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Associations between fear-avoidance and endurance responses to pain and salivary cortisol in the context of experimental pain induction

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Summary Recent clinical studies in patients with lower back pain indicate that maladaptive fear-avoidance- and endurance-related pain responses (FAR and ER) have an influence on pain-induced physiological stress levels. The aim of the present study was to follow-up these results under well-controlled laboratory conditions. For this purpose, 30 healthy adults were asked to indicate their usual responses to pain, and were then confronted with an experimental pain stimulus (cold pressor test). Cortisol served as a measure of physiological stress. The results reveal positive associations between cortisol and FAR patterns, and negative associations between cortisol and behavioral ER. Conceivably, FAR contribute to long-lasting elevated stress levels in patients with stress-related musculoskeletal pain. In contrast, short-term, stress-lowering effects of ER might even be considered an advantage in coping with pain.

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1. Introduction

The activation of the hypothalamic—pituitary—adrenocortical (HPA) axis is an essential response to stressors such as acute pain, and is influenced by several factors, including stress-associated cognitions and coping behavior (Heim et al., 2000; Ursin and Eriksen, 2004). Clinical studies in patients with lower back pain have investigated the associations between cognitive, affective and behavioral pain responses and HPA axis activity as measured by salivary cortisol release (Sudhaus et al., 2009, 2012). These studies were based on the assumptions made by the Avoidance-Endurance Model (AEM) (Hasenbring and Verbunt, 2010). Concerning musculoskeletal pain, the AEM describes two time-stable maladaptive pain response patterns, both increasing the risk of pain chronification. The fear-avoidance-related (FAR) pattern, including pain responses such as depressive mood, helplessness/hopelessness, and avoidance of activities potentially causing pain, heightens the risk of chronification of musculoskeletal pain primarily via physical disuse. The endurance-related (ER) pattern (i.e. active coping strategies such as humor/distraction and pain persistence behavior) heightens the risk of chronification via an overload/overuse of physical structures, primarily due to long-lasting pain persistence behavior. Regarding the impact of FAR and ER responses on stress levels and HPA axis activity, the results of the above-mentioned studies suggest that FAR responses have a stress-increasing effect. In contrast, and although maladaptive in the long term, ER responses appear to have a short-term, stress-lowering effect (Sudhaus et al., 2009, 2012). The aim of the present study was to follow up these results under well-controlled laboratory conditions. For this purpose, 30 healthy adults were asked to indicate their usual responses to pain, and were then confronted with an experimental pain stimulus. Changes in salivary cortisol concentrations served as a neuroendocrine marker of stress. It was hypothesized that FAR responses would be positively, and ER responses would be negatively associated with cortisol.

2. Material and methods

2.1. Participants

Thirty healthy students participated in the study. Inclusion criteria allowed for students between the age of 18 and 35, and a body mass index between 18 and 27. Exclusion criteria were as follows: any acute or chronic somatic disease or psychiatric disorder; smoking and/or drug use; administration of corticosteroids within the preceding eight weeks; insufficient knowledge of the German language; shift work with night hours within a week before participation; current high emotional pressure (e.g. exam period); use of oral contraceptives; menses on the day of participation. To recruit participants, posters and flyers advertising the study were placed at different locations on the University campus. Interested students were informed about the procedure (pain induction) and checked for in- and exclusion criteria on the phone. Immediately after arriving at the laboratory, participants received more detailed information about the study and provided informed consent. All participants were compensated. The study was approved by the local Ethics Committee.

2.2. Procedure and measurements

2.2.1. Pain induction

Pain induction took place 30 min after the arrival of the subjects, using the Cold Pressor Test (CPT). This is a widely used, reliable and valid low-risk method used in research to expose participants to pain, and is known to induce robust and reliable stress responses (Smeets et al., 2008). Subjects were instructed to keep their non-dominant hand submerged in a basin with ice-cold water (0—3° C) up to the wrist and without moving their fingers for as long as they could tolerate it. CPT duration was limited to 180 s, but subjects did not know this.

2.2.2. Self-reported data

FAR and ER patterns were measured with the Avoidance-Endurance Questionnaire (AEQ; Hasenbring et al., 2009), an instrument that assesses the habitual frequency of several affective, cognitive and behavioral responses to pain. Higher scores indicate a higher frequency of self-reported responses. Based on former study results (Sudhaus et al., 2009), the ER pattern was represented by the AEQ scales Humor/Distraction and Pain Persistence, whereas the scales Helplessness/Hopelessness, Avoidance of Social Activities and Avoidance of Physical Activities represented the FAR pattern. To reduce the number of statistical tests, an overall behavioral avoidance scale was created by averaging together the two avoidance subscales ($\alpha = .89$) (Hasenbring et al., 1994). The Beck Depression Inventory (BDI; Beck et al., 1961) served to assess depressive mood, a potential consequence of long-term FAR coping in patients with musculoskeletal pain (Hasenbring and Verbunt, 2010). Higher scores indicate a more depressive mood. Both questionnaires were completed before pain induction. In order to control for potential effects of affect on cortisol, participants additionally filled out the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988) before, immediately after and 25 min after cessation of the CPT. Pain intensity was measured with an 11-point numerical rating scale (0 = no pain, 10 = maximal imaginable pain). Subjects were asked to verbally rate the pain intensity at removal of their hand from the water as well as every 20 s leading up to 120 s after withdrawal. A stopwatch served to assess pain tolerance by measuring the time from submersion of the hand until withdrawal. Maximum pain tolerance time was 180 s.

2.2.3. Physiological data: salivary cortisol

Physiological stress levels were measured by means of salivary cortisol as an indicator of HPA axis activity (Dickerson and Kemeny, 2004). Participants were requested to refrain from strenuous exercise, alcohol, drugs and pain relievers 24 h before testing, and not to eat, drink (except tap water) or exercise during the hour before testing. Saliva samples were taken with Salivette collection devices (Sarstedt, Nuembrecht, Germany) five minutes before (baseline) and 3, 10, 25 and 45 min after submersion of the hand. Sampling took between two and three minutes, depending on the individual amount of saliva production. The saliva