Psychoneuroendocrinology (2008) 33, 581–590

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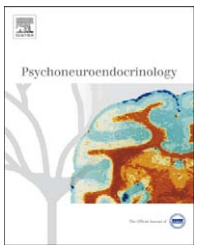

HPA system regulation and adult attachment anxiety: Individual differences in reactive and awakening cortisol

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Received 4 July 2007; received in revised form 22 January 2008; accepted 30 January 2008

KEYWORDS
HPA;
Cortisol responsivity;
Cortisol response to awakening;
Stress;
Adult attachment anxiety;
Hypocortisolism;
Personality development;
PSI theory

Summary
Early life experiences can influence hypothalamus–pituitary–adrenal (HPA) axis regulation in adulthood, in both animals and humans. In humans, they have also been shown to influence adult attachment styles. However, the relationship between adult attachment styles and HPA axis regulation is largely unexplored. The present study investigated the relationship among varying levels of attachment anxiety and avoidance with both the cortisol response to acute stress (CRS) and the cortisol response to awakening (CRA) in 48 adult women. Attachment-unrelated stress was induced by a laboratory stress task. Saliva for free cortisol assessment was sampled before and after the stress task in the laboratory and at home on 2 consecutive days in the morning after awakening. We found that attachment anxiety but not attachment avoidance was associated with cortisol measures. Attachment anxiety was positively correlated with CRS and negatively with CRA. Finally, the two cortisol parameters were negatively associated with one another. The results are discussed with respect to (1) recent findings suggesting that the HPA system and hippocampus are programmed during critical development periods, establishing a certain trajectory of physiological responsiveness throughout life, and (2) a model that links development of the hippocampus with self development.

1. Introduction

Frequent early life stress like, for example, inadequate parental care, can have enduring effects on stress reactivity, hypothalamus–pituitary–adrenal (HPA) system regulation, and neurodevelopment as evidenced by studies on rodents (e.g., Sapolsky, 1996; Sapolsky and Meaney, 1986; Meaney et al.,

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doi:10.1016/j.psyneuen.2008.01.013

1988), monkeys (e.g., Coplan et al., 1996), and humans (e.g., Heim and Nemeroff, 1999; Heim et al., 2001; Buss et al., 2007). In humans, quality of parental caretaking is considered to be particularly crucial while brain systems critically involved in the regulation of the HPA axis such as the hippocampus or the prefrontal cortex are developing (Sanchez et al., 2001; Teicher et al., 2003). Accordingly, while high parental responsiveness and sensitivity during this period attenuates HPA reactivity throughout the life span (Spangler et al., 1994; Gunnar, 1998) and promotes adequate biobehavioral regulation and well-being of the offspring in general (Gunnar, 2003, 2005; Gunnar and Donzella, 2002), adverse early rearing conditions such as insensitive and unresponsive care (e.g., De Wolff and van IJzendoorn, 1997), have been linked to increased HPA reactivity, increased risk for substance abuse and psychopathology, and poor biobehavioral regulation throughout the life span.

Interestingly, attachment insecurity, which refers to inappropriate behavior and expectations in the context of close relationships (Bowlby, 1973; see also Ainsworth et al., 1978), has been associated with adverse early rearing conditions as well. Attachment insecurity can be described along two dimensions, attachment anxiety and attachment avoidance (Brennan et al., 1998; Shaver and Mikulincer, 2002) and shows relative stability from infancy to adulthood (Fraley, 2002; Simpson et al., 2007). A high level of attachment anxiety is characterized by worries about relationships, strong need for closeness, and fear of being abandoned. By contrast, a high level of attachment avoidance is characterized by self-reliance and emotional distance from close relationships. Because both HPA axis regulation and attachment styles are influenced by early rearing conditions, we wanted to investigate whether HPA axis regulation is associated with variations in attachment styles as well.

It has previously been shown that adult attachment insecurity is associated with impairments in stress regulation (Shaver and Mikulincer, 2007). Specifically, attachment anxiety is linked to hyperreactivity to threats and catastrophic beliefs about potentially aversive situations (Bartholomew and Horowitz, 1991; Mikulincer and Florian, 1998). Moreover, individuals high in attachment anxiety report higher subjective levels of psychological stress in response to stressful events, and a stronger tendency to ruminate about them (see Mikulincer and Florian, 1998, for a review). Attachment avoiders, on the other hand, use defensive regulation mechanisms (e.g., repression of unpleasant emotions) that allow them to control emotional stressful situations (e.g., Mikulincer et al., 1990; Dozier and Kobak, 1992; Mikulincer and Orbach, 1995; Fraley and Shaver, 1997; Mikulincer and Horesh, 1999). Therefore, it is interesting to investigate whether adult attachment insecurity, particularly attachment anxiety, is related to HPA regulation.

When investigating HPA axis regulation, the circadian rhythm (baseline regulation) needs to be differentiated from the response of the system to acute stimulation, e.g., stress. Over the course of the past decade, the cortisol response to awakening (CRA) as part of the circadian rhythm has extensively been investigated. The CRA typically constitutes the circadian peak of cortisol secretion and has been identified as a reliable marker for studying individual differences (Pruessner et al., 1997b). Although the CRA has been found to be related to a number of factors such as age, time of awakening, sleep quality, and genetic differences, the determinants of CRA have not been fully explained yet. Importantly, recent work suggests that the integrity of the hippocampus is essential for the CRA (Buchanan et al., 2004; Pruessner et al., 2005; Wolf et al., 2005).

There is considerable evidence that the cortisol increase after awakening is reduced in individuals scoring high on personality dimensions that have been associated with high levels of attachment security such as self-esteem, internal locus of control (Pruessner et al., 1999a), life satisfaction, autonomous control (Brandtstädter et al., 1991), and emotional stability (Gilbert et al., 1996; Westrin et al., 1998). One study has directly related reduced morning cortisol in individuals with high attachment insecurity (Adam and Gunnar, 2001).

Regarding the HPA axis *response to stress*, there is considerable evidence suggesting that an elevated cortisol response to acute stress (CRS) is related to attachment insecurity in children (Spangler and Grossmann, 1993; Hertsgaard et al., 1995; Nachmias et al., 1996; Gunnar et al., 1996; Spangler and Schieche, 1998; van Bakel and Riksen-Walraven, 2004). However, little research has been conducted on the relationship between attachment styles in adults and the CRS. In a recent study investigating cortisol responses to an interpersonal conflict situation in young adult participants, Powers et al. (2006) found that attachment insecurity was associated with increased HPA reactivity. Specifically, attachment avoidance in female participants was related to increased HPA reactivity, whereas a combination of attachment avoidance and attachment anxiety predicted HPA reactivity in male participants. In a similar vein, an elevated CRS has also been observed in psychological dispositions that have typically been associated with attachment insecurity such as low self-esteem (Pruessner et al., 1999b) or low subjective autonomous control (Pruessner et al., 1997a). Likewise, Luecken (1998) found that adults who reported poor early relationships to their parents, which is a typical finding for insecurely attached individuals, showed heightened cortisol as a response to a video clip that showed the death of a parent. Similarly, individuals with early loss of a parent showed pronounced cortisol elevations as a reaction to a stressful speech task only when they reported poor early family relationships (Luecken, 2000).

In sum, the relationship between cortisol and adult attachment dimensions has not been explored extensively. Further, there are only few studies available that have investigated the CRA together with the CRS, and none of these studies have assessed individual differences in adult attachment styles. Thus, we wanted to investigate the mutual relationships between adult attachment styles, CRA and CRS.

2. Methods

2.1. Participants and study design

Forty-eight adult working women (mean age 33.9±8.4 years) were recruited via advertisements and invited to