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Effort-reward-imbalance and overcommitment are associated with hypothalamus—pituitary—adrenal (HPA) axis responses to acute psychosocial stress in healthy working schoolteachers

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Summary In this study, we examined HPA axis responses to acute psychosocial stress in relation to effort-reward-imbalance (ERI) and overcommitment (OC) to test whether chronic stress at work is accompanied by altered HPA axis stress responses in teachers. According to Siegrist's work stress model, ERI reflects stress due to a lack of reciprocity between personal costs and gains at work, whereas OC is conceptualized as a personality trait mainly characterized by the inability to withdraw from work obligations. Fifty-three medication-free, non-smoking, healthy teachers (33 women, 20 men, 29—63 years, mean age 49.9 ± 8.58 years) were confronted with the Trier Social Stress Test (TSST), a widely used standardized stress protocol to induce acute psychosocial stress in the laboratory. ACTH (five samples), total plasma (six samples) and free salivary cortisol (eight samples) were repeatedly measured before and after challenge. In the total group, ERI and OC were only marginally associated with HPA axis responses to acute stress. However, in the subgroup of responders ($N = 30$) high levels of OC were significantly associated with lower ACTH ($p = 0.03$) as well as plasma ($p = 0.02$) and salivary cortisol ($p < 0.001$) responses and results remained significant controlling for depressive symptoms. When additionally controlling for acute perceived stressfulness of the TSST, significant associations between OC and HPA axis responses emerged in responders as well as the total study sample. In respect to ERI, higher stress levels were solely related to significantly stronger plasma cortisol increases after TSST exposure, but this effect became non-significant controlling for depressive symptomatology. In sum, our findings support the notion of HPA axis hyporeactivity in highly overcommitted schoolteachers.

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1. Introduction

Psychosocial workplace characteristics have recently been implicated in the genesis of chronic work stress (Siegrist et al., 2004). The model of effort-reward-imbalance (ERI) suggested by Siegrist and co-workers is rooted in the notions of reciprocity and fairness as the basic grammar of social exchange. It provides a conceptual framework for possible associations between chronic work stress and adverse health outcomes by postulating that personal self-regulation, which is assumed to impact on health and well-being, is dependent on distributive justice. Threats to successful social exchange, for example a lack of reciprocity between personal costs (effort) and personal gains (reward) at the workplace are assumed to elicit stress, consequently increasing the risk for stress-related disorders (Siegrist, 2002). Efforts represent job demands and obligations imposed on the employee, whereas rewards are conceptualized as three distinct categories, namely financial reward, esteem and security/career opportunities. Thus, a working individual not receiving the adequate appreciation for her or his efforts at the work place, potentially experiences stress as reflected in ERI. Furthermore, in this model the inability to withdraw from work obligations combined with a high need for approval was conceptualized as a personality trait called overcommitment (OC). OC reflects a cognitive-motivational pattern of coping with demands based on elements of Type A behaviour that reflect an extreme ambition in combination with a special need for control and approval (see van Vegchel et al., 2005). Thus, overcommitted individuals tend to repeatedly exaggerate their efforts at work while at the same time overtaxing their resources. This consequently diminishes their potential to recover from job demands which eventually results in exhaustion and poor health (Siegrist, 2001; Preckel et al., 2005).

Numerous studies have applied the ERI/OC model to different health outcomes. High ERI has been found to be related to increased risk for cardiovascular disease, type 2 diabetes, depression, alcohol dependence, and sleep problems (Tsutsumi et al., 2001; Kivimäki et al., 2002; Kudielka et al., 2004b; Kumari et al., 2004; Kouvonen et al., 2006). Whereas OC has been shown to be associated with musculoskeletal pain (Joksimovic et al., 2002), incidence of cardiovascular disease (Bosma et al., 1998; Kivimäki et al., 2002) as well as cardiovascular risk factors like elevated blood lipids and blood coagulation factors (Vrijkotte et al., 1999). According to Siegrist's conceptualization (Siegrist, 2002) ERI leads to a state of distress, thereby activating the two major stress axes, the sympathetic—adrenomedullary system (SAM) and the hypothalamic—pituitary—adrenal (HPA) axis. These neuroendocrine systems regulate the adaptation to increased demands and enable the organism to maintain homeostasis under acute stress. Under chronic stress however, this originally adaptive response can have numerous deleterious consequences. Thus, impaired functioning of HPA axis regulation has been associated with several stress-related diseases and psycho-pathologies (for reviews see Heim et al., 2000; Raison and Miller, 2003; Miller et al., 2007).

To-date, there is a paucity of data on the relationship between HPA axis regulation and ERI or OC. So far, only four studies have investigated the association between model components (namely ERI and OC) and basal HPA axis regulation. A first study by Hanson et al. (2000) could not find significant associations between ERI/OC and salivary cortisol levels using the experience sampling method. Seventy-seven subjects (health professionals and office clerks) collected saliva samples and simultaneously answered diary questions at semi-random intervals up to ten times over the course of a day. In this study, neither ERI/OC nor a momentary demand-satisfaction-ratio was significantly associated with salivary cortisol levels. Steptoe et al. (2004) investigated whether ERI/OC are related to the free cortisol increase after awakening as well as salivary cortisol profiles over a working day in 86 men and 79 women from the Whitehall II cohort. They could show that OC is positively associated with the increase in salivary cortisol after awakening in men but not in women. Furthermore, they report a main effect of OC on free cortisol day profiles in men, an effect which is mainly driven by higher cortisol values at a single time point (14—1430 h). Eller et al. (2006) measured free cortisol responses to awakening and two additional salivary cortisol samples over the remainder of the day in 83 healthy subjects. In women, they observed a higher cortisol awakening rise (CAR) with higher ERI. In men, effort, ERI and OC were associated with a higher CAR as well as higher free cortisol levels throughout the day. In a recent analysis of salivary cortisol day profiles across two working days and one leisure day, we could not find an association between ERI/OC and basal HPA activity in an own cohort of healthy teachers (Bellingrath et al., 2008). However, applying a low dose dexamethasone suppression test (0.25 mg) in 120 teachers we observed a stronger cortisol suppression in teachers with low reward from work suggesting an increased HPA axis negative feedback sensitivity. Finally, Wirtz et al. (2008) were the first to investigate the relationship between the model component OC and salivary cortisol responses to acute psychosocial stress in 50 healthy men. Applying the Trier Social Stress Test (TSST), they showed that higher OC scores were associated with lower levels of salivary cortisol.

To the best of our knowledge, there is yet no study available that analyzed whether the different components of the ERI/OC model (namely the subscales effort and reward, ERI ratio and OC) are associated with HPA axis regulation in men and women under acute psychosocial stress in terms of adrenocorticotropin (ACTH), total plasma cortisol as well as free salivary cortisol responses. To answer this question, we therefore recruited working healthy male and female schoolteachers. Teachers have been chosen since the teaching profession has been repeatedly described as a potentially stressful occupation (Guglielmi and Tatrow, 1998), as reflected in alarmingly high rates of early retirement among German schoolteachers (Weber et al., 2001). Thus, the aim of the present study was to investigate possible associations between all scales of the ERI/OC model and HPA axis responses to acute psychosocial stress in male and female teachers.

2. Methods

2.1. Participants and general experimental outline

Sixty-two currently employed schoolteachers from the region of Trier (Germany) and Luxembourg (Luxembourg) consented