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Early adversity, hypocortisolism, and behavior problems at school entry: A study of internationally adopted children

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ABSTRACT

The hypothalamic–pituitary–adrenal (HPA) axis is influenced by early life adversity; however, less is known about the potential for recovery following marked improvements in care. The present study examined longitudinal changes in children's cortisol reactivity in the laboratory (4 assessments over 2 years) after adoption. Post-institutionalized ($N = 65$) and post-foster care children ($N = 49$) demonstrated blunted reactivity relative to non-adopted peers ($N = 53$). Furthermore, post-institutionalized children exhibited no evidence of expected adaptation to repeated sessions in the 2 years following adoption. As evidenced by blunted cortisol reactivity, flatter diurnal slope, and lower home morning cortisol, we found support for hypocortisolism among children experiencing adverse early care. Hypocortisolism served as a mediator between adversity and teacher-reported attention and externalizing problems during kindergarten. Early adversity appears to contribute to the down-regulation of the HPA axis under both basal and stress conditions.

1. Introduction

Early adversity appears to affect the development of hypothalamic–pituitary–adrenal (HPA) axis reactivity in both animals and humans leading to reduced resilience and heightened risk for mood and health disorders (Danese and McEwen, 2012). However, the literature is mixed, with hyper-, hypo-, and no changes in HPA axis function being obtained in different studies (Strüber et al., 2014). There are a number of possible reasons for these mixed results, but one source of inconsistent findings can be attributed to whether basal or stress reactivity is the outcome measure. Initial research focused on stress *reactivity* (Liu et al., 1997). However, once researchers began to study ambulatory cortisol patterns (Hellhammer et al., 2004) and vulnerable children (e.g., Carlson et al., 1995) the focus shifted to basal diurnal activity. With this shift came greater concern with low or blunted patterns of hormone production (Heim et al., 2000).

Many but not all studies of children exposed to early adverse care have reported a lower morning and flatter daytime cortisol rhythm (for review see Strüber et al., 2014). While this altered pattern has at times been described as hypocortisolism, this conclusion is premature. Hypocortisolism involves not only lower basal levels and a flatter diurnal pattern, but also blunted stress responses (Heim et al., 2000). We are aware of only two studies, both with adults, that examined associations between the hypocortisol patterns in diurnal activity (i.e., low morning and a flatter diurnal slope) and cortisol stress responses, with mixed results (Kidd et al., 2014; van Eck et al., 1996). Examining whether hypocortisolism in cortisol reactivity and home diurnal patterns co-occur or are divergent patterns was one of the primary goals of the present study. To achieve this, we sought to create an index of hypocortisolism reflecting indices of both home diurnal and laboratory stress reactivity that capture the down-regulation of the HPA axis in the context of early adversity.

We examined children adopted internationally with a focus on those adopted from institutional or orphanage care because these children experience a marked improvement in care at the time of adoption and provide a good model of early adversity (van Ijzendoorn and Juffer, 2005). There have been only two studies of cortisol reactivity among post-institutionalized (PI) youth, both of which used the Trier Social Stress Test (Gunnar et al., 2009; McLaughlin et al., 2015). One found no evidence of a blunted stress response among 10- to 12-year-olds (Gunnar et al., 2009), while the other found blunted responding but only if the youth were removed from institutional care after two years of age (McLaughlin et al., 2015). The heterogeneity in findings may suggest that the

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HPA stress response recovers in some but not all children. If so, we have little knowledge of how responses to stress change in the immediate years after adoption.

As an extension of our previous work in this sample on diurnal HPA activity following international adoption, we examined changes in the children's cortisol reactivity to laboratory challenges over the first two years post adoption from institutional care settings. Previously, comparable to other studies of early adversity (Strüber et al., 2014), we found that these children exhibited a flatter diurnal slope that was associated with less supportive socioemotional care prior to adoption (Koss et al., 2014). Notably, however, we found that children who had been adopted at earlier ages from international foster care settings also exhibited a similarly blunted diurnal cortisol rhythm. Thus the effects were not due specifically to institutional care but were common more broadly to orphaned and abandoned children. Examining cortisol reactivity to stressors, its potential recovery following adoption, and association with institutional versus other types of pre-adoption conditions was a second goal of this study.

Finally, both hyper- and hypo-cortisolism are described as the result of chronic or frequent stressors and are expected to mediate impairments in health and behavior (McEwen, 1998; Strüber et al., 2014). Furthermore, associations between hyper- and hypo-cortisolism and behavior problems may differ depending on the type of behavioral problems evidenced. Although findings remain somewhat mixed, elevated cortisol is often associated with internalizing problems whereas blunted or low cortisol may be associated with externalizing problems (for a review see Gunnar and Vazquez, 2006). Children experiencing early adversity in the form of institutional care exhibit a number of behavioral and emotional problems (Juffer et al., 2004). We previously reported that blunted diurnal cortisol predicted parent-reported broadband behavior problems prior to kindergarten entry (Koss et al., 2014). In the present study we examined whether the combination of diurnal home and laboratory cortisol reactivity patterns, indicative of hypocortisol, served as a mediator between early adversity and the type of behavior and emotional problems as reported by parents and teachers during kindergarten (e.g., internalizing, externalizing, ADHD problems).

The goals of the present study were three-fold. Building on our previous investigation of diurnal cortisol, we sought to examine differences in children's cortisol reactivity to a laboratory setting among children with varying degrees of early life experiences. This included investigations of the impact of early life adversity on cortisol reactivity as well as examinations of longitudinal change, indicative of recovery of the HPA axis, in children's cortisol reactivity following adoption. Second, we examined the extent to which indices of diurnal cortisol and stress reactivity together reflect hypocortisolism in the context of chronic stress. Lastly, we examined whether this hypocortisolism may serve as a mediating mechanism for distinct types of behavioral problems.

2. Method

2.1. Participants

Participants included 167 children taking part in a larger longitudinal study of the transition to family care following international adoption. Sixty-five children (38 female, 27 male) were adopted from orphanages or institutions (post-institutionalized; PI), 49 children (19 female, 30 male) were adopted from international foster care (post-foster care; PFC) and 53 non-adopted (NA) same-aged children (27 female, 26 male) who were born and raised in similar types of families (education/income) that adopt internationally-born children. PI and PFC participants were recruited through adoption agencies, an international adoption medical clinic, and enrollment on the International Adoption Registry maintained by our research group. NA children were recruited through a University department-maintained participant pool recruited through letters mailed at birth and on-line advertising. PI children met the following criteria: their last care type prior to adoption was an institutional setting (M age at adoption = 24.66 months, SD = 5.04, M = 75.9% of pre-adoptive life in institution, SD = 29.4), began study participation within 3 months of their adoption, and were 18–36 months at recruitment (T1 M age = 26.36 months, SD = 5.05). PFC children met the following criteria: were adopted from international foster care (M age at adoption = 9.66 months, SD = 1.47), spent most of their pre-adoption lives in foster care and less than 50% in institutional settings (M = 87.3% of pre-adoptive life in foster care, SD = 12.2; M = 10.0% of pre-adoptive life in institutional care, SD = 12.3), and were 18–36 months at recruitment (T1 M age = 32.48 months, SD = 5.27). NA children met the following criteria: were 18–36 months at recruitment (T1 M age = 27.80 months, SD = 5.77) and were reared in their families of origin. Exclusions included facial indices of fetal alcohol exposure using the FAS Facial Photographic Analysis software (7 PI, 2 PFC; Astley and Clarren, 2000) and congenital and endocrine disorders (2 PI). NA children were included as a typically developing comparison group; NA children were excluded if they experienced early adversity or had been diagnosed with neurodevelopmental disorders (autism 1 NA, maltreatment 1 NA).

Children participated in four laboratory sessions roughly 2, 8, 16, and 24 months after adoption timed from the PI children's entry into the US (PI time since arrival M = 1.70 months, SD = .78). At the first laboratory session, children were between the ages of 18 and 36 months (M age = 28.61 months, SD = 5.90). Behavior problems were assessed during kindergarten (M = 5.98 years, SD = .29) by both parents and teachers. There were 64 Asian children (26 PI, 37 PFC, 1 NA), 58 Caucasian (10 PI, 48 NA), 23 Black/African (23 PI), 11 American Indian/Alaskan Native (2 PI, 9 PFC), and 11 multiracial or other racial backgrounds (4 PI, 3 PFC, 4 NA). Additionally, 17 children were Hispanic/Latino (2 PI, 12 PFC, 3 NA). For additional pre-adoptive participant and family demographics of this sample see Koss et al. (2014). All procedures were approved by the University's institutional review board.

2.2. Measures and procedures

2.2.1. Laboratory salivary cortisol

Saliva was collected using procedures described in detail previously (Koss et al., 2014). Samples were stored at −20 °C prior to assaying in duplicate using a time-resolved fluorescence immunoassay (DELFIA). Intra-assay and inter-assay coefficients of variation were 6.7% and 8.8% or less, respectively. Each laboratory session was approximately 2 h and consisted of a number of challenging tasks, including brief separations, exposure to novel and arousing stimuli, interactions with strangers, transitions between tasks and rooms, and electrophysiological assessments (see Supplemental materials for a detailed description of tasks and timing of cortisol sampling). Three saliva samples were collected throughout the laboratory session at each of the four assessments (12 total laboratory samples). The samples were not collected in response to any one task but rather reflect children's reactivity to the demands of the laboratory session as a whole. The majority of laboratory sessions occurred in the mid-morning and early afternoon hours (Sample 1 M time range: 10:46 am–11:04 am; SDs 92–115 min). Analyses controlled for individual differences in testing and waking times by including calculated time-since-waking (time-since-waking M range: 225–267 min, SDs 105–182 min). Cortisol values more than 4 SDs of the mean were Winsorized (4–7 values at each session). Data for children with fevers at the laboratory session were deleted from the data (n = 2). Parent-reported