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Attachment security buffers the HPA axis of toddlers growing up in poverty or near poverty: Assessment during pediatric well-child exams with inoculations

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ABSTRACT

Poverty is associated with poor physical and emotional development. Activation of the hypothalamic-pituitary-adrenocortical (HPA) axis is argued to be one of the pathways through which poverty acts on these outcomes. While studies of school-aged children have found some evidence for this, there is little evidence for this hypothesis early in development. This may be, in part, because for very young children, the security of their attachment relationships with parents moderates the impact of poverty on HPA axis functioning. The current study investigated the relations between family income as a percentage of the federal poverty limit (FPL), salivary cortisol and attachment (Attachment Q-sort) during well-child checkups with inoculations in 177 toddlers between 12- and 22-months of age. Approximately half of the toddlers were in families living below 150% FPL, with 47% of these classified as securely attached, compared to 72% of toddlers in families living above 150% FPL. Cortisol levels increased in response to the inoculation and this did not differ by poverty or attachment security. Overall, however, beginning at clinic arrival toddlers in families living below 150% FPL who had an insecure attachment had significantly higher cortisol compared to toddlers living in poverty or near poverty with secure attachments. This finding held when we removed toddlers with high levels of negative life events in their families and primary caregivers who exceeded the screening cutoff for depressive symptoms. Thus, attachment was a significant moderator of the association between poverty and HPA axis activity, with significant implications for screening and referral of caregiving dyads at risk.

1. Introduction

In the United States, between a fifth and a quarter of children are growing up in poverty and approximately another twenty percent live in households with incomes in the near poor range (Yoshikawa et al., 2012). Growing up poor in disadvantaged neighborhoods increases an individual's risk of a range of adverse physical and mental health outcomes (Aber et al., 1997; Diez Roux and Mair, 2010; Yoshikawa et al., 2012), including early death (Meijer et al., 2012). Recent work has also noted a range of socioeconomic variables may have significant impacts on brain development (see review, Farah, 2017). Not all children growing up in poverty experience adverse outcomes. Both stress and parenting have been invoked as potential mediators of the effects of poverty on behavior, health, and the brain (Farah, 2017; Kim et al., 2013; Mayer, 1997).

Stress activates the hypothalamic-pituitary-adrenocortical (HPA) system, among other stress-responsive systems (McEwen, 2008). Glucocorticoids (cortisol in humans) produced by the HPA system have been shown in animal models to have significant impacts on neural and behavioral development (Oitzl et al., 2010). Adverse early life care in animals predicts hyper-responsiveness of the HPA system to stressors measured in adulthood, in part mediated through epigenetic programming of glucocorticoid receptors in the hippocampus (Meaney and Szyf, 2005). There has been considerable interest in the translation of these findings to human development. In one of the earliest studies of poverty and cortisol it was shown that morning cortisol levels at school were negatively correlated with socioeconomic status as early as 6 years of age (Lupien et al., 2000). Maternal depression partially mediated this effect. Several other studies have noted elevated cortisol levels associated with poverty and disadvantage as shown in higher levels at baseline (Blair et al., 2011), overnight urinary levels (Evans and English, 2002), and larger increases in daily levels over two years of

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assessment (Chen et al., 2010). Similarly, using neighborhood disadvantage as the predictor, the National Comorbidity Survey Replication Adolescent Supplement found elevated cortisol in adolescents from high disadvantaged neighborhoods prior to a stress interview but no evidence of a larger response as a function of living in a disadvantaged neighborhood (Rudolph et al., 2014).

Nevertheless, a nearly equal number of studies have reported blunting of cortisol levels and/or reactivity associated with poverty. Using the Study of Early Child Care and Youth Development sample, a blunted cortisol awakening response was noted among adolescents girls who experienced poverty in infancy and adolescence but not poverty during childhood (McFarland and Hayward, 2014). Likewise, in the Whitehall II Study, an epidemiological study of British civil servants, women but not men showed a blunted cortisol response to the Trier Social Stress Test if they came from disadvantaged neighborhoods and perceived themselves to be low in social control (Barrington et al., 2014). Therefore, gender is an important factor to consider in studies of poverty and stress. Some also have hypothesized that age of the child may moderate the association between economic status and cortisol, with older children exposed for longer periods to harsher economic circumstances showing blunted and younger children exposed for shorter periods showing elevated cortisol levels. This was noted by Ursache et al. (2015) in 6- to 12-year-old children with the transition in the direction of association occurring sometime in middle childhood. However, this hypothesis does not explain results showing blunted levels present already among preschoolers (Badanes et al., 2011). Certainly one explanation for the variation in findings is the use of different measures of cortisol, in addition to different ages of the participants.

To date it is unclear how early in life HPA axis activity begins to reflect children's socioeconomic status. The Family Life Project, a large representative study of rural poverty, has reported a number of findings related to HPA axis activity, but there has been little evidence of a direct relationship between family income and cortisol levels or reactivity in the first years of life. Indeed, when cortisol levels were studied multiple times between 12 and 36 months, no associations with degree of poverty were noted (Hill-Soderlund et al., 2015). However, when neighborhood disadvantage was used as the predictor, high neighborhood disadvantage was associated with higher cortisol levels emerging by 24 months for White but not Black children (Finegood et al., 2017). In the following study, we examined whether poverty would be associated with either cortisol levels or reactivity to an aversive stimulus in toddlers between 12 and 22 months of age.

Parenting quality is also expected to be an important mediator of the effects of poverty on child outcomes. Sensitive and responsive parenting is associated with positive outcomes for children and can be impaired by stress and financial worries (Mayer, 1997; Repetti et al., 2002). Sensitive and responsive parenting supports the development of secure attachment relationships, which are powerful buffers of stress for children at all income levels (see review, Gunnar, 2017). While numerous studies have demonstrated that children living in poverty are more likely than their wealthier peers to develop insecure attachment relationships (Aber et al., 2000; Fish, 2001; Spieker and Booth, 1988; van Ijzendoorn et al., 1999), when secure relationships are formed, these relationships may buffer children from the negative impacts of growing up in impoverished households (Sroufe et al., 1990). Indeed, attachment security has been shown to buffer poor school-aged children from depressive symptoms (Graham and Easterbrooks, 2000). Secure attachment also has been found to moderate the relation between stress in utero and fearful behavior in early childhood (Bergman et al., 2008). To our knowledge, however, only one study has examined whether attachment security moderates the association between poverty and activity of the HPA axis. That study was one of impoverished adolescents in South Africa in which poverty was associated with a blunted cortisol response to the TSST, but only for youth with insecure attachment histories (Fearon et al., 2017). In the Family Life Project, however, maternal sensitivity was found to buffer poor toddlers exposed to intimate partner violence from heightened cortisol reactivity to mildly stressful tasks at 24 months of age (Hibel et al., 2011). Thus, it seems likely that attachment security as a reflection of a history of sensitive parenting by the toddler period might buffer effects of poverty on the HPA axis.

The purpose of the present study was to examine the association between family income and toddler's cortisol levels and reactivity. We assessed the toddlers during their well-child pediatric visit with inoculations. It has been shown previously that children display a cortisol response to inoculations, although the magnitude of response wanes with age (Gunnar et al., 1996a; Lewis and Ramsay, 1995). Because of the current inoculation regimen, children are now typically seen at 12, 15 and 18 months for pediatric well-child exams and inoculations. We assessed each child at one of these visits. Trained observers accompanied the child and parent throughout the clinic visit and during an additional free play period immediately following the physical exam and inoculations. Based on these observations they used the Attachment Q-sort to assess the child's use of the parent as a secure base during the clinic visit (Waters and Deane, 1985). We predicted that children reared in poverty would have higher levels of cortisol and/or greater cortisol elevations to inoculations, but that this would be true only or primarily for those who were less able to use the parents as a secure base during the clinic visit. Finally, a number of poverty co-factors were also assessed, including negative life events and maternal depression, as possible confounding or explanatory factors in poverty-attachment-cortisol associations.

2. Methods

2.1. Participants

The participants were 177 toddlers and their English or Spanish speaking parents living in an urban region of the Midwest. They were assessed at their 12-, 15-, or 18-month well-child medical visits with inoculations. Because of delays in scheduling and attending these exams, 12-month appointments were spread until nearly 15 months, and so on for each age target. The age range was 11.9 to 21.9 months. Children who were not given their inoculations at that visit (n = 10), children born prematurely (< 36 weeks, n = 5), and children whose parents did not complete the demographic questionnaire (n = 1) were excluded from the sample, resulting in the 177 reported above. The demographics of the sample are shown in Table 1. The sample was just under 50% White, with broad representation of other racial groups. Although most children were living in two parent households, the income level ranged widely.

2.2. Measures

2.2.1. Percent of Federal poverty index

Parents reported income in 15 thousand dollar units and the number of individuals in the household. Family size ranged from two to ten. Using the National Center for Children in Poverty http://www.nccp.org/tools/converter/ income converter and the midpoint of each income bracket, the family's income as a percent of the federal poverty limit (FPL) was calculated for each child. This resulted in approximately 35.4% of the participant sample classified as living below the FPL and another 16.6% living between 100% and 150% of the FPL. To examine the impact of poverty on children's cortisol levels we divided the sample at 150% of FPL, resulting in n = 85 of the 177 categorized as living in poverty or near poverty. The pattern of results does not change when assessing income continuously.

2.2.2. Salivary cortisol

Saliva was sampled for cortisol determination at three points during the clinic visit: at clinic arrival immediately following consent, immediately following the physical exam but before the inoculation, and