change = 6.55, $p < .05$). Without controlling for depression, PTSD severity continued to significantly predict AUC_G (F Change = 5.22, $p < .05$).

Discussion

This study represents the first study, to our knowledge, to investigate the cortisol awakening response as a function of IPV-related PTSD severity and abuse chronicity in a sample of recently abused battered women in shelters. Our results suggest that IPV-related PTSD severity and abuse chronicity have opposite effects on early morning salivary cortisol levels in battered women. Specifically, we found IPV-related PTSD severity to be associated with a significantly greater cortisol output the first hour after awakening. However, more chronic abuse was associated with lower waking cortisol output.

Our finding that IPV-related PTSD severity was associated with higher cortisol output is consistent with research findings with premenopausal women (Lemieux & Coe, 1995; Rasumsson et al., 2003), prior findings in survivors of repetitive interpersonal trauma (e.g., Lemieux & Coe, 1995; Carrion et al., 2002), as well as more recent research with battered women (Inslicht et al., 2006). However, these findings are inconsistent with prior research on the cortisol awakening response and PTSD in male veterans (Lauc et al., 2004), a heterogeneous sample of trauma-exposed men and women (Wessa et al., 2006), and male and female on-duty police officers (Neylan et al., 2005). Our findings suggest that the cortisol awakening response may be impacted differently in battered women in shelters who have experienced both recent and chronic trauma; however, further research is needed to confirm our findings.

Interestingly, in our sample, battered women who did not have PTSD appeared to have a flattened waking cortisol curve (see Figure 2). While this may simply reflect a variant within the normal range (Wust et al., 2000) prior research suggests that such flattened curves are associated with chronic stress or pathology (Pruessner et al., 1999). An inspection of our group of battered women who did not meet criteria for PTSD revealed that, although they did not meet PTSD criteria, there was significant psychopathology in this group, with 60% having at least one Axis I diagnosis. Thus, the flattened waking curve may reflect the severe psychopathology present in our no PTSD group (Wust et al., 2000) although this would not explain the lack of a flattened curve in the PTSD group, which also had significant comorbidity.

The apparent opposite affects of IPV-related PTSD symptoms and abuse chronicity represents a unique finding that deserves further scrutiny. One potential explanation that has been posited for the variable findings regarding cortisol levels in PTSD is differing amounts of time that has passed since trauma exposure (Lemieux & Coe, 1995; Rasmusson et al., 2001). The negative relationship found here between abuse chronicity and waking salivary cortisol output may be an artifact of the timing since the actual initiation of the IPV (i.e., longer time since the initiation of abuse may be more associated with lower salivary cortisol levels). However, these findings are also similar to those of Pruessner et al. (1999). In their study, teachers with higher levels of burnout had lower cortisol output during the first hour after waking. However, those teachers with higher levels of perceived stress had higher levels of cortisol during the first hour after awakening. These findings in conjunction with the findings from our study provide some evidence that chronic stress and PTSD symptoms may have a differential impact on HPA axis functioning. Further research with more rigorous methodology is required to adequately tease out the reasons for these differential effects.

Conclusions that can be drawn from this study are limited by the relatively small sample size and cross-sectional design. Additionally, reliability of our estimates of the cortisol awakening response is unknown because we assessed waking cortisol levels on only a single occasion. Findings from this study also may not generalize to battered women who do not seek shelter. Strengths of this study, however, include its use of a standardized assessment of PTSD, as well as its use of an ethnically diverse and well-defined sample of battered women. Further, this study used a rather robust assessment of the dynamic activity of the HPA-axis that is less likely

to be influenced by many of the uncontrollable confounds that may impact cortisol levels (Pruessner et al., 1997). Regardless, this study represents an initial effort to better understand the impact of abuse chronicity and PTSD severity on the waking cortisol response in battered women, and the results emphasize the need for continued research to better understand the impact of IPV and PTSD on the HPA axis.

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Figure 1.
Summary of participant retention.

Figure 2.
Waking Cortisol Levels as a Function of PTSD Diagnosis

Figure 3.
Waking Cortisol Levels as a Function of Abuse Chronicity

Table 1

Correlations Among Study Variables

	1	2	3	4	5
AUC _I	---				
AUC _G	.73**				
Age	-.05*	.10			
Depression	.28*	.08	-.07		
PTSD	.34*	.31*	.02	.61**	
Chronicity	-.21	-.26	.42**	-.06	-.10

Note.

* $p \leq .05$

** $p \leq .01$

Table 2
Results for Hierarchical Regression Analyses for AUC_G with PTSD Severity and Abuse Chronicity Entered as the Final Step

Dependent Variable	Step	Independent Variables	R ²	Adjusted R ²	Δ R ²	Beta	F Change
AUC _G	1	Age Depression Chronicity	.14	.08	.14	.28 .08 -.37*	2.43
	2	Age Depression Chronicity	.20	.13	.07	.24 -.12 -.33*	3.88 ^a
AUC _G	1	PTSD	.12	.06	.12	.33 ^a .10 -.14*	2.05
	2	Age BDI PTSD	.20	.13	.09	.38* .24 -.12 .33 ^a .33*	4.98*

Note.
* $p < .05$
^a $p = .055$