



## Developmental histories of perceived racial discrimination and diurnal cortisol profiles in adulthood: A 20-year prospective study



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### ABSTRACT

Perceived racial discrimination (PRD) has been associated with altered diurnal cortisol rhythms in past cross-sectional research. We investigate whether developmental histories of PRD, assessed prospectively, are associated with adult diurnal cortisol profiles. One-hundred and twelve ( $N = 50$  Black,  $N = 62$  White) adults from the Maryland Adolescent Development in Context Study provided saliva samples in adulthood (at approximately age 32 years) at waking, 30 min after waking, and at bedtime for 7 days. Diurnal cortisol measures were calculated, including waking cortisol levels, diurnal cortisol slopes, the cortisol awakening response (CAR), and average daily cortisol (AUC). These cortisol outcomes were predicted from measures of PRD obtained over a 20-year period beginning when individuals were in 7th grade (approximately age 12).

Greater average PRD measured across the 20-year period predicted flatter adult diurnal cortisol slopes for both Black and White adults, and a lower CAR. Greater average PRD also predicted lower waking cortisol for Black, but not White adults. PRD experiences in adolescence accounted for many of these effects. When adolescent and young adult PRD are entered together predicting cortisol outcomes, PRD experiences in adolescence (but not young adulthood) significantly predicted flatter diurnal cortisol slopes for both Black and White adults. Adolescent, but not young adult PRD, also significantly predicted lower waking and lower average cortisol for Black adults. Young adult PRD was, however, a stronger predictor of the CAR, predicting a marginally lower CAR for Whites, and a significantly larger CAR for Blacks. Effects were robust to controlling for covariates including health behaviors, depression, income and parent education levels. PRD experiences interacted with parent education and income to predict aspects of the diurnal cortisol rhythm. Although these results suggest PRD influences on cortisol for both Blacks and Whites, the key findings suggest that the effects are more pervasive for Blacks, affecting multiple aspects of the cortisol diurnal rhythm. In addition, adolescence is a more sensitive developmental period than adulthood for the impacts of PRD on adult stress biology.

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## 1. Introduction

### 1.1. Overview

Racial and ethnic disparities exist across a wide range of adult health conditions (Williams and Collins, 1995; Mensah et al.,

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2005; Myers, 2009; Williams and Mohammed, 2009). Differing health care access and health behaviors do not appear to fully account for these disparities, leading investigators to propose that race-based social stress such as perceived racial discrimination (PRD) may play a role, by way of its influence on stress biology (Kuzawa and Sweet, 2009; Williams and Mohammed, 2009). The hypothalamic–pituitary–adrenal (HPA) axis and its primary product cortisol are frequently implicated in theoretical models of race-based stress and health (Myers, 2009). Racial/ethnic differences have been found in diurnal cortisol rhythms (Cohen et al., 2006; DeSantis et al., 2007), and perceived discrimination has been associated with altered basal/diurnal levels of cortisol in past research (Kaholokula et al., 2012; Zeiders et al., 2012).

Most existing research on discrimination and cortisol, including the current study, has focused primarily on interpersonal forms of discrimination, including daily hassles and microaggressions related to race/ethnicity (Harrell, 2000; Sue et al., 2007). Past research on discrimination and cortisol has also been cross-sectional, focusing on current or recent PRD, rather than cumulative histories of past PRD exposure. In the current study, we examined the impact of cumulative exposure to PRD assessed prospectively over a 20-year period. We also examined whether PRD experiences measured in adolescence were more strongly related to adult cortisol than PRD experiences measured in early adulthood. We controlled for potential confounds related to cortisol levels and/or discrimination experiences, including health behaviors, socioeconomic variables, and depressive symptoms. We also tested whether effects of histories of PRD on cortisol are stronger for Black adults and for individuals with lower socioeconomic status. Before describing our methods, we give a brief introduction of perceived discrimination and on HPA axis activity, then review past research on associations between them. Methodological issues, such as the importance of considering developmental timing, socioeconomic context, and potential confounds are discussed. Finally, the current project is described.

## 1.2. Perceived discrimination

Perceived discrimination involves an individual perceiving that they are receiving or have received unfair treatment on the basis of membership in a group (Tajfel, 1982; Fishbein, 1996; Brown and Bigler, 2005; Major and Kaiser, 2008). When asked about perceived discrimination across a range of categories (e.g., gender, race, ethnicity, age, religion, physical appearance, sexual orientation), racial and ethnic minorities in the U.S. describe higher levels of discrimination than their White counterparts (Kessler et al., 1999). Due to the fact that racial/ethnic categorization is relatively stable, and as result of historical mistreatment and oppression based on race within U.S. society, discrimination based on race/ethnicity (perceived racial/ethnic discrimination, PRD) may have particularly strong effects on the well-being of racial/ethnic minority individuals, including Black Americans (Branscombe et al., 1999; Harrell, 2000; Feagin et al., 2001).

## 1.3. Stress-related changes in diurnal cortisol rhythms

Basal cortisol levels follow a strong circadian or diurnal rhythm, involving high levels upon waking, a substantial (50–60%) increase in the 30–40 min after waking (the cortisol awakening response or CAR), and a subsequent decline across the day, reaching a nadir around midnight (Pruessner et al., 1997; Adam and Kumari, 2009).

Periodic activation of the HPA axis is considered adaptive and necessary to cope with acute stress, and cortisol levels are particularly responsive to stress of a social-evaluative nature (Dickerson and Kemeny, 2004). Stress-related changes in several aspects of the diurnal cortisol rhythm have been identified. The CAR has been

found to increase in the presence of acute daily stressors (Adam et al., 2006; Chida and Steptoe, 2009; Fries et al., 2009). It has been found to be lower, however, in the presence of traumatic stress, particularly when accompanied by post-traumatic stress symptoms or disorders (Rohleder et al., 2004; Wessa et al., 2006). Chronic stress has also been associated with lower waking cortisol levels flatter diurnal cortisol slopes (Adam, 2012; Doane et al., 2013). Flatter cortisol slopes have been linked to higher depression (Doane et al., 2013), fatigue (Bower et al., 2005; Kumari et al., 2009), and cardiovascular disease (Matthews et al., 2006; Kumari et al., 2011). Chronic, and particularly traumatic stress, also predicts overall reductions in cortisol across the day, known as hypocortisolism (Heim et al., 2000; Fries et al., 2005; Miller et al., 2007). Hypocortisolism is associated with the presence of fatigue and pain syndromes, and overactivation of immune and inflammatory systems (Fries et al., 2009).

## 1.4. Perceived discrimination and diurnal cortisol rhythms

Past research has consistently found flatter diurnal cortisol rhythms in African Americans as compared to Whites (Cohen et al., 2006; DeSantis et al., 2007, 2015; Skinner et al., 2011; Martin et al., 2012). Higher PRD has been proposed as a potential mediator between race/ethnicity and flatter diurnal cortisol slopes (DeSantis et al., 2007). There are relatively few empirical studies of associations between PRD and diurnal cortisol rhythms. Some studies have examined major life events related to racism, although most have focused primarily on everyday interpersonal discrimination (daily race-related hassles and microaggressions).

One study of young adults (Skinner et al., 2011) assessed retrospective lifetime racism and racial daily hassles and found that discrimination predicted flatter diurnal cortisol slopes among both Black and White youth. Another study found associations between everyday PRD and flatter diurnal cortisol slopes among racial/ethnic minority young adults, but not racial/ethnic majority group members (Zeiders et al., 2014). This latter result is in line with prior evidence showing that racial/ethnic minorities are more sensitive to the effects of stress on the cortisol diurnal rhythm (DeSantis et al., 2015). In pregnant women, Suglia et al. (2010) found cumulative stress, including measures of major and everyday PRD, predicted lower morning cortisol and flatter waking to bedtime cortisol slopes for Black, but not Hispanic women. By contrast, one study of adults found that everyday discrimination predicted flatter diurnal cortisol slopes in White adults, but steeper diurnal cortisol slopes in Black adults (Fuller-Rowell et al., 2012b). Another study of preadolescents did not find significant associations between everyday discrimination and cortisol diurnal rhythms (Martin et al., 2012).

Less research has focused on PRD and average cortisol levels, however a study of Hawaiians found perceived racism to be associated with an overall lowering of cortisol levels across the day among Native Hawaiians (Kaholokula et al., 2012). Thus, with a few exceptions, existing research suggests that PRD is associated with a flattening of the diurnal cortisol rhythm and potentially an overall lowering of the diurnal cortisol curve across the day, with some evidence that effects are stronger for racial/ethnic minorities.

## 1.5. The importance of developmental histories

Prior empirical research on discrimination and cortisol has focused on recent discrimination, rather than taking into account histories of exposure. As a result, past work has not been able to assess effects of chronic PRD exposure, or the relative impacts of PRD exposure at different developmental stages. Life-span developmental theories suggests that experiences may have cumulative impacts on biology over time; events occurring during times of

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