EXAMINING THE EFFECTS OF AN ATTACHMENT-BASED INTERVENTION ON DIURNAL CORTISOL PRODUCTION AMONG TODDLERS IN FOSTER CARE

by

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ABSTRACT

Children in the foster care system are at risk for biological dysregulation due to their various experiences of early adversity, such as the separation from their biological parents and unstable placements. These experiences may lead to disruptions in functioning of the hypothalamus-pituitary adrenal (HPA) axis, including the diurnal production of cortisol. This study presents findings from a randomized clinical trial that assessed the effectiveness of an attachment-based intervention (Attachment and Biobehavioral Catch-up for Toddlers; ABC-T) with regard to HPA functioning. Contrary to expectations, children in the ABC-T intervention and the control group did not significantly differ in their cortisol production across the day. Instead, both groups of children showed the expected decline in cortisol levels across the day. Possible explanations for the differences between these findings and the results of previous studies may be due to the population of toddlers in the foster care utilized in this study. Previous studies examining the regulatory effects of an attachment-based intervention used populations of Child Protected Services (CPS) referred children and implemented the intervention at infancy rather than toddlerhood. Future research will lead to greater insight on how to most effectively intervene in order to enhance self-regulatory capabilities among children in foster care.

Chapter 1

LITERATURE REVIEW

Children in the foster care system experience many forms of early adversity, putting them at risk for the development of physiological dysregulation (Jackson, Gabrielli, Fleming, Tunno, & Makanui, 2014; Bernard, Butzin-Dozier, Rittenhouse, & Dozier, 2010). In particular, foster children experience sudden separation from their biological parents, frequent changes in caregivers, and unstable parental care (Dozier & Lindhiem, 2006; Sanchirico & Jablonka, 2000). In addition to these disruptions in care, it is not uncommon for these children to have experiences of abuse and neglect that may have led to their initial placement into the foster care system (Kohl, Edleson, English, & Barth, 2005). Taken together, these experiences may make it difficult for these children to develop proper psychophysiological self-regulation capabilities. In particular, early adversity has been shown through human and nonhuman studies to lead to disruption in functioning of the hypothalamus-pituitary adrenal (HPA) axis (Ladd, Huot, Thrivikraman, Nemeroff, & Plotsky ,2004). Given this link between early adversity and dysregulation, it is critical that early preventative interventions be developed to promote normalized psychophysiological functioning among foster children. The goal of this study is to examine whether an attachment-based intervention implemented in toddlerhood is effective in regulating diurnal cortisol production among foster children.

The HPA axis connects the central nervous system and the endocrine system to achieve regulatory control of the stress response. The HPA system serves to: 1)

activate the body in response to an external stressor, and 2) help the body to maintain a diurnal pattern. In the presence of stressful stimuli, corticotrophin-releasing hormone is released from the hypothalamus and signals the anterior pituitary gland to release adrenocorticotropic hormone (ACTH). Once released, ACTH travels via the bloodstream to the adrenal cortex where it binds to its receptors to stimulate the release of glucocorticoids. In humans, cortisol is the glucocorticoid end product of the HPA axis. Positive and negative feedback systems within the human body help to regulate the amount of cortisol release according to internal and external stimuli. Cortisol is released both as a response to stress and also in a diurnal pattern that follows the day-night cycle. A typical diurnal cortisol pattern is characterized by high levels of cortisol production in the morning, peaking approximately 30 minutes after wakeup. This climax is followed by a gradual decline throughout the day reaching its lowest levels following bedtime. This pattern arises a few months after birth and remains relatively constant throughout the lifetime (Gunnar and Cheatham, 2003; White, Gunnar, Larson, Donzella & Barr, 2000).

The production of cortisol can be dysregulated by adversity, with this dysregulation having deleterious consequences for the development of areas of the brain, including the prefrontal cortex (Teicher, Andersen, Polcari, Anderson, Navalta, & Kim, 2003). Due to cortisol's natural circadian rhythm, it may also influence other essential cyclical functions. Therefore, a disruption in the regulation of this glucocorticoid may, in turn, affect the functioning of other essential processes such as metabolism, immune system functions, mood, digestion and energy levels (Loman & Gunnar, 2010). Dysregulations in neuroendocrine systems such as the HPA axis have been linked to greater susceptibility to future psychiatric disorders, disturbances in

emotion regulation, antisocial behavior as well as other harmful developmental outcomes (Haltigan, Roisman, Susman, Barnett-Walker, & Monahan, 2011).

Early caregiving experiences have been shown to impact the diurnal functioning of children's HPA systems (Bernard,Lind, & Dozier, 2013). Children exposed to early maltreatment have been found to exhibit lower levels of morning cortisol and a flatter waking to bedtime slope of cortisol production across the day than non-maltreated children (Bernard et al. 2010; Bruce, Fisher, Pears, & Levine, 2009; Fisher, Stoolmiller, Gunnar & Burraston, 2006; Gunnar & Vasquez 2001). Similar patterns of blunted cortisol production have also been observed in institutionalized children (Bruce Fisher, Pears, & Levine, 2000; Carlson & Earls, 1997). Children placed in foster care have also been shown to exhibit atypical cortisol patterns indicative of HPA dysregulation (Dozier, Manni, Gordon, Peloso, Gunnar, Stovall-McClough, & Levine, 2006). Previous research has indicated that high-risk children with early childhood experiences of maltreatment that remained with their birth parents after Child Protective Services (CPS) involvement showed a blunted diurnal cortisol pattern in comparison to a low-risk control group. Therefore, children in this high-risk group showed lower wakening levels of cortisol production and a less steep slope of cortisol decline throughout the day. CPS referred children who were later placed in foster care fell in between the low-risk and high-risk groups in terms of their early-adversity experiences and their patterns of cortisol production (Bernard, 2010). This suggests that the improvement in caregiving children experience when moving from maltreating homes to foster care facilitate partial recovery in the functioning of their HPA systems. One implication of this finding is that interventions

targeting the foster parent's caregiving behaviors may be effective at ameliorating risks associated with early adversity.

While experiences of early life adversity may leave children at risk for disturbances in their regulatory systems, studies have shown that the neuronal circuitry of the HPA axis may possess much plasticity during early stages of development (Bernard, 2010). In light of our knowledge regarding early life adversity and its effects on the HPA axis, early childhood interventions may serve as a useful tool to remediate the biological effects of these early life experiences. The Attachment and Biobehavioral Catch-up for Infants (ABC-I) intervention was developed to promote healthy biological regulation among children exposed to early adversity. The ABC-I intervention aims to increase the quality and frequency of nurturing behaviors, increase the caregiver's sensitivity to the children's non-distress signals, and reduce behaviors that are over-stimulating or frightening to the child. This will provide at-risk children with the responsive caregiving that is critical to the development of positive self-regulatory capabilities (Dozier, Meade, & Bernard, 2014)

The ABC-I intervention has been shown to be effective in normalizing cortisol regulation among infants whose caregivers were referred to CPS. Specifically, infants whose parents received the ABC-I intervention had a steeper diurnal decline in cortisol levels than infants whose parents received the control intervention (Bernard Dozier, Bick, & Gordon,2015a; Bernard, Hostinar & Dozier, 2015b). One study conducted by Dozier et al. (2008) analyzed the effectiveness of the ABC-I intervention on diurnal cortisol among infants placed in foster care. Contrary to expectations, children whose foster parents received ABC-I had *lower* overall cortisol than children whose foster parents received a control intervention. Because these findings are not

consistent with other research on the effects of adversity on the functioning of children's HPA systems, it is important to evaluate whether these findings will replicate in a second sample of foster children. Additionally, there is also a lack of empirical research regarding the effectiveness of an attachment-based intervention targeted at toddlers. For this reason, the ABC-I intervention was adapted for intervening with toddlers in foster care.

Attachment and Biobehavioral Catch-up for Toddlers (ABC-T) is very similar in nature to the ABC-I intervention in terms of structure, duration, and its intended target behaviors. However, while both the ABC-I and ABC-T interventions attempt to promote the child development by encouraging caregivers to create sensitive and nurturing environments, the ABC-T also aims to provide foster parents with the skills to help toddlers effectively cope with frustration and calm down in times of distress. The focus of ABC-T is to help foster parents function as effective co-regulators by remaining physically and psychologically available to their children. The emotional availability and support provided by the foster parent is expected to aid in the child's development of proper self-regulation (Lind, Raby, Caren, Roben & Dozier, under review). ABC-T attempts to promote an environment that encourages positive co-regulatory experiences between child and caregiver with the objective of the child taking on more self-regulatory responsibility over time. Enhanced regulatory skills among this vulnerable population of children may translate to enhanced biological and behavioral regulatory capabilities that are essential for success in academic and peer settings.

Prior to this study, no research has looked at whether the modified version of the ABC intervention (ABC-T) is efficacious in normalizing the diurnal cortisol

pattern of children placed into the foster care system. This research study aims to fill in the gap of research by examining the diurnal cortisol patterns of toddlers with histories of foster care involvement that receive early childhood intervention. Given the emphasis on improving children's regulatory capabilities in the ABC-T intervention, I expected that children who were randomly assigned to the ABC-T intervention would show a more normalized diurnal cortisol pattern than children assigned to a control intervention. Therefore, toddlers assigned to the control intervention were expected to show a more blunted diurnal cortisol pattern than those assigned to the ABC-T intervention. This blunted pattern of cortisol production is characterized by a low cortisol level at wake-up and a high cortisol level in the evening.

Chapter 2

METHODS

Participants

The sample consisted of 82 foster children and 61 foster parents. Of the 61 foster parents, 40 parents had 1 child and 21 had more than 1 child enrolled in the study. Children were, on average, 37.7 months old when they enrolled in the study (*SD* = 10.5). Following enrollment, families were randomly assigned to receive either the ABC-T intervention or a control intervention (Developmental Education for Families; DEF). Forty-eight child-parent dyads were randomly assigned to ABC-T, and 34 were assigned to DEF (Table 1).

There were some differences found between the parents of the two intervention groups (ABC-T and DEF) with respect demographic variables (Table 2). The chi-squared statistical test revealed that caregivers who received the ABC-T intervention were more likely to be Caucasian than caregivers who received DEF ($p < .01$). There were also significant differences between the two groups with regard to the education level of the primary caregiver ($p = .02$). A *t*-test determined that caregivers who received the DEF intervention had a higher education level than those who received the ABC-T intervention (Table 2). There were also no significant differences between the two intervention groups with regard to children's age, ethnicity and gender or parents' gender, age, or household income. Table 1 and Table 2 show child and parent

demographic characteristics for each group. Information regarding children's foster care histories is listed in Table 3.

Table 1 *Demographic Characteristics for Foster Children*

Child Characteristics	DEF Intervention (*n* = 34)	ABC-T Intervention (*n* = 48)
Sex, %		
Male	58.8	55.8
Female	41.2	44.2
Race/Ethnicity, %		
White	12.9	27.3
African American	77.4	65.9
Multi-racial	3.2	6.8
Hispanic	6.5	0.0
Age at pre-intervention, Months		
Mean (*SD*)	30.7 (9.4)	28.5 (8.2)
Range	10.3 – 45.9	16.4 – 53.4
Age at post-intervention, Months		
Mean (*SD*)	38.0 (10.6)	37.5 (10.4)
Range	15.1 – 61.8	22.6 – 63.0

Table 2 *Descriptive Characteristics for Foster Caregivers*

Parent Characteristics	DEF Intervention (n = 24)	ABC-T Intervention (n = 37)
Sex,%		
Male	2.6	8.3
Female	97.1	91.7
Race/Ethnicity, %		
White	15.6	42.5
African American	65.6	52.5
Multi-racial	9.4	0.0
Hispanic	0.0	2.5
Other	9.4	2.5
Education, %	0.0	20.0
Less than HS	25.0	17.1
HS degree or GED	17.9	22.9
Some college/ professional training	25.0	31.4
4-year college degree	32.1	8.6
Post-bac		
Income, %	3.7	12.1
Less than $10,000	3.7	12.1
$10,000-$19,000	7.4	6.1
$20,000-$29,000	33.3	21.2
$30,000-$39,000	7.4	3.0
$40,000-$59,000	29.6	30.3
$60,000-$99,000	14.8	15.2
Over $100,000		
Age at pre-intervention, Years		
Mean (SD)	48.5 (11.1)	45.9 (10.8)
Range	22.9 – 76.6	31.3 – 67.9

Note. ABC-T = Attachment and Biobehavioral Catch-up for Toddlers;

DEF = Developmental Education for Families.

Table 3 *Descriptive Statistics for Foster Children's Caregiving Histories*

Variable	DEF Intervention (n = 34)	ABC-T Intervention (n = 48)
Numbr of placements		
Mean (*SD*)	0.54 (1.0)	0.51 (0.9)
Range	1 – 5	1 – 3
Age removed from biological parent, Mo.		
Mean (*SD*)	13.4 (13.2)	13.7 (13.7)
Range	0 – 48.0	0 – 48.0
Age of placement with current foster parent, Mo.		
Mean (*SD*)	18.8 (15.1)	17.9 (14.8)
Range	0.1 – 52.9	0.0 – 49.3
Reason for removal, valid %		
Physical abuse	17.9	22.2
Sexual abuse	10.7	11.1
Neglect	50.0	54.1
Caregiver incarceration	0.0	30.6
Caregiver substance abuse	32.1	40.5
Dependency (i.e., inability to care for child)	60.7	50.0
Caregiver mental health problems	17.9	8.3
Domestic violence	25.0	30.6
Other	46.4	35.1
Child problematic behavior	3.6	2.8

Note. ABC-T = Attachment and Biobehavioral Catch-up for Toddlers; DEF = Developmental Education for Families.

Procedure

Pre-intervention and post-intervention research assessments.

Pre-intervention data were collected when the families first enrolled in the study, before randomization to the ABC-T or DEF intervention. Follow-up assessments were scheduled approximately one month after full completion of the intervention as well as at the time of the child's birthday at 36, 48, and 60 months of age. Data for this study were collected at the time of the pre-intervention visit (when available) and the first available post-intervention visit in which valid cortisol collection was received by the lab. Approval for the conduct of this research was obtained from the University of Delaware Institutional Review Board.

Interventions

The ABC-T and DEF interventions were analogous in nature including similarities in structure, frequency, and duration. Both interventions consisted of ten, hour-long sessions in which caregivers received feedback regarding their behaviors present throughout the sessions. ABC-T and DEF interventions were both based on structured manuals and conducted in the families' homes.

Experimental intervention. Attachment and Biobehavioral Catch-up Intervention for Toddlers (ABC-T)

Attachment and Biobehavioral Catch-up for Toddlers (ABC-T) was adapted from the original Attachment and Biobehavioral Catch-up for Infant (ABC-I) and focused on three primary targets: increasing parental nurturance, parental following

the lead behaviors, and encouraging parents to serve as co-regulators for the child when the child became frustrated or upset. Nurturance and following the lead behaviors are two targets previously implemented in the ABC-I intervention and have since proven to be effective in improving physiological regulation (Bernard, Dozier, Bick, & Gordon, 2015; Bernard, Hostinar, & Dozier, 2015) as well as in promoting secure and organized attachments (Bernard et al., 2012; Dozier et al., 2009).

Modifications were made to the original ABC-I to address the developmental changes in self-regulatory capabilities that occur during this time period. During the stage of toddlerhood, children begin to take on more independent regulatory strategies rather than relying on those present within their external environment for regulatory support (Eisenberg, Cumberland, & Spinrad, 1998; Kopp, 1982; Silk et al., 2011). The third target of the ABC-T intervention address the difficulties in proper self-regulation faced by children who have experienced early-life adversity and aims to create opportunities in which the caregiver can function as a co-regulator to the child. During times in which the child is distressed or otherwise overwhelmed with emotion, foster parents are encouraged to remain emotionally available to the child and sensitive to their needs thereby, helping soothe the child and assist in proper regulation. These three intervention targets were implemented in order to help children better regulate their emotion, behavior, physiology and cognition.

Interventionists ("parent coaches") worked to change parenting behaviors through discussion of relevant research, practice of target behaviors during structured

activities and throughout sessions, and presentation of videos to illustrate and highlight the intended target behaviors. An important component of the ABC-T intervention was parent coaches' delivery of "in the moment" responses about the quality of the caregivers' interactions with their children during the 10 sessions in regards to the target behaviors (Dozier, Meade, & Bernard, 2014). "In the moment" comments consisted of parental coaches observing parental behavior during each of the intervention sessions followed by comments regarding the frequency and quality of behaviors relevant to intervention. By providing immediate feedback to the caregiver as the parent-child interaction is taking place, "in the moment" comments are intended to improve caregivers' comprehension and implementation of the ABC-T target behaviors.

Control intervention. Developmental Education for Families (DEF)

The Developmental Education for Families (DEF) intervention was modified from an established home-visiting program that was proven to be successful in enhancing intellectual functioning, fine and gross motor, cognitive, and linguistic skills (Brooks-Gunn, Klebanov, Liaw, & Spiker, 1993; Ramey, Yeates, & Short, 1984). Parent coaches discussed and practiced methods by which to help children improve developmentally. As with ABC-T, the intervention consisted of ten, in-home, manualized sessions with a parent coach followed by additional video feedback to help review skills and illustrate improvement in child capabilities over the course of the intervention. In the moment commenting and target behaviors present within the ABC-T were not included within the DEF intervention

Saliva Sampling and Cortisol Assaying

Standard protocol was followed during the collection and assaying process of diurnal cortisol (e.g., Bernard et al., 2010). Parents collected saliva samples from children twice per day (within 30 minutes of waking and right before bedtime) during a 3-day period. Three days of data collection ensured that a reliable assessment of cortisol levels would be collected for the two time periods. Clear instructions were given to parents on how to properly collect and store their child's saliva in order to ensure for accurate cortisol collection. Research staff kept in contact with caregivers via phone communication to ensure that proper data collection protocol was being followed and that instructions were clearly understood.

Child saliva was collected through the mouthing of a dental cotton roll until sufficiently moistened with saliva. Once the cotton roll was soaked with saliva, the caregiver was told to place the cotton roll into the provided pre-labeled vial and to store the sample in their freezer at home until all six samples were completed and were ready to be returned to the lab. Along with the vials, caregivers also filled out a diary indicating the time the saliva sample was collected. If the child was sick or suffering from other acute physical conditions that may have interfered with cortisol data, saliva sample collection was delayed until the child's condition sufficiently improved.

When saliva samples were returned to the lab by staff or caregivers, they were properly stored in a -20°C freezer until they were ready to be assayed. Upon assaying, samples were thawed and centrifuged at 3,000 rpm for 10 minutes and then pipetted

into test wells. The sample test volume was 50ul and the intra and interassay coefficients of variation (C.V.) are 3.99% and 7.39%, respectively. All samples from a child were utilized in the same assay in order to minimize variability. Standards were included in every assay to ensure that assaying conditions remained constant. A collection of saliva from various donors was stored in the freezer and used as a control in all assays.

Cortisol Data Preparation

Established procedures were followed when preparing the cortisol data for analyses. Up to six samples were collected from each participant (i.e., 3 wakeup and 3 bedtime samples). Cortisol values greater than 2.0 μg/dL were considered to be biologically implausible, and values 3 *SD*s above the mean were deemed as outliers and therefore were excluded from the analyses. A C.V. of 15 or higher was used as the threshold for determining whether the measures for the sample were reliable as in previous studies conducted by the lab. Saliva sampling instructions asked caregivers to collect samples within the first 30 minutes following wakeup. I allowed for an additional 15-minute lag time to account for any measurement error. Therefore, samples with a lag time greater than 45 minutes between time of wakeup and collection were excluded from the analyses.

Any cortisol data were available for 90 children. Of the 540 possible samples, 31 were removed as outliers, 44 were excluded due to implausible C.V. values, and 24 were eliminated due to too high a lag time between wakeup and cortisol collection. As in previous studies, cases in which cortisol values were below detectable limit of the assay, values were replaced with .004 μg/dL. Eight participants were completely

omitted due to no valid cortisol samples at AM or PM. After excluding various samples due to reasons previously mentioned, a total of 436 saliva samples were included in the analyses. A total of 82 participants had at least one morning and evening cortisol sample at the post-intervention assessment. Additionally, 64 of those that completed the pre-intervention assessment had both morning and evening cortisol data at the post-intervention assessment. Log10 transformation was used to normalize the distribution of cortisol values due to high positive skew. Composite measures of wakeup and bedtime cortisol were created by averaging the information from the three morning (α = .48) and three evening (α = .71) samples. See Table 3 for descriptive information regarding cortisol levels and time of cortisol assessment for children assigned to ABC-T and DEF.