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Hormonal Alterations in Victimized Women Explained by Their Hostile Reactions in Coping with Couple Violence

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Abstract. Recent studies have highlighted the dysregulation of hypothalamic-pituitary-adrenal (HPA) axis activity and its end products, cortisol and dehydroepiandrosterone (DHEA), in women with a history of intimate partner violence (IPV) victimization. These studies analyzed several coping styles, but they neglected to examine the use of violent strategies to confront IPV and the way these strategies affect HPA functioning. This latter proposal would be based on the gender symmetry model of IPV, which sustains that IPV is generally symmetrical, but that women's violence tends to be a reaction to male violence. Hence, the main objective of the present study was to examine whether women's violent reactions to IPV would significantly predict salivary cortisol and DHEA levels, as well as the cortisol/DHEA ratio (assessed through two saliva samples per day on four consecutive work days), controlling for the women's prior IPV abuse, psychopathology, and demographic variables. Our data demonstrated that, specifically, psychological confrontation strategies predicted vespertine cortisol levels (adj R^2 = .18, β = .447, p < .01) and the cortisol/DHEA ratio (adj R^2 = .08, β = .322, p < .05), even after controlling several confounding variables, whereas physical and total confrontation in response to IPV did not predict these hormonal parameters.

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Keywords: cortisol, dehydroepiandrosterone, intimate partner violence, victimization.

Intimate partner violence (IPV) is a relatively common type of aggressive behavior in adult men and women, with about one in five men (and one in four women) reporting IPV victimization at some time in their lives (Desmarais, Reeves, Nicholls, Telford, & Fiebert, 2012a; 2012b). The rates of IPV types are different, with psychological IPV being more frequent than physical IPV (Fletcher, 2014; Groves et al., 2015). Psychological IPV, sometimes called emotional abuse, encompasses behavior toward a partner that is offensive or degrading—usually verbally—and may include criticism, threats, ridicule, withholding affection, and restrictions, including financial control (Capaldi, Knoble, Shortt, & Kim, 2012; O'Leary & Maiuro, 2001). In addition, physical IPV involves forceful physical actions such as pushing, grabbing, shoving, etc. Obviously, this kind of violence entails disruptions in victims' health and hormonal regulation (e.g. cortisol and dehydroepiandrosterone [DHEA]). In fact, IPV victims have been found to present higher levels of stress and poorer mental health (Garcia-Linares, Sanchez-Lorente, Coe, & Martinez, 2004; Sanchez-Lorente, Blasco-Ros, Coe, & Martinez, 2010).

Recent studies have highlighted the role of dysregulated hypothalamic-pituitary-adrenal (HPA) axis activity and its end product, the stress hormone cortisol, in women with a history of IPV victimization. These studies concluded that women who were victims of physical IPV showed lower levels of morning cortisol and higher evening salivary cortisol – as well as a lower cortisol awakening response and reduced diurnal changes, compared to non-battered women (Inslicht et al., 2006; Kim et al., 2015; Pico-Alfonso, Garcia-Linares, Celda-Navarro, Herbert, & Martinez, 2004; Seedat, Stein, Kennedy, & Hauger, 2003). Recently, a study demonstrated that severe IPV victimization involves an absence of the cortisol awakening response (Pinto, Correia-Santos, Costa-Leite, Levendosky, & Jongenelen, 2016), which might indicate the existence of a direct association between the severity of the victimization and the flattening of diurnal cortisol rhythms.

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In addition to cortisol, other neuroactive steroids act as mediators between chronic stress and poor health. Studies have also suggested the existence of alterations in dehydroepiandrosterone (DHEA) levels in battered women. The activity of DHEA is directly regulated by the adrenocorticotropic hormone (ACTH) and secreted primarily by the adrenal gland (Chinnock, Zwickey, Connelly, & Gregory, 2009; Roberts, Geiss, Fawaz, & Lopez-Duran, 2016). In this regard, one study reported that physically and psychologically maltreated women presented higher morning and evening DHEA than non-maltreated women (Pico-Alfonso et al., 2004), suggesting that it is a risk factor for developing depression in this population. Because DHEA demonstrated anti-glucocorticoid effects and diminished the effects of cortisol on neural degeneration (Roberts et al., 2016), the cortisol and DHEA imbalance might be employed as a marker of chronic stress (Kamin & Kertes, 2017; Kroboth, Salek, Pittenger, Fabian, & Frye, 1999; Raison & Miller, 2003). The Blasco-Ros, Herbert, and Martínez (2014) study did not find differences in the cortisol/DHEA ratio (morning and evening) between IPV victims without depressive symptomatology and non-abused women. In fact, only those IPV victims who presented depressive symptoms showed a lower morning cortisol/DHEA ratio than non-abused women. Hence, psychopathology should be considered a mediator factor between IPV victimization and alterations in hormonal levels.

Previous studies have significantly contributed to the literature by illuminating the potential role of several socio-demographic precursors, hormonal correlates, and health outcomes of different types of IPV victimization (Bonomi et al., 2006; Breiding et al., 2005; Hellmuth et al., 2013; Hines & Douglas, 2011). However, there is a gap in the scientific literature about whether IPV victims, especially women, who react violently to couple violence present hormonal alterations (e.g. diurnal cortisol and DHEA patterns). Many studies have analyzed how several coping styles, such as avoidance, problem solving, and social support to deal with IPV, affect victims' self-reported health (Sullivan, Schroeder, Dudley, & Dixon, 2010), but they have neglected to analyze the use of violent strategies to cope with IPV. This issue is associated with the gender symmetry model of IPV, which proposes that IPV is generally symmetrical, but that women's violence tends to be a reaction to male violence (Allen, Swan, & Raghavan, 2009; Cercone, Beach, & Arias, 2005).

With all this in mind, the primary objective of the present study was to examine whether women's (recruited through service centers for abused women) violent reactions to IPV (e.g. screaming, fighting, challenging, etc.) would significantly predict their salivary cortisol and DHEA levels (assessed through two saliva samples per day on four consecutive work days), controlling for the women's prior IPV abuse, depressive and posttraumatic stress disorder (PTSD) symptoms, and demographic variables (e.g. age, educational level, pharmacological treatment, among others). Based on the evidence that severe IPV victimization predicts hormonal disruptions (e.g. cortisol and DHEA) (McBurnett et al., 2000; Platje et al., 2013; Shoal et al., 2003), and that high levels of hostility in couples tend to be associated with higher cortisol levels (Arbel, Rodriguez, & Margolin, 2016), high levels of women's hostility (elevated number of violent reactions) to IPV victimization would be expected to significantly predict disturbances in HPA axis activity (higher salivary cortisol and DHEA levels) – as well as a cortisol/DHEA imbalance. Because effects of women's psychopathology (e.g. depression and PTSD), demographic variables (tobacco, drugs, age, educational level…), and concurrent IPV victimization are involved in HPA disruptions (Garcia-Linares et al., 2004; Inslicht et al., 2006; Kim et al., 2015; Pico-Alfonso et al., 2004; Sanchez-Lorente et al., 2010; Seedat et al., 2003), they were included in the analyses in order to consider their potential effects on the association between women's hostility to IPV victimization and their HPA axis alterations.

Methods

Participants

The final sample was composed of 38 Spanish female victims of IPV. These women were recruited from 24-hour women's aide centers. The present study is part of a larger study whose main objective was to assess the impact of IPV on women's mental and physical health, as well as their hormonal and immunological correlates.

All the participants gave written informed consent. The experiment was performed in accordance with the Helsinki Declaration and approved by the University Ethics Committee.

Procedure

This study was part of a previous longitudinal project that assessed the impact of IPV on victims' health for four consecutive years. Measurements were taken during a baseline period (T–1) and three years later (T–2). Results from this study were obtained during T–2 (psychological and hormonal measurements). During each session, the participant was interviewed in a face-to-face structured interview performed by two trained psychotherapists who asked her about her life (e.g. demographic variables, self-reported health, relationship with the aggressor/partner, type of IPV experienced…). Information was collected about sociodemographic characteristics, intervention treatment, evolution of the relationship with the IPV perpetrator,

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marital status and cohabitation, detection of prior IPV signals, IPV victimization, the development of coping strategies during the period assessed, lifetime history of victimization, functional social support, life events, and mental health (depressive symptoms, thoughts and attempts of suicide, among others) through different questionnaires validated in Spanish and a semi-structured interview (for details, see Blasco-Ros, Sánchez-Lorente, & Martinez, 2010; Sanchez-Lorente, Blasco-Ros, & Martínez, 2012). Among these instruments, we focused on a self-elaborated and non-validated questionnaire that studied the detection of prior IPV signals and coping strategies, specifically the part that analyzed how victims cope with IPV. Each woman was interviewed by the same psychotherapist 4–6 times, due to the length of the questionnaires, with each session lasting 1.5 hours.

Regarding hormonal assessment, participants were asked to provide saliva samples for hormonal analysis. They were instructed to abstain from food, caffeine, alcohol, brushing their teeth, exercise, and any medication in the 2 hr before saliva collection. They provided a minimum of 0.5 ml of saliva in a methacrylate tube twice a day (between 08:00 and 09:00 and between 20:00 and 21:00) on four consecutive days at home, starting the fourth day after the beginning of menstruation. It is critical to have repeated measurements over multiple days to improve measurement reliability (Hellhammer et al., 2007).

Coping with violence

A questionnaire was constructed to obtain detailed information about the different confrontation strategies the women usually employed (e.g. screaming, fighting, challenging, etc.) when they initially detected signs of batterers' abuse. Participants were asked whether they presented certain kinds of verbally hostile reactions (e.g. 'she screamed after identifying the signs of her partner's psychic abuse while living together'; 'she insulted her aggressor after identifying the signs of her partner's psychic abuse while'…); or physically hostile reactions (e.g. 'she pushed her aggressor after identifying the signs of her partner's psychic abuse while living together'…) after IPV victimization. This part of the questionnaire was made up of seventeen dichotomous questions. Women gave answers of either "yes" (= 1) or "no" (= 0) about performing each act. A total score was obtained by adding up all the positive answers, with a high score corresponding to more hostile behaviors. Cronbach's alpha for this study was 0.88.

Self-reported health

The Spanish adaptation (Conde & Useros, 1975) of the Beck Depression Inventory (BDI) was used to assess depressive symptoms (Beck, Ward, Mendelsohn, Mock, & Erbaugh, 1961). Its total score ranged from 0 (= *no symptoms of depression*) to 63 (*severe depressive symptoms*). The internal consistency coefficient was 0.88.

The existence of Posttraumatic stress disorder (PTSD) was assessed with Echeburúa's Severity of Symptom Scale of Posttraumatic Stress Disorder (Echeburúa, Corral, Amor, Sarasua, & Zubizarreta, 1997). This is a structured interview based on DSM–IV–TR criteria, and its internal consistency is 0.92. Its total score ranges from 0 (= *no symptoms of PTSD*) to 63 (*severe PTSD symptoms*).

Hormonal parameters

Saliva was directly collected from the participant's mouth using a methacrylate tube for the analysis of the level of cortisol and DHEA. Participants were informed about the necessity of following the instructions for saliva sampling in order to obtain hormonal data. The samples were frozen at –21 °C until they were analyzed.

Cortisol was measured by validated ELISA on 20 μL samples of saliva (antibody Cambio UK) without extraction (intra-assay variation: 4.1%; inter-assay: 7.6%). DHEA was measured by validated radioimmunoassay on 333 μL samples after extraction into hexane/ether (4:1) (antibody Bioclin; intra-assay variation: 5.1%; inter-assay: 11.2%). All the values were expressed in nmol/L.

To reduce the number of tests, increase power for the effect size, and aid interpretation within a conceptual framework, cortisol and DHEA samples were combined into two single variables (cortisol and DHEA average levels). Moreover, a ratio of cortisol and DHEA levels was employed. Cronbach's alphas for the hormonal parameters ranged from 0.80 to 0.86.

Data Analysis

To analyze the direct association between confrontation strategies and hormonal parameters, we performed regression analyses. To assess the moderating role of the demographic and psychopathological variables, we included these variables as moderators.

Data analyses were carried out using IBM SPSS Statistics for Windows (Version 22.0). The threshold for statistical significance was set at p values $\leq .05$. Average values are reported in the tables as mean ± *SD*.

Results

The means and standard deviations of the abused women's descriptive characteristics are shown in Table 1. Thirty-eight women with ages ranging from 37 to 70 years and a mean age of 51.08 ± 8.03 years were investigated. Regarding the women's profile,

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Table 1. *Mean ± SD of Descriptive Characteristics of Abused Women*

Abused women (n = 38)		
Age (years)		51.08 ± 8.03
Educational level	**Able to read and write**	5%
	Incomplete primary school	24%
	Primary school	50%
	Graduate	13%
	College	8%
Employment status	**Working full or part time, pensioner**	55%
	Unemployed	45%
Type of cohabitation	**None**	29%
	Partial cohabiting	39%
	Full-time cohabiting	32%
Smoke	**Yes**	26%
Drugs	**No**	74%
	Yes	42%
	No	58%
Number of children		2.37 ± 0.85
IPV victimization		
Type of abused received	**Physical and psychological**	58%
	Psychological	42%
Did you suffer maltreatment during the last year?	**Yes**	89%
	No	11%
Time from last assault (months)	8.38 ± 11.65 (ranged from 0 to 40 months)	
Did you psychologically attack the batterer after IPV victimization?	**Yes**	21%
	No	79%
Mean average of confrontations	0.37 ± 0.79	
Did you physically confront the maltreatment?	**Yes**	5.2%
	No	94.,8%
Mean average of confrontations	0.21 ± 0.87	
Self-reported health		
BDI score	12.89 ± 11.90	
PTSD score	8.63 ± 12.75	
Hormone levels		
Cortisol values (nmol/L)	**AM**	9.13 ± 4.48
	PM	1.42 ± 1.37
DHEA (nmol/L)	**AM**	1.32 ± 0.67
	PM	0.82 ± 0.43
Cortisol/DHEA ratio	**AM**	8.50 ± 5.86
	PM	2.06 ± 1.98

a significantly high percentage of the women had completed elementary school (50%), had an average of two offspring, and were employed (55%). Moreover, less than 30% of the participants were smokers, and 42% received pharmacological treatment. Regarding IPV victimization, 34 (89%) of the women had been physically and/or psychically abused in the previous year.

Abused women's aggressive strategies to deal with IPV victimization as predictors of the hormonal parameters (cortisol, DHEA, and cortisol/DHEA ratio)

Psychological confrontation strategies predicted 17.8% of the PM cortisol values (nmol/L) (β = .447, p < .01) and 7.9% of the PM Cortisol/DHEA ratio (β = .322, p < .05). After controlling for demographic variables and psychopathology (depression and PTSD) and the number of months since the last assault, these predictors were still significant (β = .435, p < .01 and β = .349, p < .05, respectively). Nevertheless, psychological confrontation strategies did not predict AM cortisol, AM DHEA, PM DHEA, or the AM Cortisol/DHEA ratio.

Physical and total confrontation did not predict hormonal parameters.

Discussion

The present study examined whether women's violent reactions to IPV victimization would significantly predict

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HPA disruptions, controlling for the women's psychopathology and demographic variables. Our data demonstrated that a high number of violent psychological reactions (e.g. defiant responses, crying, screaming, insults, arguing…) to IPV victimization significantly predicted higher evening cortisol levels and cortisol/DHEA ratio, even after controlling for women's depressive and PTSD symptoms and demographic variables (e.g. age, educational level, tobacco consumption…). However, physical and total confrontation did not predict hormonal parameters.

It should also be noted that, in general, the findings only partially supported the hypothesis that women with higher levels of hostility in response to IPV victimization would report elevated cortisol levels and a greater imbalance between cortisol and DHEA levels (Kamin & Kertes, 2017; Kroboth et al., 1999; Raison & Miller, 2003). If HPA dysregulation indeed predicts IPV victimization in couples, this information will further our understanding of IPV victimization by including psychobiological explanations and facilitating the development of more effective IPV prevention/intervention programs. Emerging evidence suggests that treatment can effectively help to regulate HPA axis activity in certain individuals, such as those with chronic fatigue syndrome (Papadopoulos & Cleare, 2011; Tomas, Newton, & Watson, 2013).

Only a few of the women in the sample were psychologically hostile in reaction to IPV victimization (around 20%), and, thus, this violent profile may have caused alterations in the HPA axis, leading to psychological IPV violent reactions during couple arguments (Feinberg, Jones, Granger, & Bontempo, 2011). Nonetheless, we did not examine hostility levels through self-reports. Thus, it is difficult to demonstrate that these participants are highly aggressive. Another alternative interpretation of the results could be that the positive relationship found in the present study between cortisol, the cortisol/DHEA ratio, and psychological hostile reactions to IPV perpetration would be due to the fact that battered women are chronically stressed. It has been suggested that these individuals tend to report a lack of control and present HPA hyperactivity (Hamilton, Carré, Mehta, Olmstead, & Whitaker, 2015; Rodriguez & Margolin, 2013;).

More importantly, it should be highlighted that only psychological responses to IPV affected HPA activity, but not physical responses or the combination of these two types of violence. In line with these results, we could hypothesize that sequelae following psychological abuse might be more persistent than in the other types of violence. Furthermore, our results might be explained by methodological reasons, such as the possibility that the selected hormonal times are not optimal, or that to understand IPV consequences we cannot focus only on HPA dysregulations, but must also consider their interactions with other brain or hypothalamic systems. In this regard, we did not assess the typical cortisol level increases 30- or 45-min post awakening, that is, the cortisol awakening response (CAR) (Pruessner et al., 1997). This measurement has been considered a good and a reliable marker of HPA dysregulation due to chronic stress, among other psychosocial and contextual factors (Kudielka & Wüst, 2010). Thus, future research should focus on CAR reactivity in these kinds of victims.

Because specific underlying mechanisms through which cortisol and DHEA levels influence women's hostile reactions were not tested in the present study, it is difficult to determine whether there is a direct association between these variables, or if this association is mediated by other factors. Thus, future studies should consider other factors (such as testosterone, immunoglobulines, C-reactive protein, and cardiovascular and skin conductance measures) that may help to explain the association between HPA regulation and violent reactions to IPV victimization, and identify more nuanced pathways from HPA axis activity to IPV victimization in adult women.

A few limitations of the study should be noted. First, although the present study is based on cross-sectional data and a limited sample size, it is not an experimental study. Therefore, causality of the association between variables should be interpreted with caution. Second, only a few women exhibited relatively high levels of psychological and/or physical violent reactions to IPV victimization. This limited variability might have contributed to the significant effects of violent reactions on hormonal levels. Moreover, it should be noted that we employed our own questionnaire, which is not a validated questionnaire. This reinforces the need to validate the questionnaire and the semi-structured interview in order to increase the validity of this manuscript and future research. Furthermore, as suggested by the dual-hormone hypothesis, there may be an inverse and reciprocal association between cortisol and testosterone that facilitates the onset of violence when cortisol levels are low and testosterone is high (Hamilton et al., 2015; Pfattheicher, 2017; Romero-Martínez, González-Bono, Lila, & Moya-Albiol, 2013). However, the role of these two hormones in the prediction of future IPV perpetration could not be examined. It is also worth noting that we employed cortisol and DHEA levels, which is the average of all hormonal measurements. Nevertheless, we did not examine daytime reactivity or the cortisol awakening response. Additionally, as mentioned above, the absence of CAR measurements is a potential limitation, and the CAR should be considered for use in future studies. Therefore, the study findings should be interpreted with caution

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because this parameter only offers information about the total cortisol and DHEA levels, but not about HPA reactivity.

Despite these limitations, the present study presents a number of strengths. Hormonal levels were based on salivary collections assessed twice a day on four consecutive days, which is likely to be a robust indicator of cortisol and DHEA volume. Therefore, the present study provides a rigorous test of the effect of IPV perpetration on hormonal levels. Moreover, the inclusion of control variables in the analysis provides a relatively stringent test of effects of independent violent reactions to IPV on HPA regulation.

In conclusion, the present study indicated that high cortisol levels were significantly associated with higher levels of psychological violent reactions to IPV perpetration in victimized women. Previous research tended to view violence as a homogeneous phenomenon (only considering total and general violence). Findings from the present study contribute to the literature by examining the specific relationship of cortisol and DHEA with psychological hostile reactions to IPV perpetration in couples. Given the relatively high prevalence of IPV in couples in several countries around the world (World Health Organization; WHO, 2013) and the urgent need for effective prevention/intervention efforts, it is important to understand the physiological processes underlying IPV victimization.

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