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Socioeconomic status, hair cortisol and internalizing symptoms in parents and children

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ABSTRACT

Socioeconomic disadvantage is consistently linked with higher risk for internalizing problems, and stress is likely one important mechanism explaining this increased risk. Few studies have examined socioeconomic differences in hair cortisol, a novel biomarker of long-term adrenocortical activity and chronic stress. Moreover, no studies have examined whether differences in hair cortisol might explain socioeconomic disparities in internalizing problems. To address these gaps, we first examined relations of socioeconomic status (SES; family income and parental education) to variation in both parents' and children's hair cortisol concentrations (HCC) and then tested whether HCC and perceptions of stress mediated relations of SES to parents' and children's internalizing symptoms. Participants were a socioeconomically diverse sample of 35 parents and 26 children (ages 5–7). Parents completed questionnaires, and hair samples were collected from parents and children. Parents reported on children's internalizing symptoms on average 2 years after the initial visit. Results demonstrated that lower parental education was associated with higher HCC for both parents and children. Effects for child HCC held even after controlling for parent HCC. Lower family income was associated with higher parent HCC, but not child HCC. This relation was nonlinear, such that the relation between HCC and income was strongest among the most disadvantaged parents. Furthermore, associations of SES with parental anxiety were significantly mediated by parental perceptions of stress and marginally mediated by parent HCC. These findings suggest that socioeconomic disadvantage is associated with greater accumulation of cortisol in hair in parents and children, and that both perceived and biological markers of stress capture important facets of the experiences that underlie socioeconomic disparities in adult anxiety.

1. Introduction

1.1. SES, hair cortisol and internalizing symptoms in children and their parents

There are well-established socioeconomic disparities in risk for internalizing problems, such as anxiety and depression, with a greater risk for such problems among both low SES adults (Alegria et al., 2000; Callan et al., 2015; Hudson, 2005; Lorant et al., 2003; Murali and Oyebode, 2004) and children from low SES families (Bradley and Corwyn, 2002; Evans and Cassells, 2014; McLaughlin et al., 2011; Reiss, 2013; Slopen et al., 2010; Tracy et al., 2008). Low-SES families frequently face a host of stressors, such as financial uncertainty, crowding, noise, household chaos, fewer family routines, and a generally higher level of unpredictability, all of which can contribute to an increase in stress for both parents and children (Adler and Snibbe, 2003; Combs-Orme and Cain, 2006; Evans et al., 2005). Indeed, socioeconomic disadvantage has been linked with higher levels of stress, at both the behavioral (e.g., perceptions of stress) and physiological levels (e.g., salivary cortisol) (Dowd et al., 2009). In addition, behavioral measures of stress and salivary cortisol have been linked with internalizing problems (Russell et al.,

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2012; Staufenbiel et al., 2013). Yet, few studies of SES have focused on measures of chronic physiological stress, such as hair cortisol concentration (HCC). There is also a lack of research investigating associations among SES, HCC, and risk of internalizing problems in parents and children. To address these gaps in the literature, we first examined relations of SES to HCC in parents and children. We then examined the extent to which HCC and parental perceptions of stress mediated the association between SES and internalizing symptoms in parents and children.

1.2. Associations between SES and hair cortisol

Several studies have demonstrated links between SES and variations in cortisol in both children and adults (Dowd et al., 2009). These earlier studies, however, used salivary, urinary, or serum measures of cortisol which are affected by acute factors and which provide estimates of HPA axis activity at a certain point in time. As such, they are limited in their ability to capture *chronic* stress (Staufenbiel et al., 2013). Recently, the measurement of cortisol in hair (HCC) has emerged as a promising technique for assessing chronic stress levels (Russell et al., 2012). Cortisol accumulates in hair as it grows and is stable for at least the first 6 cm of hair, which corresponds to about 6 months of hair growth (Russell et al., 2012). As SES is a proxy for chronic stress, it may be that hair cortisol, as a biological marker of chronic stress, would be more strongly linked to SES and would better explain socioeconomic disparities in internalizing problems than would other physiological measures of stress.

Several recent studies have examined associations between SES and HCC, and findings have been mixed. In adults, one study reported that lower income was associated with higher HCC (Serwinski et al., 2016), but others have not found differences in adult HCC by income (Chen et al., 2013; Wosu et al., 2015) or education (Serwinski et al., 2016; Wosu et al., 2015). In children, some studies have reported that lower parental education (Rippe et al., 2016; Vaghri et al., 2013; Vliegenthart et al., 2016) and lower family income (Rippe et al., 2016) are associated with higher HCC, whereas others have not found associations between child HCC and parental income (Vaghri et al., 2013) or parental education (Groeneveld et al., 2013; Karlen et al., 2013; Liu et al., 2016). At least two of these studies, however, may have been limited in their ability to detect associations of SES with HCC because they utilized small samples, which were not purposefully recruited from a broad range of socioeconomic backgrounds (Groeneveld et al., 2013; Liu et al., 2016). Differences in the measurement of SES may also have contributed to these mixed findings. Even among those measuring the same construct (i.e., income or education), some studies used continuous measures whereas others used categorical measures, which also differed across studies. Interestingly, Karlen et al. (2013) did find that children living in apartments versus in villas had higher cortisol, suggesting that socioeconomic differences may have played a role. Moreover, because there may be some genetic heritability of HCC (Karlen et al., 2013), it may be important to control for parental HCC when examining SES disparities in child HCC, in order to rule out possible genetic bias.

1.3. Associations between hair cortisol and internalizing problems

There has long been interest in understanding the role of the HPA axis in anxiety and depressive disorders. However, most prior studies examining these associations have measured salivary or serum cortisol (Staufenbiel et al., 2013). Higher HCC have been hypothesized to be associated with anxiety and depression in both children and adults, but evidence regarding these associations has been mixed (Ouellette et al., 2015). One study reported higher HCC in adults diagnosed with depression (Dettenborn et al., 2012) whereas other work has found no difference in HCC by depression diagnosis in a sample of patients with coronary artery disease (Dowlati et al., 2010) and no relation of HCC to depressive symptoms (Ouellette et al., 2015). One study of adults found that lower HCC was associated with generalized anxiety disorder (Steudte et al., 2011). In children, higher maternal depression has been associated with lower HCC at 1 year of age (Palmer et al., 2013), but another study found no association between children's HCC and their symptoms of anxiety or depression (Ouellette et al., 2015). This mixed pattern of results may be influenced by differences in the measurement of internalizing problems (i.e., diagnosis versus symptom report) or by diversity across samples in terms of demographic characteristics such as age, sex, and comorbidities.

1.4. The current study

In the current study, we first examined associations between SES (family income and parental education) and HCC in parents and children. Importantly, because there may be some genetic basis for HCC (Karlen et al., 2013), we controlled for parent HCC when examining socioeconomic differences in children's HCC. Family income and parental education were analyzed separately because they contribute distinctly to children's development (Duncan and Magnuson, 2012; Hanson et al., 2011; Noble et al., 2012). Second, we investigated associations between HCC and internalizing symptoms in parents and children. These analyses controlled for SES and parental perceptions of stress. Finally, given the large prior literature documenting socioeconomic disparities in risk for internalizing problems, we examined whether relations of SES to anxiety and depression in both parents and children were mediated by parental perceptions of stress and by parents' or children's own HCC, respectively. Given that perceptions of stress and physiological measures of stress are largely dissociable (e.g., Gunnar et al., 1981), we examined the independent roles of both parental perceptions of stress and HCC as mediating mechanisms.

2. Materials and methods

2.1. Participants

We recruited a socioeconomically diverse sample of children and their parents through local street festivals, children's events, and posting flyers in local neighborhoods in a large Northeastern U.S. city. Recruitment aimed to reach families from a range of socioeconomic backgrounds. More specifically, we aimed to enroll roughly equal numbers of mothers with high school, some college, college, and post-graduate education.

2.2. Procedure

During a lab visit, parents and their children first provided informed consent. Parents completed questionnaires, including measures of perceived stress and self-report measures of their own internalizing symptoms. Hair samples were collected from parents (n = 35) and children (n = 28) in order to assess cortisol accumulation in hair. Hair samples were not collected in instances when hair was too short or the participant did not agree to provide a sample. None of the parents were from the same household. Measures of child internalizing symptoms (n = 22 of the 28 children who provided hair samples) were collected during a follow-up phone call with parents, which on average, occurred 2 years after the initial visit. All procedures were approved by the Institutional Review Board at the New York State Psychiatric Institute.