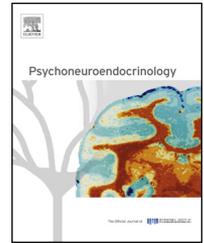




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Salivary cortisol and psychopathy dimensions in detained antisocial adolescents

Johanna Feilhauer^{a,*}, Maaïke Cima^{d,e}, Andries Korebrits^{b,c},
Nancy A. Nicolson^a

^a Maastricht University, Maastricht, The Netherlands

^b Radboud University, Nijmegen, The Netherlands

^c St. Joseph Foundation, Cadier en Keer, The Netherlands

^d Tilburg University, Tilburg, The Netherlands

^e Forensic Psychiatric Center “de Rooyse Wissel”, Venray, The Netherlands

Received 10 April 2012; received in revised form 13 January 2013; accepted 14 January 2013

KEYWORDS

Psychopathy dimensions;
HPA axis;
Cortisol;
Conduct disorder;
CU traits;
Narcissism;
Impulsivity;
Aggression

Summary Previous research revealed hypothalamic–pituitary–adrenal (HPA) axis abnormalities in relation to antisocial and aggressive behavior. Some evidence suggests that low cortisol levels may serve as a biological marker for a severe antisocial subgroup with pronounced callous–unemotional (CU) traits. Children displaying the combination of severe antisocial behavior and CU traits appear to be particularly at risk of developing adult psychopathy. Given the lack of studies on the relationship between cortisol levels and CU traits in antisocial adolescents, the current study investigates whether cortisol levels are uniquely associated with CU traits as compared to other psychopathy dimensions (i.e., narcissism and impulsivity). Detained antisocial adolescents ($n = 63$) and a community comparison group ($n = 62$) completed diaries and collected three saliva samples daily on two days, with compliance monitored electronically. Psychopathy dimensions were assessed through self-report questionnaires. Externalizing symptoms were assessed by structured clinical interview. Multilevel regression analyses indicated no differences in cortisol levels or diurnal slopes between the two groups. Overall, cortisol levels were not significantly related to psychopathy dimensions. However, greater impulsivity was associated with lower cortisol levels in the community sample, but not in the antisocial group.

Conclusion: Results cast doubt on the notion of low cortisol levels as a biological marker for CU traits. Low basal cortisol levels appear to be more closely related to a general deficit in behavioral regulation. Implications for future research are discussed.

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* Corresponding author at: Department of Clinical Psychological Science, Faculty of Psychology and Neuroscience, Maastricht University, P.O. Box 616, 6200 MD Maastricht, The Netherlands. Tel.: +31 43 3881600; fax: +31 43 3884155.

E-mail address: J.Feilhauer@maastrichtuniversity.nl (J. Feilhauer).

1. Introduction

Childhood behavioral disorders are the most common diagnoses in child and adolescent psychiatric settings. Among these, conduct disorder (CD) describes the most severe form of antisocial and aggressive behavior, causing the highest mental health and public expenditures of all problem behaviors (Schmeck and Poustka, 2000; Foster and Jones, 2005). Aside from the environmental risk factors that play a role in the development of severe antisocial and aggressive behavior, certain neurobiological factors may be of importance. The hypothalamic–pituitary–adrenal (HPA) axis and its end product, the stress hormone cortisol, are of particular interest in this respect (van Goozen et al., 1998; McBurnett et al., 2000). It is theorized that low levels of arousal in the central nervous system are causally related to the development and maintenance of antisocial and aggressive behavior (van Goozen et al., 2000). According to this line of thought, low HPA axis activity, as reflected in low cortisol levels, may be a neurobiological marker of underarousal and thus of predisposition toward aggressive and antisocial behavior. The mechanisms through which underarousal and low cortisol contribute to antisocial behavior have been conceptualized in terms of two largely compatible theories.

First, according to the fearlessness theory, the neurobiological systems that normally process threat information, including the amygdala and the prefrontal cortex, are believed to be compromised in highly antisocial and aggressive individuals (van Goozen and Fairchild, 2008). Fearless individuals are thus physiologically underaroused and less sensitive to stress (Raine, 1996). Being less afraid of negative consequences of their actions and less sensitive to punishment, they do not experience normal inhibitions against engaging in aggressive and antisocial behavior (Raine, 1993).

Second, the stimulation-seeking theory suggests that a certain level of arousal or stress is needed in order to feel pleasant; underarousal thus represents an aversive condition. Chronically underaroused individuals are believed to seek physiological stimulation through aggressive and antisocial behavior in order to counteract this negative state (Zuckerman, 1979).

In adults, studies have repeatedly found associations between antisocial, aggressive behavior and low cortisol levels (Woodman et al., 1978; Virkkunen, 1985). Several studies in children and adolescents have also reported negative associations between CD symptoms and basal cortisol levels. For example, children with antisocial fathers showed both more CD symptoms and lower cortisol levels (Vanyukov et al., 1993). In particular, the severity and persistence of aggressive, antisocial behavior has been linked to low cortisol (McBurnett et al., 1996, 2000; Matthys et al., 2004; van de Wiel et al., 2004; Popma et al., 2006). However, patterns appear to be less consistent than in adults, as a number of carefully conducted studies have reported mixed findings (van Goozen et al., 2000; Azar et al., 2004; McBurnett et al., 2005; van Bokhoven et al., 2005). For example, van Bokhoven et al. (2005) reported that reactive aggression was positively associated with cortisol levels, whereas Azar et al. (2004) found no association of aggression or CD with cortisol. Sondejker et al. (2007) found no evidence that disruptive behavior was associated with low basal cortisol levels in a

community sample. They concluded that this aspect of HPA axis activity might not be a useful biological marker of disruptive, antisocial, aggressive behavior (Sondejker et al., 2007). The same research group also investigated whether low cortisol levels might predict the development of disruptive behavior in pre-adolescent youth from the general population (Sondejker et al., 2008). Interestingly, their longitudinal data suggest that low cortisol, although not a good predictor of future disruptive behavior, might help identify a severe subgroup among those children who already show disruptive behavior problems (Sondejker et al., 2008).

A recent meta-analysis of 82 studies in child and adolescent samples found a significant but small ($d = -0.10$) relationship between antisocial behavior and low cortisol levels; no association was found between antisocial behavior and cortisol reactivity (Alink et al., 2008). Thus, despite inconsistent findings, the leading hypothesis – in line with underarousal theory – still postulates a negative relationship between aggressive, antisocial behavior and basal cortisol (van Goozen et al., 2007; Shirtcliff et al., 2009). At the same time, it is clear that this relationship is less strong and more complex than originally thought.

Differences in sample characteristics and other methodological aspects have likely contributed to the observed inconsistencies. First, heterogeneity arises from divergent operationalizations of antisocial behavior, which include delinquency, covert and overt aggressive, oppositional behavior, and psychiatric externalizing disorders like CD or ADHD. Second, the research population and settings have varied widely, with participants drawn from healthy community samples, at-risk community samples, clinically referred samples with diverse diagnoses, and samples of incarcerated offenders. Third, the samples have differed in age and gender (see Alink et al., 2008, for a more detailed discussion). Fourth, studies have differed in how cortisol was assessed: most importantly, some investigated basal cortisol levels, whereas others measured cortisol reactivity to experimental stressors. Furthermore, the timing, frequency, and method of cortisol assessment as well as the applied statistical analyses need to be taken into account. These methodological differences, which occur not only between studies conducted by different research groups but also within large research consortia, complicate the comparison of findings (Rosmalen and Oldehinkel, 2011).

Inconsistent findings may also be due to heterogeneity within aggressive, antisocial samples. Low cortisol might not be related to all types of aggression and antisocial behavior, but particularly to severe forms associated with stimulation seeking, reward dominance, fearlessness, and insensitivity to punishment (O'Brien and Frick, 1996; Mitchell et al., 2002; van Honk et al., 2003). O'Brien and Frick (1996) found the strongest evidence for a reward-dominant response style, in which behavior is stimulated by the gain of quickly available short-term rewards, rather than by the avoidance of punishment, in children with conduct problems and psychopathic traits. At present, research suggests that the combination of severe aggressive, antisocial and impulsive behavior, as often seen in youth with a diagnosis of CD, together with callous–unemotional (CU) traits delineates a highly severe behavioral group, with a close resemblance to the adult picture of psychopathy (e.g. Barry et al., 2000; Frick and White, 2008).

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