



Low basal salivary cortisol is associated with teacher-reported symptoms of conduct disorder

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Abstract

Cortisol has been implicated in psychobiological explanations of antisocial behavior. This study measured basal salivary cortisol in a sample of 25 children (age range 6 to 12 years) selected to vary in levels of antisocial behavior. Regression analyses were used to predict cortisol concentrations from parent- and teacher-reported symptoms. Parent-reported symptoms did not predict basal cortisol. Teacher-reported conduct disorder (CD) symptoms explained 38% of the variance in the cortisol concentrations, with high symptom severity associated with low cortisol. When a distinction was made between aggressive and non-aggressive CD symptoms, aggressive CD symptoms were more clearly related to low cortisol than non-aggressive CD symptoms. In contrast to previous research, no evidence was found for a mediating role of anxiety symptoms in the relationship between CD and cortisol. The results support biologically based models of antisocial behavior in children that involve reduced autonomic activity.

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1. Introduction

Antisocial behavior in children is of great concern because of its devastating impact on the child, the child's social environment, and society, as well as the high risk for antisocial personality disorder and criminality (Loeber et al., 2000). Current diagnostic

classification systems (American Psychiatric Association, 1994) distinguish between two forms of antisocial behavior: oppositional defiant disorder (ODD) and conduct disorder (CD). The essential features of ODD are a recurrent pattern of negativistic, defiant, disobedient, and hostile behavior toward authority figures, whereas the essential features of CD are a repetitive and persistent pattern of behavior in which the basic rights of others and major age-appropriate societal norms or rules are violated (American Psychiatric Association, 1994).

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One of the most provocative neuroendocrinologic findings reported in ODD and CD is abnormal basal cortisol concentrations (Vanyukov et al., 1993; Scerbo and Kolko, 1994; Moss et al., 1995; Van Goozen et al., 1998; McBurnett et al., 2000; Pajer et al., 2001; Karyawasam et al., 2003; Shoal et al., 2003; Van de Wiel et al., 2004). Cortisol is one of the main outputs of the stress system. Stress activates the rapidly responding sympathetic division of the autonomic nervous system, and the slower but longer-acting hypothalamic–pituitary–adrenal axis (HPA axis). In the HPA axis, stress triggers the release from the hypothalamus of corticotropin-releasing hormone (CRH) and arginine–vasopressin (AVP), which both stimulate secretion of adrenocorticotropic hormone (ACTH) from the anterior pituitary. ACTH is released into the general circulation and acts on the adrenal cortex, stimulating it to produce glucocorticoid hormones, mainly cortisol (Stratakis and Chrousos, 1995; Pliszka, 1999; Miller and O’Callaghan, 2002; Tsigos and Chrousos, 2002). Cortisol has been implicated in psychobiological explanations of antisocial behavior from two partially overlapping perspectives.

First, cortisol may be regarded as a peripheral indicator of autonomic activity. Several studies have found evidence for reduced autonomic activity in children, adolescents and adults with antisocial behavior, including lowered heart rate and skin conductance (Pliszka, 1999). Activity in the sympathetic branch of autonomic nervous system goes hand in hand with the release of cortisol from the HPA axis. Thus, low basal cortisol concentrations may reflect reduced autonomic activity.

Second, the stress system has an important role in learning and memory. Antisocial behavior has been related to a failure to learn from aversive consequences of behavior. It appears that antisocial individuals are less afraid of the aversive consequences of their actions than others are. Normal autonomic reactivity is required for normal conditioned emotional responding to signals of threat of punishment and passive avoidance learning to occur (McBurnett et al., 1996). Furthermore, activation of the stress system triggers the amygdala, the principal brain locus for fear-related behaviors, and facilitates the long-term storage of aversively charged emotional memories in sites such as the hippocampus and striatum (Tsigos and Chrou-

sos, 2002). Thus, reduced activity in the stress system may impede the process of learning from aversively charged stimuli, which may contribute to the development and maintenance of antisocial behavior (McBurnett et al., 1996; King et al., 1998). Low basal cortisol concentrations may thus be associated with impaired learning and memory.

Several studies provide evidence for low basal cortisol in children characterised by antisocial behavior. Correlational studies have shown that measures of antisocial behavior including symptom counts of ODD and CD are associated with low cortisol (Vanyukov et al., 1993; Scerbo and Kolko, 1994; Moss et al., 1995; McBurnett et al., 2000; Van de Wiel et al., 2004). Others have found lower levels of cortisol in children with ODD and CD as than in normal developing peers (Van Goozen et al., 1998; Karyawasam et al., 2003). While most of these studies were restricted to boys, low cortisol concentrations have also been reported in girls with CD (Pajer et al., 2001). Interestingly, a recent longitudinal study by Shoal et al. (2003) has demonstrated that low resting cortisol levels may actually predict aggression 5 years later. However, other studies have found no evidence for the relationship between low cortisol concentrations and antisocial behavior either measured dimensionally or categorically (Dabbs et al., 1991; Stoff et al., 1992; Scerbo and Kolko, 1994; Schulz et al., 1997; Jansen et al., 1999; Van Goozen et al., 2000; Snoek et al., 2002). All in all, evidence for low basal cortisol in children with antisocial behavior is inconsistent.

To elucidate further the relationship between antisocial behavior and low basal cortisol, research has distinguished between aggressive (overt confrontational, such as fighting) and non-aggressive (covert non-confrontational, such as theft) CD symptoms (Berkowitz, 1993, 1994; Frick et al., 1993; Fergusson et al., 1994). Low cortisol concentrations seem to be associated with aggressive CD symptoms in particular and less clearly with non-aggressive CD symptoms (McBurnett et al., 1996, 1997, 2000; Pajer et al., 2001), although not all studies found support for this (Schulz et al., 1997).

Furthermore, studies of basal cortisol in children with antisocial behavior have focused on the impact of comorbid anxiety. In contrast to antisocial behavior, anxiety has been associated with heightened cortisol

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