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**Cortisol, Family Coping and Burden in Informal Caregivers  
of Addicts**

**Cortisol, Coping Familiar e Sobrecarga em Cuidadores Informais  
de Toxicodependentes**

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## Abstract

This study focuses on the prospective mediation role of family coping between burden and cortisol levels in informal caregivers of addicts as well as on the feasible use of two different ways to analyse the salivary cortisol levels. Participants were 120 Portuguese informal caregivers of addicts. The cortisol samples were collected at awakening, 45 minutes later and after a 30 minute presentation of images taken from the International Affective Picture System. Family coping and caregiver burden were measured using the Portuguese versions of the Caregiver Reaction Assessment, and the Family Crisis Oriented Personal Evaluation Scale. Cortisol samples were collected in salivettes and the results were computed in order to determine the Area Under the Curve scores (AUC<sub>g</sub>, AUC<sub>i</sub>). Results found family coping to be negatively correlated with burden and AUC<sub>g</sub> levels (i.e. overall intensity) and positively correlated with either AUC<sub>g</sub> and AUC<sub>i</sub> (i.e. change over time). The mediation model revealed that family coping was a partial mediator in the relationship between the burden and AUC<sub>g</sub> levels. Therefore, Family Coping appears to be an essential variable in understanding the stress response and should be considered in further studies and interventions. In addition, the use of two different formulas for calculating cortisol levels provided important new information concerning the relationship between cortisol, burden and family coping. It seems that burden has a more profound effect on the overall intensity of the neuroendocrine response to caregiver stress and not so much on the sensitivity of the system.

**Keywords:** cortisol, family coping; burden; caregivers; addicts

## Resumo

Este estudo centrou-se na utilização viável de duas maneiras diferentes para analisar os níveis de cortisol salivar e no papel moderador do *coping* familiar entre níveis de cortisol e sobrecarga em cuidadores informais de toxicodependentes. A amostra incluiu 120 cuidadores informais de toxicodependentes. As amostras foram recolhidas ao acordar, 45 minutos mais tarde e depois de uma apresentação de 30 minutos de imagens retiradas do IAPS (International Affective Picture System). O coping familiar e a sobrecarga foram avaliados usando as versões em português do Caregiver Reaction Assessment (CRA) e Family Crisis Oriented Personal Evaluation Scale (F-Copes) respetivamente. As amostras de cortisol foram recolhidas em salivettes e os resultados foram computados, a fim de determinar a área sob a curva (AUC<sub>g</sub>, AUC<sub>i</sub>). Os resultados encontraram que o *coping* familiar encontrou-se negativamente correlacionado com a carga e os níveis AUC<sub>g</sub> (i.e. intensidade global) e positivamente correlacionada com AUC<sub>g</sub> e AUC<sub>i</sub> (ou seja, a mudança ao longo do tempo). O modelo revelou que o coping familiar foi um mediador parcial na relação entre a sobrecarga e os níveis de AUC<sub>g</sub>. Assim, o uso de duas fórmulas diferentes para calcular os níveis de cortisol forneceu novas informações importantes sobre a relação entre o cortisol, sobrecarga e coping familiar. Parece que a sobrecarga tem um efeito mais profundo sobre a intensidade global da resposta neuroendócrina ao stress do cuidador e não tanto na sensibilidade do sistema.

**Palavras-chave:** cortisol, coping familiar; sobrecarga, cuidadores, toxicodependentes

### Introduction

Addiction is a disabling, chronic disorder that places numerous challenges in its management and consequences. It often represents a significant adversity to the informal caregiver due to the implied strenuous tasks and conflicting relationship, which includes frequent patient hospitalizations, legal complications, overall disrupting behaviour and the need for long-term psychosocial and economic support (Alliance, 2006).

The informal caregivers of addicts undergo very stressful situations for long periods of time, in a process that has not been fully studied. These demands are common to caregivers of other illnesses such as depression, dementia, cancer, schizophrenia or bipolar disorder (Perlick, Rosenheck, et al., 2007; Schumacher, et al., 2008; Sewitch, McCusker, Dendukuri, & Yaffe, 2004; Young, Vazquez, Jiang, & Pfeffer, 2006; Zhang, Mitchell, Bambauer, Jones, & Prigerson, 2008).The chronic

stress that these caregivers endure puts them at risk for emotional, mental and physical health problems (Perlick, et al., 2007). Indeed, the impact of caregiving may directly affect the health needs of the caregiver. Different studies have shown that caregivers have lower levels of subjective well-being and physical health than non-caregivers (Brehaut, et al., 2004; Brouwer, et al., 2004; Pinquart & Sörensen, 2003; Schulz, O'Brien, Bookwals, & Fleissner, 1995). Up to 60% of all caregivers have reported fair or poor health status, one or more chronic conditions or a disability, compared to 33% of non-caregivers. Caregivers also reported chronic conditions (including heart attack/heart disease, cancer, diabetes and arthritis) at nearly twice the rate of non-caregivers (45% vs. 24%) (Alliance, 2006). Caregivers suffer from increased rates of physical complaints, including acid reflux, headaches, and pain/aching (Evercare & Caregiving, 2006), increased

tendency to develop serious illness (Shaw, et al., 1997) and have high levels of obesity and bodily pain (Barrow & Harrison, 2005).

The elevated levels of distress and burden have been associated to disturbances in neuroendocrine regulation (Bella, Garcia, & Spadari-Bratfisch, 2011; Steptoe, Gylfe, Shamaei-Tousi, Bergstrom, & Henderson, 2009; Tarrier, et al., 2002). In fact, several studies have demonstrated that caregivers have higher levels of stress hormones and lower levels of antibody responses (Vitaliano, Scanlan, & Zhang, 2003), which may influence their slower wound healing (Gouin, Hantsoo, & Kiecolt-Glaser, 2008). The diminished immune response also puts them at risk for frequent infection and increased risk of cancers (Glaser & Kiecolt-Glaser, 1997; Kiecolt-Glaser, Dura, & Speicher, 1991; Kiecolt-Glaser, Glaser, Gravenstein, Malarkey, & Sheridan, 1996; Vitaliano, et al., 1998). The impact on a person's immune system can go up to three years

after their caregiving role has ended, increasing the possibility for the development of a chronic illness (Kiecolt-Glaser, et al., 2003).

Cortisol analysis is one of the most important tools to better understand the neuroendocrine regulation of the caregiver stress process (Davis, et al., 2004; De Vugt, et al., 2005; Vedhara, et al., 2002). The use of two different formulas for the analysis of cortisol results is one of those tools. The computation of the Area Under the Curve (AUC) has proven to be useful in characterizing the hormonal output (change over time - AUC<sub>i</sub> vs. overall intensity – AUC<sub>g</sub>) and might be beneficial in revealing associations between variables (Pruessner, Kirschbaum, Meinlschmidt, & Hellhammer, 2003).

Considering the stress experienced by the caregivers, as a result of an imbalance between the demands and the resources available, it must be taken into account the role of coping, particularly family coping. In fact, the quality of the

relationship between caregiver and the patient has been related to depression and burden in caregivers and depression, physical functioning and medication adherence in patients (Miller, Bishop, Herman, & Stein, 2007). To some extent, the quality of the relationship can predict 40% of the variance on burden and 22% on depression (Parker, 2008). The specific coping strategies assessed by the instrument Family Crisis Oriented Personal Evaluation Scale (F-COPES, McCubbin, Olson, & Larsen, 1996) has been found to be related with caregiver burden (Minnes, Graffi, Nolte, Carlson, & Harrick, 2000; Pratt, Schmall, Wright, & Cleland, 1985; Redinbaugh, Baum, Tarbell, & Arnold, 2003; Wright, Pratt, & Schmall, 1985). From a definition of coping going back to Folkman and Lazarus, positive coping strategies have been shown to reduce health-related risk factors (Sjogren, Leanderson, & Kristenson 2006). However, different studies have not associated family coping

with burden, which could provide additional and important information regarding the problem-solving behaviors, in families, as they respond to stressors.

In this study cortisol levels (AUC<sub>i</sub>, AUC<sub>g</sub>) and their association to family coping and burden were analyzed in order to evaluate the neuroendocrine response of caregivers of addicts. In addition, family coping was analyzed as a mediator between burden and cortisol levels.

## Method

### *Participants*

Participants were 120 informal caregivers of drug and/or alcohol addicts residing in Portugal. There were 91 females and 29 males, with mean age of 51.51 years. Most of them were married (76.7%) and had high school (33.3%) or elementary (22.5%) education. In spite of the fact that most (66.7%) did not have a diagnosed illness, 56.7% used psychotropic medication. Average caregiving duration was 11.17 years.

### *Instruments*

The demographics/clinical questionnaire asked the caregiver to complete information regarding age, marital status, education and general health as well as the addict's substance abuse number of treatments detoxifications and legal problems. The purpose of this assessment was to have some input on the caregiver's perception of the severity of the family member's addiction consequences.

- Caregiver burden was assessed using the Portuguese version of Caregiver Reaction Assessment (Given, et al., 1992), a 24-item scale designed to measure specific aspects of caregiving, including positive and negative caregiver reactions. It has also been widely used in caregiver studies (Kinsella, Cooper, Picton, & Murtagh, 1998; Nijboer, Triemstra, Tempelaar, Sandermanc, & Bos, 1999; Sousa, 2005). A total score can be computed, in which higher scores suggest a more severe impact of burden on the

caregiver daily life (Gro, Fosså, Tonnessen, & Dahl, 2006). Prior studies have reported Cronbach's alphas ranging from .80 to .90 (Given, et al., 1992; Gro, et al., 2006; Kinsella, et al., 1998; Nijboer, et al., 1999). Cronbach's alpha in the current study was .95.

- Family coping was assessed using the Portuguese version of Family Crisis Oriented Personal Evaluation Scale (F-COPES), a 29-item scale aimed at identifying problem-solving behaviors in families as they respond to difficulties or crises (McCubbin, et al., 1996; Vaz Serra, 1990). Higher scores suggest a greater family ability to cope with stressful situations. Prior studies have reported Cronbach alpha for the global score ranging from .86 to .87 (Azevedo, 2007; McCubbin, Thompson, & McCubbin, 2001). In this study Cronbach alpha was .86.

-Cortisol levels were assessed by participants'saliva i.e., caregivers were asked to collect saliva by placing a sterile

cotton wad in their mouth for a few minutes and then sealing the cotton in a salivette (Sartstedt Inc., Rommelsdorf, Germany). The samples were coded and kept cooled until shipped for assay at Dresden Technical University. The results (AUC<sub>g</sub>, AUC<sub>i</sub>) were computed using a tailored formula proposed in Pruessner, et al. (2003) to fit a three sample measure<sup>1</sup>.

The protocol included a psychological stress situation was presented to the participants on the same morning that the cortisol samples were collected. This was done to assure that the cortisol assessment proceeded under a standardized condition, eliciting a stress response. This test consisted in a 30 minute PowerPoint presentation of images taken from the International Affective Picture System (Lang, et al., 2005). The images presented had pleasant (e.g. baby

smiling)<sup>2</sup>, unpleasant (e.g. drug abuse)<sup>3</sup> and neutral valence (e.g. chair)<sup>4</sup>, and were balanced and counterbalanced in order to avoid practice, fatigue or order effects. The criteria used for the image selection were the relevance to addiction and the higher valence scores (Lang, et al., 2005; Moltó, et al., 1999; Ribeiro, Pompeia, & Bueno, 2005).

### *Procedure*

Caregivers were contacted in therapeutic communities in the north region of Portugal, where the patients were undergoing treatment. They were also contacted in self-help support groups and in local community services. Participation was voluntary. After informed consent, demographics were collected, and participants completed the questionnaires.

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<sup>2</sup> IAPS picture numbers 1440, 1604, 1710, 1750, 1811, 1900, 2341, 2360, 2540, 2550, 2660, 5200, 5760, 5831 and 8420

<sup>3</sup> IAPS picture numbers 2710, 2751, 2752, 2753, 3220, 3230, 6010, 6250, 6360, 6550, 9007, 9102, 9910, 9911 and 9912

<sup>4</sup> IAPS picture numbers 6150, 7002, 7006, 7009, 7010, 7020, 7025, 7030, 7040, 7050, 7150, 7175, 7185, 7190 and 7235

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<sup>1</sup>  $AUC_g = (B+A)/2 + (C+B)/2$ ;  $AUC_i = ((B+A)/2 + (C+B)/2) - 2xA$

They were also presented with two salivettes marked with “at awakening - A” and “45 minutes after - B”. These two salivettes were to be used the next morning, at which point the participants would undergo a psychological stress test. After the presentation, the participants were asked to use a third salivette marked “after IAPS - C”. The three samples, used in that day were then stored and kept cooled until shipment.

The presentation and sample collection occurred in the University of Minho Experimental Psychology Laboratory or in a selected room in the location where the participant was first contacted. The participants did not report any unusual situations prior to sampling. In fact, one of the questions in the cortisol reception protocol was related to the caregiver’s everyday experience of the last few days prior to the study. The protocol was designed to exclude participants that could present atypical results. The standardized situation was designed to

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ensure that every participant’s cortisol collection was homogeneous and simultaneously elicited a stress response in order to determine a relationship between the psychological and physiological variables.

The study was approved by the scientific Committee of the University of Minho. All participants signed an informed consent.

### **Data Analysis**

Data regarding association among variables was analysed using Pearson correlations. The model of mediation was first tested in SPSS v.21 , using the macro developed by Preacher and Hayes (2008), with a Bootstrap sample of 5000 and a confidence interval of 95%.

### **Results**

#### ***Relationships between Family Coping, Burden, and Cortisol levels***

The correlations among family coping, burden, and cortisol levels were



significant. Family coping was negatively correlated with burden ( $r = -.27$ ;  $p < .01$ ) and AUCg ( $r = -.34$ ;  $p < .01$ ) and positively correlated with AUCi ( $r = .35$ ;  $p < .01$ ) and AUCi ( $r = .22$ ;  $p < .05$ ) (Table 1). In previous studies, the influence of age

and gender on cortisol levels were found to be significant (Pruessner, Hellhammer, & Kirschbaum, 1999; Pruessner, et al., 1997), however, this was not evident in this sample.

**Table 1**

*Correlations among Burden, Family Coping and Cortisol levels (nmol/l) (N=120)*

	1	2	3	4
Burden	-			
Family Coping	-.27**	-		
AUCg	-.34**	.35**	-	
AUCi	-.131	.22*	.49**	-
Mean (SD)	46.81 (16.11)	92.26 (14.80)	31.04 (12.74)	8.22 (8.81)

\*\* $p < .01$ ; \* $p < .05$

***Family Coping as a Mediator between Burden and Cortisol levels***

Since burden and AUCi were not correlated, the conditions to test for mediation were not present (Preacher, Rucker, & Hayes, 2007). Therefore, a

mediation effect was tested for the relationship between burden and AUCg.

The results showed that each of the separate indirect effects as well as the total indirect effect is significant (Table 2). The computation of the ratio of indirect to direct effect was .27 [-.0579 / -.2150] and

the proportion of the total effect due to the indirect effect was .21  $[-.0579 / (-.0579 + (-.2150))]$ . Therefore, family coping was a

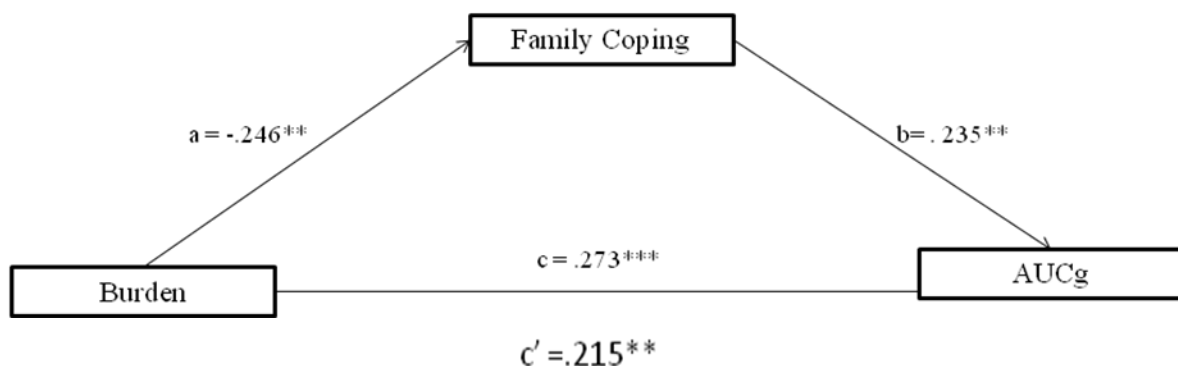
partial mediator of the relationship between family coping and burden and the strength of the mediation is 21%.

**Table 2**

*Burden effect on Cortisol Levels through Family Coping*

(N=114, Bootstrap = 5000, C. I. = 95%)

Predictors/Outcomes	Coefficient	se	t	p
Path a Burden/Family Coping	-.246	.084	-2.91	.004
Path b Family Coping/AUCg	.235	.076	3.08	.003
Path c and c' Burden/AUCg	-.273	.071	-3.85	.002
AUCg/Family Coping	-.215	.071	-3.03	.003



**Figure 1.** Family Coping as a partial mediator in the relationship between burden and cortisol levels

### Discussion

The influence of psychosocial stress on hormonal levels has long been a matter of study. This has mainly occurred due to the impact on caregiver health status, either by the propensity to develop chronic conditions or psychosomatic complaints. This study focused on assessing the neuroendocrine response of caregivers of addicts, measure by the computation of two distinct formulas. The AUC<sub>g</sub> is a measure related to the total hormonal output. Our findings revealed a negative association between AUC<sub>g</sub> and burden. Considering these results, it is possible to assume, in situations of an increase in typical psychosocial caregiver stress, that the endocrinological response involves a down regulation of cortisol production. Hypocortisolism has also been found in populations that report chronic stress and even PTSD symptoms (Glover & Poland, 2002; Yehuda, 2000) which may suggest that caregivers of addicts may experience these symptoms. As a result,

caregivers may experience physical consequences such as weakness, dehydration, hypotension, irritability, depression and lowered immunity/inflammatory response (Shelby & Kathryn, 2001). However, the results also showed a positive association between AUC<sub>g</sub> and family coping. This result may indicate that the detrimental stress effects require more family coping skills. In addition, the positive association with AUC<sub>i</sub>, which provided information regarding the sensitivity of the system, further corroborates this dynamic view of the family coping process. These findings have been partially corroborated by recent studies (Turner-Cobb, et al., 2010).

The mediation model showed a significant influence of family coping on cortisol levels. This finding further validates the notion that problem-solving skills have an indirect but significant influence on the global hormonal output. Therefore, it seems that although family

coping plays an important role on hormonal stress regulation, other variables may also affect the more sensitive and immediate response. Therefore, there is a need for more research on variables affecting AUC<sub>i</sub> scores. Additionally, health care professionals must take in consideration family variables when designing interventions to reduce burden in caregivers of addicts.

This study has some limitations that need to be acknowledged: caregivers were volunteers, and some participated in self-help groups which may have represented a different sample of the general population without access to any support. Cortisol was sampled over a single day with only three samples, and it has been recommended that cortisol profiles should be recorded over several days with at least five samples to establish reliable profiles. Future studies should asses other family variables as protective factor between burden and cortisol levels as well as other physiological parameters,

on this population. Despite the importance of cortisol in health, this sole parameter is insufficient to explain caregivers' physical health condition, hence it will require additional studies that include biological indicators of health status and its relationship with psychosocial variables. These indicators may be related to the general evaluation of physical health (e.g. BMI, cholesterol levels, blood pressure), as well as specific to immune function since biological markers of stress, provide valuable information that can guide therapeutic interventions.

The association between cortisol responses and cortisol AUC<sub>g</sub> provides evidence that despite the stress testing involving short-term stimuli, variations in cortisol responses nevertheless predict output over the day. Family coping in this study only functioned as a partial mediator, emphasizing the need to look for other variables that may also mediate the relationship between burden and cortisol levels. Finding the variables that influence

cortisol levels, may provide valuable insights into the pathways between family

variables and cortisol that contribute to health outcomes.

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