SHORT COMMUNICATION

Associations of cortisol with posttraumatic stress symptoms and negative life events: A study of police officers and firefighters

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Summary   Given the inconsistent associations of cortisol with posttraumatic stress disorder (PTSD), analysis of basal functioning of the hypothalamic—pituitary—adrenal (HPA) axis in subjects frequently exposed to trauma and critical incidents with a range of PTSD symptomatology, may be valuable. In an epidemiological sample of 1880 police officers and firefighters, associations of salivary cortisol with PTSD, negative life events (NLE) and exposure to a major air disaster more than 8 years earlier, was explored. Probable PTSD was unrelated to cortisol level while past (>8 years earlier) and more recently experienced NLE were associated with lower cortisol levels even after adjustment for confounders. Disaster exposure interacted significantly with PTSD symptoms on cortisol level. In the disaster-exposed subgroup, PTSD symptomclusters of intrusion and hyperarousal (in particular sleep disturbances), were associated with lower and higher cortisol levels, respectively. A final model using backward elimination strategy, retained time of saliva sampling, smoking, gender, and NLE > 8 years earlier in the total sample, and additionally symptomclusters of intrusion and hyperarousal in the disaster-exposed subgroup. The final model explained 10% of the variance in cortisol. The findings are discussed in relation to literature on posttraumatic stress and basal functioning of the HPA-axis.
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Posttraumatic Stress Disorder (PTSD) has been associated with neuroendocrine changes related to the traumatic exposure preceding this disorder, such as the release of cortisol by the hypothalamic—pituitary—adrenal (HPA) axis. Particularly alterations in the basal activity of the HPA-axis reflected by hypocortisolism are thought to be a significant factor in the development of stress-related disorders like PTSD (see review of Fries et al., 2005). A meta-analysis of 37 studies showed, however, no significant difference in pooled cortisol levels between PTSD subjects and healthy controls while lower cortisol was related to being female and to PTSD following physical and sexual abuse specifically (Meewisse et al., 2007).

Because basal activity of the HPA-axis has often been assessed in highly symptomatic samples of traumatized combat veterans or victims of abuse, findings from samples with a wider range of symptomatology such as community samples (e.g., Young and Breslau, 2004), can add valuably to the literature. In this respect, findings regarding cortisol levels in samples of for example police officers or firefighters, who are frequently exposed to (work-related) traumatic events and at risk of developing PTSD while at the same time relatively healthy, are of interest as well (e.g., Neylan et al., 2005).

In this report we explored the association between a proxy of basal salivary cortisol and PTSD in an epidemiological sample of police officers and firefighters by comparing cortisol levels of subjects with probable PTSD to subjects without probable PTSD. We hypothesized that PTSD+ subjects would not have significantly different salivary cortisol levels compared to PTSD− subjects. Furthermore, we explored associations of cortisol with PTSD symptomclusters, negative life events (NLE) and exposure to a major air disaster in 1992 with linear multiple regression models and fitted a final model that best explained variance in cortisol.

1. Method

1.1. Subjects

The study sample consisted of 1880 police officers and firefighters from the Epidemiological Study Air Disaster Amsterdam (ESADA). Subjects participated in this study either as professional exposed to the air disaster or as non-exposed control. Excluded were subjects who had cortisol outliers of 50 nmol/l or higher ($n = 3$), were treated with prednisone or prednisolone ($n = 12$), had a shortage of saliva ($n = 112$), or had no recorded time of saliva sampling ($n = 2$). Recruitment of subjects, response rate and study design including descriptions of questionnaires assessing demographic information have been described in detail elsewhere (Slottje et al., 2005). All subjects signed informed consent and participated voluntarily.

1.2. Procedure

During a 2-h hospital visit scheduled either in the morning (900 h and 1200 h), noon (1200 h and 1430 h), or afternoon (1430 h and 1630 h), saliva and blood samples were collected and questionnaires were completed. The factual time of saliva collection was recorded. Self-report data on disaster exposure and employer information was used to assess disaster exposure.

1.3. Measures

Subjects completed the 22 items of the Self-rating Inventory for PTSD (SRIP; Hovens et al., 2002) resembling the three PTSD symptomclusters (DSM-IV, APA, 2000) in relation to unspecified past events, and the 15 intrusion and avoidance items in reaction to the disaster of the Impact of Event Scale (IES: Horowitz et al., 1979). Previously determined cut-off values of 39 and 25, respectively, on the SRIP and IES were indicative of probable PTSD. Fifteen NLE based on the Social Readjustment Rating Scale (Holmes & Rahe, 1967) were scored with regard to experience before and/or after the disaster in 1992 and were subcategorized into A: events that had threatened subjects own health and social- or occupational functioning (e.g., Serious illness or injury or other significant changes in your own health), B: events that had threatened the health or life of close relatives (e.g., The death of your partner or other immediate family or relatives), and C: events that likely fullfilled criterion A1 of the DSM-IV (e.g., 'Victim of traffic accident'). Some category C events were endorsed by many subjects indicating that these events were experienced during work (e.g., Seeing that someone was badly injured or seeing somebody die').

1.4. Salivary cortisol

Saliva was collected with Salivettes (Sarstedt, Inc., Numbrecht, Germany), a plastic tube containing a cotton—wool swab on which the individuals were instructed to chew lightly. In the laboratory, the saliva samples were centrifuged and frozen at $-20°$ C. With competitive immunoassay, i.e., the Spectria Cortisol Coated Tube Radioimmunoassay Reagents Kit (Orion Diagnostica, Espoo, Finland), and a gammacounter (Gammacounter Wizard 1470, PerkinElmer) the concentrations of cortisol in saliva were computed.

1.5. Statistical analysis

The Statistical Package for Social Sciences (SPSS, version 16.0 for Windows XP) was used to apply chi-square and t-tests for comparison of descriptive variables between PTSD+ and PTSD− subjects and for multiple linear regression models to explore associations between cortisol and independent variables, both crude and adjusted for potential confounding variables. Confounding variables, i.e., factual time of saliva sampling, age, gender and smoking, were chosen according to their statistical and clinical relevance to cortisol levels. Subgroup analyses were conditional upon significance of interaction between independent variables on cortisol. To arrive at a final model explaining most variance in cortisol, we used backward elimination method to allow each variable to be included. With each subsequent analysis the least significant variable in the model was removed until all remaining variables had individual p-values smaller than .10.

2. Results

2.1. Descriptive analyses

Prevalence rate of probable PTSD in this sample was 5.2%. Compared to PTSD− subjects, PTSD+ subjects were slightly older and more often reported to be exposed to NLE and to the disaster (Table 1). Although PTSD symptom