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PARENTAL CARING AND LOSS DURING CHILDHOOD AND ADULT CORTISOL RESPONSES TO STRESS

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This study was designed to test the hypothesis that the impact of early parental loss on adult physiological responses to stress is moderated by the level of perceived caring from the surviving parent. University students who lost a parent during childhood were compared to students raised by both biological parents. Salivary cortisol samples were collected immediately before and at 5 and 20 minutes following a stressful speech task. Perceptions of parental caring (Care) during childhood were measured using the Parental Bonding Instrument. Repeated measures multivariate analysis of variance revealed a significant ($p = .01$) three-way interaction of Loss by Care by Period (baseline, task, recovery) such that participants who lost a parent and perceived low parental caring showed higher cortisol levels following stress relative to other participants. These findings indicate that childhood loss of a parent is associated with long-term neurohormonal consequences only if the quality of the bond with the surviving parent is poor.

KEY WORDS: Cortisol, parental bond, caretaking, parental loss.

Wide individual differences exist in physiological reactivity to stress. The origins of individual differences in physiological responses most likely are a result of both genetic and environmental factors. Evidence from animal and human studies suggests that early experiences with the primary caregiver are critical in modulating the development of physiological stress response systems (e.g., Francis, 1999; Gunnar, 1998). In particular, many studies have demonstrated that early separation from the primary caregiver is linked to a number of negative short and long-term outcomes, including increases in corticosterone or cortisol secretion and increased physiological reactivity to stress (e.g., Kuhn, Pauk and Schanberg, 1990; Higley, Suomi and Linnoila, 1992; Bayart, Hayashi, Raull, Barchas and Levine, 1990; Gunnar, Gonzalez, Goodlin and Levine, 1981; Higley, Suomi and Linnoila, 1992), decreased growth hormone secretion (Kuhn, Pauk, and Schanberg, 1990) and immune suppression (Gust, Gordon, Brodie and McClure, 1994). However, the psychobiological consequences of parental separation can be reduced in magnitude in infants for whom an alternative attachment figure is available (e.g., Boccia, Laudenslager and Reite, 1994). The development of adaptive stress responses has been shown in animals given good quality maternal attention and early rearing conditions (Ader and Grota 1969; Denenberg, 1975; Meaney *et al.*, 1993; Francis *et al.*, 1999). In contrast, recent human studies have documented neurobiological correlates of child mistreatment, suggesting that early abusive

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experiences may result in long-lasting alterations in biological stress response systems (e.g., DeBellis *et al.*, 1999).

The quality of children's relationships with their primary caregiver has been associated with cortisol levels and reactivity in children. Flinn and England (1995) reported that characteristics of the family environment were related to cortisol levels in children. Neuroendocrine consequences in children with poor quality caretaking included unusually low basal cortisol with unusually high spikes, and chronically low cortisol levels. Several studies have found relationships between security of attachment (as measured by the Ainsworth Strange Situation model) and cortisol responses to stress in infants. Gunnar and colleagues (1996) reported that a combination of high fearfulness and insecure attachment in infants was associated with increased cortisol responses to a stressful medical exam. Similarly, Hertsgaard and colleagues (1995) found elevated cortisol concentrations in toddlers with disorganized-disoriented attachment relationships. Gunnar (1998) suggests that a secure attachment relationship is a powerful buffer of cortisol responses to stress, which may profoundly affect the developing central nervous system. Thus, the early development of the brain is an "experience-dependent" process (Black, 1998), and early experiences with attachment and parental loss can result in enduring biological changes in the brain and may influence the development of long-term physiological responses to stress.

Human studies of the long-term effects of early parental loss have typically focused on psychosocial outcomes (e.g., depression), with accumulating evidence suggesting that negative long-term outcomes are likely only if the quality of the relationship with the surviving parent is poor (e.g., Saler and Skolnick, 1992; Tennant, 1988). However, few studies have examined long-term physiological outcomes following childhood parental loss. Breier and colleagues (1989) compared resting cortisol, β-endorphin, ACTH levels, and lifetime history of psychiatric disorder in adults who lost a parent and control participants. Participants in the loss group who had experienced a major psychiatric disorder during adulthood showed significantly worse scores on a scale assessing the quality of home life and individual adjustment to the loss, and had significantly higher resting levels of cortisol and β-endorphin.

Luecken (1998) reported that young adults who experienced the loss of one parent during childhood or reported poor family relationships had higher blood pressure than control participants. Furthermore, participants who lost a parent during childhood had increasing cortisol levels during a stressful speech task relative to participants raised by both biological parents. Breier (1989) suggests that early stress, such as loss of a parent, during a period of high neuronal plasticity may result in long-lasting alterations in neurobiological functions, which may affect adaptability to future stress. The primary caregiver may be critical in helping children modulate physiological arousal (Field, 1985) and develop long-term adaptive physiological stress responses that are protective against the development of mental and physical illness.

Perceived parental caring independent of loss has also been associated with a number of psychiatric disorders, including personality disorders (Brennan and Shaver, 1998; Goldberg, Mann, Wise and Segal, 1985; Nordahl and Stiles, 1997), depression (Nordahl and Stiles, 1997; Vogel *et al.*, 1997), and eating disorders such as anorexia and bulimia (Haudek, Rorty and Henker, 1999; Sordelli, Fossati, Devoti and LaViola, 1996). Perceptions of parental caring and warmth during childhood may also be associated with adult physical health status. In a 25-year follow-up of medical students, Thomas and colleagues (1979) reported a higher incidence of cancer in those originally reporting parental relationships characterized by low levels of closeness and warmth. Similarly, Russek and Schwartz

(1997) conducted a 35-year follow-up of parental caring data collected on undergraduate students in the 1950's. They reported that participants who originally reported low ratings of parental caring had significantly higher incidences of coronary artery disease, hypertension, duodenal ulcers, and alcoholism.

The mechanisms by which characteristics of the early rearing environment may be associated with the development of physical illnesses in adulthood have yet to be determined. Extreme or chronic autonomic arousal in response to stress has been proposed as a mechanism behind long-term health-damaging effects of stress (Manuck, Kaplan and Matthews, 1986). Exaggerated physiological reactivity to stress has been hypothesized to contribute to the development of hypertension, cardiovascular disease, and other adverse health outcomes (e.g., Frankenhaeuser, 1991; Manuck *et al.*, 1986). Measures of physiological reactivity to stress may provide important predictive information concerning an individual's long-term vulnerability to cardiovascular and other diseases. Thus, early experiences that contribute to the development of exaggerated physiological responses to stress may increase long-term vulnerability to stress-related physical illnesses.

Relationships between early attachment experiences and adult physiological stress responses have been largely unexplored. The current study was designed to explore characteristics of the early rearing environment associated with long-term physiological reactivity to stress. The results reported in the current study provide new analyses and expand upon findings reported previously with this population (Luecken, 1998). It was hypothesized that the interaction of early parental loss and perceptions of parental caring would be associated with cortisol responses to stress in adulthood. A three-way interaction was hypothesized, in which participants who lost a parent and reported low levels of parental caring from their surviving parent would show increased cortisol reactivity to a stressful task relative to other participants.

METHOD

Participants

Participants included 61 Duke University and North Carolina Central University students, age 18–27. Participants were divided between loss ($n = 30$) and no-loss ($n = 31$) groups. Participants were recruited through advertisements posted around both campuses. Criteria for participation were either: (1) prior to age 16, the participant experienced the death of one biological parent, or (2) the participant was raised by both biological parents, and both parents were still living and had never divorced. Participants could not be experiencing significant health problems or taking medications known to affect cortisol levels. Potential participants were screened over the phone to determine eligibility. Duke University Medical Center's Internal Review Board approved the study, and participants signed informed consent forms. They were paid $25 for their participation.

Measures

Assessment of Cortisol. Saliva samples were collected from each subject for use in the determination of baseline cortisol levels and cortisol reactivity to a stressful speech task; one immediately prior to the task, one 5 minutes following the completion of the task, and one

20 minutes after the completion of the task. Saliva collection was chosen for determination of cortisol levels because it is simple, non-aversive to the subject, and can be collected repeatedly throughout the study. Salivary cortisol concentrations are independent of flow rate, and reflect unbound "free" levels in plasma (Raid-Fahmy, Read, Walker and Griffiths, 1983; Umeda *et al.*, 1981). Saliva samples were obtained with the Salivette sampling device (Sarstedt, Rommelsdorf, Germany). Saliva samples were centrifuged for 3 minutes at 3,000 RPM, and the resulting clear supernatant was collected and frozen for 3–5 months at 0°F (−17°C) until analysis. Samples were assayed at the pharmacology laboratory at Duke University Medical Center for free cortisol by commercial radioimmunoassay. The inter- and intra-assay variabilities are under 10%.

Assessment of Perceived Parental Caring. The Parental Bonding Instrument (PBI) (Parker, 1979) was completed by each subject for determination of their perception of parental caring during their childhood. The PBI is a self-report instrument developed to measure characteristics of the parent–child relationships. It provides two primary scales; Parental Care and Parental Overprotection. Parker (1989) documents reliability and validity of the scale. For the purposes of the current study, the Care scale was used as a measure of perceived parental caring. Participants completed the PBI separately for their mother and their father, and were told to complete the questionnaire retrospectively (i.e., rating their relationship with their parents prior to age 16). Participants who had lost a parent and did not remember the deceased parent only completed the PBI for the surviving parent

Procedure

Participants were scheduled to participate between noon and 5:00 P.M. Participants signed informed consent forms and rested for 15 minutes, after which the first saliva sample was obtained. For the speech task, participants were seated in front of a video camera. They were given instructions by a lab assistant reading a script, and were told to give a 3-minute speech that would be videotaped and evaluated. They were given a choice of three controversial topics: affirmative action, abortion, or same-sex marriages. They were then left for 30 seconds to prepare the speech, after which they were reminded of the speech topics, instructed not to use their hands during their speech, and told that they must speak for the entire 3 minutes. Five minutes following the completion of the task, the second saliva sample was collected. After an additional 15 minutes of rest, the third saliva sample was collected.

Statistical Analyses

Participants were divided into loss and no-loss groups. Because many of the loss participants did not recall their deceased parent, data analysis used the PBI Care score for the surviving parent for loss participants, and the average Care score for both parents for control participants. For non-loss participants, the Care scores for both parents were significantly positively correlated ($r = 0.46$, $p = .01$). The Care variable was dichotomized into a high/low split at the median of 17, with participants scoring 17 or below included in the "Low" group ($n = 29$), and participants scoring higher than 17 in the "High" group ($n = 32$). Effectively, four groups were created, a "loss/low caring" group ($n = 12$), "loss/high caring" ($n = 18$), "no loss/low caring" ($n = 17$), and "no loss/high caring" ($n = 14$).

Statistical analyses involved repeated measures analysis of covariance with cortisol levels as the dependent variable, parental loss group (Loss) and parental caring (Care) as between-subjects factors, and period (baseline, task, or recovery) as within-subjects factors. Statistical analysis included participant sex and time of day of participation as important covariates in the model. Participant sex was included due to exploratory analyses that determined a significant interaction with period ($F(2,58) = 4.6$, $p = .01$), in which males had initially higher cortisol and greater declines during the course of participation. Time of day of participation was included in all statistical models as a covariate due to its known circadian effects on cortisol levels. An α level of 0.05 was used for statistical tests. A significant three-way interaction of Loss by Period by Care was expected, in which loss participants reporting low perceived parental caring would show increased cortisol reactivity to the speech relative to other participants.

RESULTS

Demographic variables

χ-square and *t*-test analyses found no differences between loss groups or parental caring groups in ethnicity, sex, reported alcohol use or abuse, reported drug use or abuse, educational level, parental educational level, family income, reported eating disorder symptomatology, average amount of exercise, average caffeine intake, caffeine intake on the day of testing, religion or religious attendance, time of participation, day of participation, body mass index (BMI), or smoking status. Oral contraceptive use was higher for females in the loss group ($Q = 3.8$, $p < 0.05$) than for those in the no-loss group. Participants whose family incomes were greater that $60,000 reported significantly lower perceived parental caring ($F(1, 53) = 9.29$; $p < .01$). However, the average perceived parental caring for loss-participants was equivalent to that of no-loss participants. Thus, loss and no-loss groups did not differ in retrospective ratings of perceived parental caring. There were very few smokers in this study ($n = 2$). Of these, one was in a no loss/low caring group, and one in the no loss/high caring group. No statistical differences in smoking status between groups were found. The four groups (loss/low caring, loss/caring, no loss/low caring, and no loss/high caring) also did not significantly differ on time of day of participation, BMI, age, sex, ethnic group, caffeine use, alcohol use, oral contraceptive use, or educational level. See Table 1 for sample characteristics.

Cortisol responses to impromptu speech

Mean cortisol responses adjusted for time of day of participation for each group at each collection period are shown in Figure 1. A significant three-way interaction of Loss by Care by Period was found ($F(2, 54) = 4.47, p = .01$). Analysis of simple effects and contrasts showed that the differences among the four groups at baseline and at the first post-speech measurement are not statistically significant. However, at the final post-speech measurement (recovery), cortisol levels for the loss/low caring group are significantly higher than all other groups ($F(1, 60) = 4.21, p = .05$). In contrast, at higher levels of parental caring, loss participants showed recovery cortisol levels indistinguishable from those of control participants. Non-loss participants reporting low levels of parental caring appear to show initially higher mean baseline cortisol levels that decreased over the

Table 1 Sample characteristics by parental loss and parental caring groups

	Loss/Low *n*	*Loss/High* *n*	*No loss/Low* *n*	*No loss/High* *n*
Sex				
Male	2	7	7	4
Female	10	11	10	10
Educational Level				
undergraduate	10	13	14	12
graduate	2	5	3	2
Ethnic Origin				
White	6	12	12	10
Black	5	6	2	2
Asian	1	0	1	2
Hispanic	0	0	2	0
Caffeine Consumption				
None	9	14	12	11
1 serving	3	3	4	3
2 + servings	0	1	1	0
Oral Contraceptive Use				
Yes	4	5	3	0
No	8	13	14	14
Family Income				
$0–20,000	0	4	0	1
$21,000–40,000	0	4	4	2
$41,000–60,000	5	2	1	3
$60,000 and above	6	5	10	8
No answer	1	3	2	0
BMI (mean,SD)	22.1 (2.5)	24.1 (5.3)	22.3 (1.6)	22.3 (4.1)
Time of Day (mean,SD)	1:03 (90 min)	2:05 (87 min)	2:04 (77 min)	2:11 (136 min)
Average Age (mean,SD)	21.8 (2.4)	21.6 (2.6)	21.6 (2.3)	21.3 (2.2)

remaining measurement periods, however neither the initial difference nor the decrease were statistically significant. Similarly, while the means of the loss-low caring group appear to increase over the three measurement periods, the increase did not reach statistical significance. In short, the primary finding is a three-way interaction of loss by caring by period which is evidenced by similar baseline cortisol levels among all participants and significantly higher recovery levels for participants who experienced the loss of a parent and reported low levels of caring from the surviving parent. These effects remained after statistically controlling for caffeine intake, smoking, oral contraceptive use, time of day, sex, age, family income, and BMI.

DISCUSSION

The current study provides evidence that neurohormonal responses to stress in adulthood are associated with characteristics of the early rearing environment, including early disruptions in attachment (e.g., by the death of a parent), and the perceived quality of subsequent parental caring. These results provide support for the hypothesis that early loss of a parent is associated with disrupted cortisol responses to stress only for those who reported low caring from their surviving parent. Specifically, the current results suggest that participants

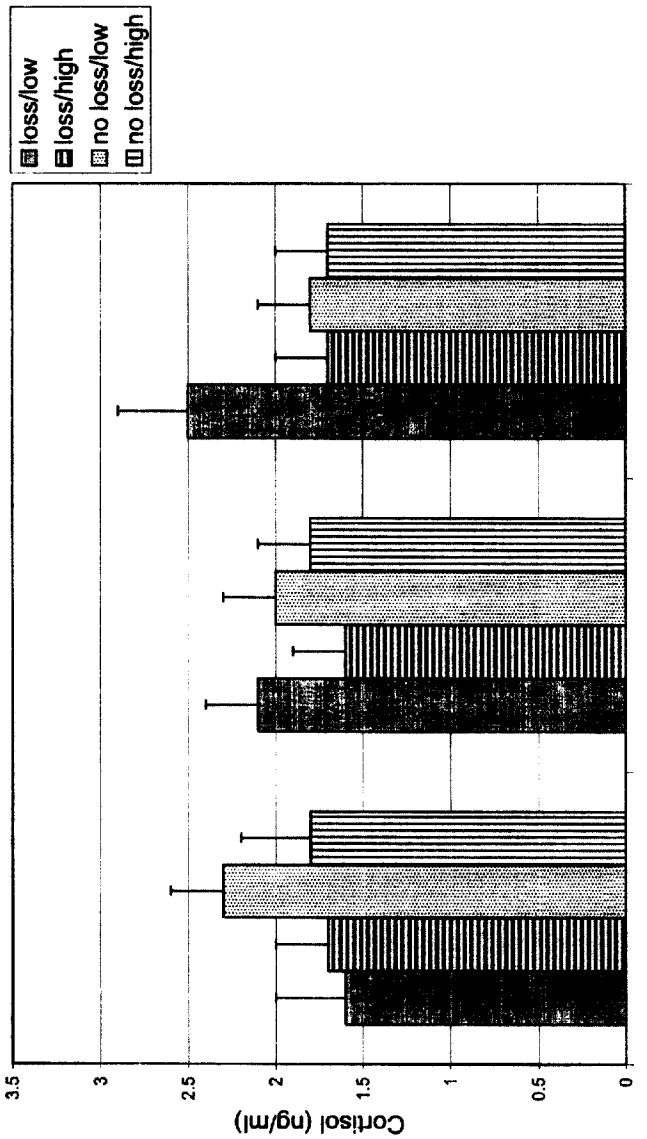

Figure 1 Effects of loss of a parent and perceived parental caring on adult cortisol responses to an impromptu speech task (means and SE adjusted for time of day = 1:54 PM).

who lost a parent and reported low caring from the surviving parent had higher cortisol levels following a stressful task relative to other participants, who showed stable cortisol levels during and after the task. This difference was primarily evident during the recovery period, during which cortisol levels for loss participants reporting low caring were significantly higher than all other participants. Similar to results from animal studies, participants who experienced early separation from a parent and who reported a caring relationship with the surviving parent showed cortisol responses similar to participants who did not lose a parent.

The current results support findings of increased cortisol reactivity in children with insecure attachment relationships (e.g., Gunnar *et al.*, 1996), and suggest that early disrupted attachment may result in long-lasting alterations in physiological responses to stress. These results are also supportive of the recent study by Russek and Schwartz (1997) documenting a higher incidence of heart disease, ulcers, and hypertension in individuals who reported low levels of parental caring during their formative years, and suggest chronic and acute autonomic arousal as a possible mechanism for long-term negative health outcomes. However, the current results suggest that a combination of early separation from a parent and low perceived caring from the surviving parent is associated with exaggerated cortisol responses and may make an individual more vulnerable to the health-damaging effects of stress.

Earlier reports (Luecken, 1998) from this sample of university students evaluated cortisol reactivity associated with a measure of the quality of overall family relationships (as determined by the Moos Family Environment Scale (FES); Moos and Moos, 1994). Participants who lost a parent were shown to have increasing cortisol levels during the speech task. However, the quality of family relationships was not associated with cortisol reactivity during the speech task. Furthermore, "family relationships" as measured by the FES was not correlated with the PBI Care scale. This suggests that the FES and the PBI measure different constructs of the early caretaking experience. The PBI was chosen to specifically evaluate the bond with the surviving parent as a moderator of long-term neurohormonal outcomes following early loss of a parent, whereas the FES provides a more global measure of family cohesiveness, conflict, and expressiveness. The current results suggest that the bond with the surviving caretaker is more relevant to the development of long-term cortisol responses to stress following the early loss of a parent.

This study has several limitations. First, perceived parental caring as determined by the PBI was based on retrospective recall. It is possible, although unlikely, that participants who showed delayed recovery to a novel stressor may have selectively recalled less parental caring. However, the negative influence of poor parental caring was evident only in participants also reporting the early death of a parent . Furthermore, Brewin and colleagues (1993) in a review of studies assessing retrospective reports of early experience conclude that there is no strong evidence to support the criticism that retrospective data is inherently inaccurate, even with psychiatric patients.

Second, the sample on which these analyses were conducted consisted of 18–27 year old university students. This sample was chosen in an attempt to minimize potential confounds, however it is not typical of the general population in terms of several socioeconomic variables (e.g., family income, educational level). Therefore, it is unclear the extent to which these results may generalize to a larger population. Third, it is possible that participants were exhibiting "help-seeking" behavior by choosing to participate, which may bias the sample towards less healthy participants. Conversely, this sample consists of relatively high-functioning participants, and individuals suffering more severe consequences may not have been recruited for this study. In that case, the present results may represent

a conservative estimate of the long-term consequences of early loss and low parental caring. However, selection bias is not likely for reports of parental caring, as PBI scores were calculated following the completion of all data collection and parental caring was not advertised or used as selection criteria.

This study was specifically designed to test the hypothesis that the quality of the relationship with the surviving parent would significantly influence any potential negative long-term physical effects of early parental loss. Therefore, it was necessary to compare participants largely raised by one parent to those raised by both biological parents. It is not possible from this sample to determine independent effects of caretaking by a single parent on cortisol responses to stress. Several other factors which may be associated with adult adjustment, including the quality of sibling relationships or relationships with other relatives or significant adults, were not measured in the current study. Data were collected concerning specific characteristics of the death (e.g., age at the time of parental death, forewarning, sex of deceased parent, participation in mourning activities, witnessing the death, receipt of professional help, remarriage of surviving parent). However, no clear findings emerged, most likely due to the small size of the loss-group alone. Similarly, while a trend was seen for increasing cortisol responses in the loss/low caring group and decreasing cortisol responses in the no loss/low caring group, these changes did not reach statistical significance, most likely because of the small subgroup sample sizes (e.g., $n = 12$ and $n = 17$). Future studies with a larger sample size will help to clarify these results.

Despite these limitations, the results from the current study provide further evidence that characteristics of the early rearing environment can have significant effects on the development of physiological stress responses that influence risk for development of cardiovascular disease. Many years of animal and human research have demonstrated that early experiences result in enduring biological changes in the developing brain (Black, 1998). These results demonstrate the importance of parental caring for the development of adaptive stress responses, which may decrease long-term vulnerability to stress-related illness. Evidence that early experiences with attachment and loss may have long-term effects on physiological stress response systems further underscores the importance of early intervention with vulnerable children who experience disruptions in attachment (e.g., through neglect or parental death).

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