



Perceived discrimination and diurnal cortisol: Examining relations among Mexican American adolescents

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ABSTRACT

Perceived discrimination remains a salient and significant environmental stressor for ethnic and racial minority youth. Although many studies have examined the impact of racial/ethnic discrimination on mental health symptomatology and physical health, little is known of the potential physiological processes underlying such experiences, especially during adolescence. In an attempt to understand how varying perceptions of discrimination relate to functioning of the hypothalamic–pituitary–adrenal axis (HPA axis), the current study examined the relation between Mexican American adolescents' ($N = 100$, $M_{\text{age}} = 15.3$ years old) perceptions of discrimination and aspects of their diurnal cortisol profiles. Three salivary samples (wakeup, +30 waking, bedtime) were collected across 3 days (total of 9 samples). Utilizing multi-level modeling, results revealed that adolescents' perceived discrimination related to greater overall cortisol output (area under the curve; AUC) after controlling for other life stressors, depressive symptoms, family income, acculturation level, daily stress levels and daily behaviors. Findings also revealed that perceived discrimination was marginally related to a steeper cortisol awakening response (CAR). Together, these findings suggest that perceived discrimination is a salient and impactful stressor for Mexican American adolescents. Understanding the physiological correlates of discrimination can provide insight into larger health disparities among ethnic and racial minority individuals.

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Introduction

Discrimination is a commonly experienced stressor among ethnic and racial minority individuals in the U.S. (Williams and Mohammed, 2009). Nearly 30% of Mexican American adults and 50% of Mexican American adolescents report experiences of ethnic discrimination on a daily basis (Fisher et al., 2000; Pérez et al., 2008). This frequency is alarming given that perceived ethnic/racial discrimination has been consistently linked to a variety of physical and mental health outcomes including hypertension, self-reported poor health, breast cancer, depression, and anxiety (for review see: Pascoe and Richman, 2009; Williams and Mohammed, 2009). Numerous theories posit that there are physiological pathways through which perceptions of discrimination affect health (Beauchaine et al., 2008; Cicchetti and Gunnar 2008; Clark et al., 1999; Meyers, 2009; Pascoe and Richman, 2009). Specifically, such experiences set in motion a process of physiological responses that include cardiovascular activity and greater stress response. These responses are theorized to contribute to health deterioration (Geronimus et al., 2006) and over time,

damaging changes in physiological functioning, often referred to as allostatic load (McEwen, 1998, 2002). Empirically, perceived racial/ethnic discrimination has been found to predict greater cardiovascular reactivity, which includes higher nocturnal blood pressure (Brondolo et al., 2008), and higher systolic and diastolic blood pressure throughout the day (Steffen et al., 2003); however, the link between perceived discrimination and other major stress–response systems remains relatively unexplored, especially among adolescents.

To address the gap in the literature and extend our knowledge of the physiological mechanisms underlying the effects of perceived discrimination during adolescence, the current study examined the relation between Mexican American youths' perceptions of ethnic discrimination and the main stress hormone of the hypothalamic–pituitary–adrenal (HPA) axis, cortisol (Johnson et al., 1992). Cortisol levels have been linked to day-to-day variation in daily stressors (Adam, 2006), more persistent, chronic life stressors (Miller et al., 2007), and recently, perceived discrimination in adults (Kaholokula et al., 2011); however, the link between perceived ethnic discrimination and cortisol has yet to be examined among adolescents. Adolescence appears to be a particularly compelling developmental stage to examine given the increased awareness of perceived discrimination (Brown and Bigler, 2005) and the increased attention to allostatic load (Hasting et al., 2011). Further, a focus on Mexican American

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youth appears critical given that they are part of the youngest and fastest growing ethnic minority population in the U.S. (U.S. Census, 2006). Exploring the physiological correlates of these adolescents' experiences has implications for our understanding of health disparities among the larger Latino population and other racial/ethnic minorities.

Perceived discrimination as a stressor

Discrimination is a reality for many ethnic and racial minority individuals living within the U.S. (Fisher et al., 2000). For Latinos specifically, recent political attention to immigration in the U.S. has increased perceptions of such experiences with nearly 61% of Latino adults describing ethnic discrimination as a "major problem" in 2010 compared to 50% in 2004 (Lopez et al., 2010). Empirical evidence of the deleterious effects of perceived discrimination in ethnic and racial minorities including Mexican Americans is mounting. In a recent meta-analysis of 134 studies, a robust and strong relation emerged between perceptions of racial/ethnic discrimination and physical health outcomes that included cardiovascular disease, hypertension, diabetes, and respiratory conditions (Pascoe and Richman, 2009). An equally strong relation emerged between racial/ethnic discrimination and mental health conditions (e.g., depression, anxiety, posttraumatic stress disorder, and perceived quality of life). Although most of this work has focused on adult populations, researchers have begun to examine the effects of discrimination on adolescents' development. Cross-sectional and longitudinal studies have consistently found that adolescents' perceptions of ethnic discrimination relate to mental and physical health outcomes in Mexican American (e.g., Berkel et al., 2010; Delgado et al., 2009; Flores et al., 2010) and other ethnic and racial minority youth (e.g., Clark, 2006; Galliher et al., 2011; Simons et al., 2002). Together, such evidence underscores the seriousness of perceived discrimination in adolescents' development.

Adolescence is a particularly compelling period of development to understand the impact of discriminatory experiences. Due to increased cognitive functioning and a greater sense of self-identity, theorists have posited that this developmental stage brings an increased understanding that societal attitudes of racial/ethnic biases are based upon opinions about and perspectives of its majority members (Brown and Bigler, 2005; Selman, 1976). Adolescents, in turn, develop a greater awareness of biases and discrimination at an interpersonal level, leading to increased perceptions of discrimination. Understanding the pathways linking discrimination to adolescents' outcomes during a developmental period in which such events gain salience could provide researchers clues into the impact of discrimination over the life course.

Hypothalamic–pituitary–adrenal axis response to stressors

The biopsychosocial model of minority health (Meyers, 2009) and other theoretical frameworks (Pascoe and Richman, 2009) posit that there are physiological pathways and mechanisms linking perceptions of racial/ethnic discrimination and health. One of those mechanisms is the HPA axis. As one of the body's major stress–response systems, the HPA axis reacts to both physical and psychological environmental stressors and includes complex interactions between the hypothalamus, the pituitary gland, and the adrenal cortex (Johnson et al., 1992). Stated simply, when stressors arise, the limbic system activates the release of corticotropin-releasing hormone (CRH) and arginine vasopressin (AVP) from the hypothalamus, which in turn interacts with receptors of the anterior pituitary, releasing adrenocorticotropin hormone (ACTH) into general circulation (Herman and Cullinan, 1997). ACTH circulates in the blood and binds to the receptors of the adrenal cortex, stimulating the release of cortisol (de Kloet and Derijk 2004). To help with self-containment, the HPA axis is equipped with important feedback mechanisms that inhibit further production of CRH,

AVP, and ACTH, effectively turning off the HPA axis when individuals have recovered from the environmental stressor (Chrousos and Gold, 1992).

The entire process of the HPA axis responding to immediate stressors is often referred to as *cortisol reactivity*. Most of the early work on cortisol has focused on this area; researchers have used laboratory stressor tasks to elicit a cortisol response (for review see Dickerson and Kemeny, 2004) and more recently examined reactivity in naturalistic settings (Adam, 2006). Researchers have also begun to understand the importance of examining cortisol outside of the reactivity framework, focusing on the basal activity of the HPA axis (e.g., Adam et al., 2010; Shirtcliff and Essex, 2008). The HPA axis produces levels of cortisol that follow a strong diurnal rhythm; cortisol levels are high upon waking, increase by 50–60% in the first 30–40 min [known as cortisol awakening response (CAR)], and then rapidly drop off throughout the day, reaching nadir around midnight (Kirschbaum and Hellhammer, 2000; Pruessner et al., 1997). Although the relation between cortisol reactivity and basal diurnal levels is not completely understood, theories of HPA axis activity posit that the periodic activation of the HPA axis and the release of cortisol are necessary to cope with acute stress; when the HPA axis response is frequent or persistent, however, chronically low or chronically high levels of cortisol can emerge, leading to changes in basal cortisol levels and possibly, damaging effects that include receptor desensitization and tissue damage and contributing to allostatic load (McEwen, 1998, 2002).

Although empirical studies have lagged behind theory, emerging research into diurnal cortisol rhythms suggests that flattened diurnal slopes, increased CAR, and/or low or high levels of overall cortisol output [typically referred to as area under the curve (AUC)] might be an indication of basal cortisol level changes and possibly, allostatic load (McEwen, 2002). For instance, prolonged or cumulative stressors have related to decreased morning cortisol levels and higher afternoon/evening cortisol levels, which results in a flatter slope or a less steep decline in cortisol across the day (for review see: Michaud et al., 2008; Miller et al., 2007). Further, persistent environmental stressors have been linked to flatter diurnal slopes (Do et al., 2011), steeper CAR (Pruessner et al., 1999, 2003a; Schulz et al., 1998) and a greater AUC (Gustafsson et al., 2006; Kirschbaum et al., 1995). Together, such evidence suggests that persistent or chronic environmental stressors have the potential of influencing diurnal cortisol patterns.

Further, studies suggest that activation of the HPA axis is sensitive and more prone to react to stressors that are *socially evaluative* and *uncontrollable*. In a meta-analysis of 208 adult laboratory studies, Dickerson and Kemeny (2004) found that adults had a strong cortisol response to stressors when exposed to threats in which an aspect of the self (e.g., trait, ability) was negatively judged by others or when stressors were deemed uncontrollable. Stressors with both characteristics evoked the strongest cortisol responses. Naturalistic studies corroborate these findings such that uncontrollable stressors and/or stressors that pose a threat to the individual's social standing were related to flattened diurnal slopes, lower morning values, and higher afternoon values (Michaud et al., 2008; Miller et al., 2007). Experiences of ethnic discrimination could be considered both socially evaluative and uncontrollable; socially evaluative because such experiences threaten an individuals' social standing in their peer group and their immediate context (e.g., school) and uncontrollable because discrimination has nothing to do with individuals' actions, but rather their ethnic appearance or national origin. Guided by these findings and theory, we might expect perceptions of ethnic discrimination to be a particularly important stressor in activating the HPA axis.

The limited empirical examinations of the relations between discrimination and cortisol among adults, however, have yielded inconsistent findings. In a study examining psychosocial mediators of the relation between SES and diurnal cortisol among African Americans

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