

Long Term Need for Recovery

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Does Long-Term Need for Recovery and Trait Rumination Affect Morning and Evening
Saliva Cortisol Secretion?

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Subjective need for recovery from work reflects short-term problems recuperating after work and is a possible early precursor of more severe work-related exhaustion or distress. Also perseverative cognition has been assumed to play a central role in the stress process. The aims of this study were to investigate the long-term influence of need for recovery and trait rumination and their interaction on morning and evening saliva cortisol secretion. The sample consisted of 76 white-collar workers, 52 males and 24 females who all provided baseline data almost 4 years earlier and also volunteered to participate in a field study where saliva cortisol secretion was measured over seven consecutive days: at wake-up and at 10 p.m. There was a significant drop from work to weekend levels in morning saliva cortisol secretion but none of the input variables affected this measure. On the other hand, both baseline need for recovery and trait rumination significantly affected evening saliva cortisol levels. A tentative conclusion from this study is that evening saliva cortisol secretion is mainly affected by long-term strain.

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Fatigue can be understood as a continuum, ranging from the everyday experienced mild variant to chronic and health damaging conditions (Jansen, Kant & van den Brandt, 2002; Lewis & Wessely, 1992). While short-term fatigue is seen as a harmless phenomenon, severe fatigue and exhaustion has been recognized as a possible cause for and/or an important component in several major work-related mental health problems, e.g. burnout or Chronic Fatigue Syndrome (Lewis & Wessely, 1992; Michielsen et al., 2003; 2004; Sluiter, Frings-Dresen, van der Beek & Meijman, 2001). Contrary to the commonly held assumption that exhaustion is mainly influenced by temporary work situations, Michielsen et al. (2004) conclude that fatigue and exhaustion are relatively persistent over time, and that studies of this phenomenon require a longitudinal design. An earlier review reported the mean duration of chronic fatigue to be 10.6 years for women and 7.9 years for men (Lewis & Wessely, 1992). Strenuous working conditions and job-related strain have been identified as important causal agents of fatigue and the ordinary type of respites from work may not always be enough to recover from all types of work-related fatigue (Eden, 2001; Jansen et al., 2002; Kuiper, van der Beek, & Meijman, 1998; Sluiter and colleagues 1999, 2001; Sonnentag & Zijlstra, 2006).

Unwinding following stress exposure is necessary for the physical and psychological recovery process and persistent failure to unwind is thought to be detrimental to health because it wears down the body's physiological restorative system (McEwen, 1998). Several authors have suggested that the speed and completeness of recovery may be as important in the aetiology of disease and illness as the acute reactivity in response to the stress exposure (Brosschot, Thayer & Pieper, 2005; Kuiper et al., 1998; Linden, Earle, Gerin & Christenfeld, 1997; Ursin & Eriksen, 2004). Recovery has been defined as “the post-stress rest period that provides information about the degree to which the reactivity in the physiological and psychological parameters measured persists after the stressor has ended” (Linden et al., 1997, p.117) The process of recovery from stress exposure is of central interest in contemporary research and is the focus of the present paper.

The subjective need for recovery from work is considered to reflect short-term problems recuperating after work but has also been suggested as an early precursor of more severe work-related exhaustion or distress (Jansen et al., 2002; Sluiter and colleagues, 1999; 2000; 2001). Longer periods of inability to recover from work may cause the onset of a vicious cycle, where previous incomplete recovery requires extra effort to meet the demands of work, which in turn creates additional need for recovery. This sustained process of incomplete recovery and forced effort mobilization can be assumed to affect health, and has been found to be associated with secretion of stress hormones, self-reported health complaints (Sluiter et al., 1999; 2001) and to have a long-term impact on sickness absence (de Croon et al., 2003).

Psychoneuroendocrinal mechanisms in the stress process

The sympathetic adrenal-medullary system (SAM), regulating the secretion of the catecholamines adrenaline and noradrenaline, and the hypothalamic pituitary adrenal-cortical (HPA) system, controlling cortisol secretion, constitute the main components of physiological stress response (e.g. Kristenson, Eriksen, Sluiter, Starke, & Ursin, 2004; Lundberg, 2005). Cortisol secretion is associated with increased energy release, and with suppression of the inflammatory response and immune response and is one of its most important functions is to protect the organism against its own self-defence systems

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(Kristenson et al., 2004). The HPA system follows a clear circadian rhythm with highest levels in the early morning and continuous decrease over the course of the day to reach its nadir in the late evening around 10 pm (e.g. Kirschbaum & Hellhammer, 1989; Kudielka, Schrommer, Hellhammer & Kirschbaum, 2004).

Cortisol has been described as “the primary mechanism through which chronic stressors get inside the body to bring about disease” (Miller, Chen and Zhou, 2007 p. 25). For instance, sustained cortisol secretion has been assumed to lead to e.g. metabolic dysregulation (Chandola, Brunner & Marmot, 2006). A number of studies have reported an association between job strain and elevated morning cortisol secretion (e.g. Lundberg & Hellström, 2002; Steptoe, Lundwall & Cropley, 2000; Schultz, Kirschbaum, Pruessner, & Hellhammer, 1998; Sluiter and colleagues, 1998; 2001). Cortisol secretion has also been found to increase under in situations that evoke feelings of uncertainty, anxiety or negative experiences (Kirschbaum & Hellhammer, 1989; Pruessner, Hellhammer & Kirschbaum, 1999; Steptoe, Cropley, Griffith and Kirschbaum, 2000). Some studies that have investigated chronic stress exposure however, have reported a reduction in cortisol secretion (Gunnar & Vazquez, 2001; Heim, Ehlert & Hellhammer, 2000; Miller et al., 2007). Hypocortisolism is a challenge that research has not been fully able to explain. In a recent review of the literature, Miller et al., (2007) argue that the time since onset of the stressor may determine the nature and direction of the cortisol response. The findings of the review suggest that chronic stress exposure may to be associated with reduced morning cortisol but an increased afternoon/ evening cortisol concentration.

Cognitive activation and psychophysiological arousal

Cognitive activation theory (e.g. Brosschot and colleagues, 2005; 2006; Ursin & Eriksen, 2004) provides a link between stress exposure and psycho-physiological arousal. Stress can be defined as physiological alarm in a homeostatic system and occurs when there is something missing or when the organism perceives a discrepancy between “what should be and what is” (Ursin & Eriksen, 2004). Despite the physiological definition of the stress response, the cognitive appraisal of a potential stressor by the individual is given a central role in the theory. When the individual perceives an imbalance of the type described above the physiological stress response is triggered off which puts the organism in a state of arousal. In the short term this state of arousal is part of an adaptive general alarm system whereas sustained periods of arousal have been associated with potentially harmful consequences (Ursin & Eriksen, 2004). While short spells of stress-induced arousal are considered as a healthy adaptive response to a mismatch between the individual needs and factors in the environment, it is assumed that damaging health effects are brought about by prolonged or repeated stress exposure and sustained arousal (e.g. Brosschot and colleagues 2005; 2006; McEwen, 1998; Ursin & Eriksen, 2004). Frequent stress, failed shut-down of the stress reactivity or inadequate response to challenges causes allostatic load (McEwen, 1998), or sensitization (Eriksen & Ursin, 2004), which have been identified as potentially pathogenic conditions eventually leading to ill-health.

Within the framework of cognitive activation theory Brosschot et al., (2006) identifies perseverative cognition as a pathway between stress exposure and psycho-physiological reactivity and eventually ill-health. According to Brosschot and colleagues stressors do not themselves directly onset the development of chronic ill-health outcomes in the stress process, this is rather brought about by the cognitive representation of the stressor which

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may prolong the impact of the harmful stress exposure with sustain psycho-physiological activation. Perceived lack of control of the stressor is according to Bosschot et al., (2006) a further prerequisite for a possible onset of worrying and rumination – which has been defined as a "passive and repetitive focus on the negative and damaging features of a stressful transaction" (Skinner, Edge, Altman & Sherwood, 2003, p. 245). Rumination has been associated with increased cortisol secretion as well as with delayed recovery after stress exposure (Roger & Narajan, 1998). The purpose of this study were to analyse the long-term impact from need for recovery from work and trait rumination and their interaction on morning and evening saliva cortisol secretion.

Method

Participants

The participants were white collar workers from six organizations across England who had previously participated in a study on stress and musculoskeletal disorders (MSD) (Devereux, Rydstedt, Kelly, Weston, & Buckle, 2004). Extensive longitudinal data on working conditions, strain reactions and a number of personality traits had been collected four years earlier. Letters were sent to 561 potential volunteers inviting them to participate in a study of work-related rumination and job strain. In all 81 people agreed to take part in the study. Four persons were excluded from the study - two failed to complete the saliva sampling and one person was found to have been misclassified in regard to occupational status. Further, from the diary entries it became clear that one participant had completely misunderstood the procedural instructions for saliva sampling.

The final sample for this study thus consisted of 76 persons, in all 52 (68%) males and 24 (32%) females participated, ranging in age from 25-62 years during the time of the field study, with a mean age of 45.8 years. In terms of occupational classification, the majority of the participants (57%) worked in professional occupations, whereas one in four (24%) were classified semi-professionals, 11% held managerial positions while the remaining 8% worked in secretarial/administrative professions. Three participants worked part-time, at baseline as well as during period of the field study while the remaining 73 persons reported to work full time, the participants on average worked 39.9 hours per week at baseline and 38.4 at the follow-up.

Procedure

Individuals were contacted by telephone and/or e-mail and meetings were arranged with a research assistant at each participant's place of work. At the meeting each participant was given a paper questionnaire, a 7 day paper diary, fourteen saliva collection tubes and instructions on how to use the research materials. After seven days the materials were collected by the research assistant.

Instruments

Questionnaire data

Information on demographic and occupational factors were taken from the 2001 baseline questionnaire of the 'Stress and MSD' study (Devereux et al., 2004) and a questionnaire distributed to participants for the present 2005 field study. The baseline questionnaire also included the Need for Recovery from Work Scale (Van Veldhoven & Meijman, 1994; English version presented in Sluiter et al., 1999). This scale includes 11 items aiming at daily fatigue and recuperation from work with Yes/No response alternatives and has a range between 1.0—2.0, where a lower value indicates a higher need for recovery. Examples of items are: "*At the end of a working day I am really*

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feeling exhausted”, “*When I get home, people should really leave me alone for some time*”. The alpha coefficient for this scale was .79. The mean value of baseline need for recovery from work was 1.50 (Sd 0.32).

Trait rumination was assessed with a scale of 18 items with true/false alternatives, developed by Roger, Guarino & Olason (2000). Examples of items include: “I’m often preoccupied with worries about my future”, “my failures give me a persistent feeling of remorse”. Also the rumination scale ranges between 1.0—2.0 The mean value for the rumination scale was 1.70 (Sd 0.30) and the alpha coefficient was .82

Psycho-physiological measures. Saliva cortisol secretion was used as an indicator of psycho-physiological reactivity and measured over seven consecutive days to include a full working week as well as the weekend. Two measures were taken each day: one in the morning and one during the evening. Saliva samples were collected with salivettes, plastic vials containing small cotton dental rolls. Participants were asked to place the cotton roll in their mouth until it was saturated with saliva. They were instructed to collect their saliva before bedtime at 10 pm and immediately after awakening. The time of going to bed, the time of awakening and the exact time of every saliva sampling was recorded in the diaries. Participants were instructed not to brush their teeth or drink tea, coffee, or caffeinated beverages before the morning saliva sampling and were also instructed not to consume alcohol or citrus drinks one hour before the evening saliva sampling. They stored their samples in a re-sealable plastic bag in the freezer compartment of their home refrigerator. The samples were then collected and stored at -20° (-13°F) until transported and assayed in the laboratory at Technical University Dresden, Germany. As recommended in the literature (Dressendörfer et al. 1992), cortisol readings three standard deviations or more away from the group mean were considered as outlying and replaced with the individual mean for the work week readings in accordance with standard protocol.

Data analyses

Since both the independent variables showed skewed distributions (-1.06 for rumination; -0.20 for need for recovery) we considered regression analysis as less appropriate. Instead ANCOVA was used for the analyses, with dichotomized need for recovery at baseline and trait rumination scales as between-subjects variables. Gender, age and period in the week cycle (workday or weekend) were used as covariates. Due to the skewed distributions of the scales and the inter-correlation between independent variables (see Table 1 below) there were of slightly unequal cell sizes; 27 participants had reported low rumination and low need for recovery from work while 15 reported low rumination but high need for recovery. In all, 22 persons reported high rumination and high for recovery from work while 13 participants reported high rumination but low need for recovery from work.

Results

INSERT TABLE 1 ABOUT HERE

In Table 1 the mean values for variables in the study and the inter-correlations between them are presented separately for males and females. For females there was a negative correlation between age and morning saliva cortisol secretion thus indicating lower morning cortisol levels with increasing age. No such association was present for the male participant. There were no relationships between the any of independent variables and morning cortisol, either for females or males. For females there was a

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strong correlation (.51, $p < .001$) between evening cortisol secretion and need for recovery – thus indicating higher evening cortisol secretion for female participants with lower need for recovery from work. For males there was a positive association between age and evening cortisol, and a significant negative correlation between evening cortisol and trait rumination. which indicates high rumination to be associated with increased evening saliva cortisol secretion. As expected trait rumination and need for recovery from were positively related for males as well for females.

INSERT TABLE 2

As revealed by the analysis shown in Table 2 (left column) neither need for recovery at baseline nor trait rumination or their interaction related to morning saliva cortisol secretion. On the other hand there was a highly significant drop from work ($m = 21.30$ nmol/l) to weekend ($m = 16.44$ nmol/l) levels in morning saliva cortisol. Gender ($m = 17.31$ nmol/l for females; 19.57 nmol/l for males) marginally failed to impact significantly on morning saliva cortisol secretion.

As shown in Table 2 (right column) there was a significant relationship between evening saliva cortisol secretion and baseline need for recovery. An inspection of the means reveals lower evening cortisol levels for participants with high baseline need for recovery ($m = 1.82$ nmol/l) as compared the group with low baseline need for recovery ($m = 2.11$ nmol/l).

As further shown in Table 2 trait rumination was also significantly related evening saliva cortisol secretion, with higher levels ($m = 2.25$ nmol/l) for high ruminators compared with participants low in rumination ($m = 1.78$ nmol/l). As also shown in Table 2, evening saliva cortisol secretion was positively associated with age.

Discussion

Neither trait rumination nor long-term need for recovery from work or the interaction between them affected the levels of morning saliva cortisol secretion. There was, however, a highly significant drop in the morning cortisol secretion from the workdays to the weekend measures, thus suggesting that the weekend respite from work promotes the psycho-physiological recovery process. Although it could be argued that this reduction in saliva cortisol secretion was in part affected by later wake up time during off-work days, previous research suggests that actual time of awakening in itself does not have any strong influence on the morning cortisol response (Kunz-Ebrecht, Kirschbaum, Marmot, & Steptoe, 2004).

In contrast to morning cortisol secretion, the evening cortisol readings were stable over the week and did not drop from workdays to the weekend. On the other hand, evening saliva cortisol secretion was shown to be significantly increased in the high-rumination group. Even though this measure of perseverative cognition did not affect morning saliva cortisol its long-term impact on evening saliva cortisol secretion is in concordance with the suggestion by Miller et al., (2007) that chronic stress seems to be associated with increased evening cortisol secretion. Obviously this finding requires further empirical testing. To further our understanding of hypocortisolism and stress, studies on the possible differential cortisol reactivity patterns associated with acute or more chronic stress exposure should to be one of the central themes of future research in the field of stress research. Although trait rumination is not in itself a stressor, the impact of rumination on this indicator of chronic stress reactivity also support the role of perseverative cognition as an important pathway between stress exposure and disease as

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suggested by Brosschot and colleagues (2005; 2006). The limited sample size in the present study allowed only for the use of rumination as a main variable. It is important therefore for future studies to further examine the mediating role between stress and disease outcomes in a long-term time frame.

Need for recovery at baseline was found to be significantly related to evening saliva cortisol secretion, although contrary to what could be expected, participants with lower baseline need for recovery from work had a higher evening saliva cortisol secretion than participants with high need for recovery at baseline. As shown in Table 1. this paradoxical significant inter-correlation showing lower evening saliva cortisol secretion to be associated to higher need for recovery from work was found only for the female but not for the male participants. A parallel finding was reported by Sluiter and colleagues, who found in sample of male workers – lower cortisol reactivity the day off after a period of work (assessed by urine samples) to be associated with higher subjective need for recovery (Sluiter et al., 2001). There may also however, be a behavioural explanation for why higher need for recovery was associated with higher evening saliva cortisol secretion. Individuals with higher need for recovery may feel more tired in the evenings due to having a high work demand, and therefore pursue more passive activities in their leisure time, for example, relaxing or watching television. Whereas, those with lower need for recovery my do more active tasks like exercising, or doing house work.

There are some factors that limit the validity of the findings in this study. Due to, among other things, a high staff turnover in many of the companies and attrition of our baseline sample, it was not possible to reach our initial target of sample consisting of at least 100 participants. Other nuisance factors included failed or missed cortisol samplings as well as the inability to follow the instructions in regard to the sampling procedure, which resulted in some additional data attrition. A circumstance of collecting data in the field is the lack of control for when samples are taken and this may have interfered with the within-subjects drop in morning cortisol at the weekend. Some participants took readings when they awoke from sleep, which may have been different to their regular time during the week. Considering the diurnal pattern of cortisol this may to some extent have inflated the work /days-off difference in morning cortisol secretion.

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Table 1.
Inter-Correlations between Cortisol Secretion, Age, Baseline Need for Recovery and Trait Rumination. Females (n=24) above the Diagonal, Males (n=52) below the Diagonal.

			1	2	3	4	5
	m		17.3	1.87	47.6	1.50	1.57
	sd		5.86	0.99	9.79	0.31	0.32
	m	sd					
1. Morning cortisol	19.6	6.92	-	.30*	-.37**	.15	.04
2. Evening cortisol	2.01	1.09	.14	-	-.16	.51**	-.12
3. Age	44.9	9.00	.03	.35**	-	-.13	-.10
4. Need for recovery (α .79)	1.63	0.30	.12	-.09	-.18	-	.33*
5. Trait rumination (α .82)	1.77	0.22	-.13	-.27**	-.12	.37**	-

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Table 2

Analysis of Variance (ANCOVA) of saliva morning and evening cortisol secretion (nmol/l) for baseline low/high need for. Gender, age and weekday (work/weekend) as covariates. (N=77/154).

	Morning	Evening
	df F	df F
Baseline Need for Recovery (A)	1 2.98	1 6.49*
Trait Rumination (B)	1 1.04	1 11.08**
A x B	1 0.12	1 0.41
Work/weekend	1 22.89**	1 0.43
Age	1 1.00	1 4.50*
Gender	1 3.72	1 3.28
Error	145 (38.06)	145 (1.01)

Note. Values enclosed in parentheses represent mean square errors.

* $p < .05$ ** $p < .001$

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