

# The Effects of Race-related Stress on Cortisol Reactivity in the Laboratory: Implications of the Duke Lacrosse Scandal

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Published online: 12 February 2008  
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## Abstract

**Background** The experience of race-related stressors is associated with physiological stress responses. However, much is unknown still about the complex relationship between how race-related stressors are perceived and experienced and potential moderators such as strength of racial identity.

**Purpose** This research examines the impact of a real-life stressor and strength of race identity on physiological responses to a social evaluative threat induced in the laboratory.

**Methods** Salivary cortisol measures were collected throughout a stressor protocol. African-American participants were also randomized to one of two conditions designed to promote either racial identification or student identification, before the experimental task. Unexpectedly, a highly publicized real-life racial stressor, the Duke Lacrosse (LaX) scandal, occurred during the course of the data collection. This allowed for pre–post LaX comparisons to be made on cortisol levels.

**Results** These comparisons showed that across both priming conditions, participants post-LaX had highly elevated cortisol levels that were nonresponsive to the experimental stress task, while their pre-LaX counterparts had lower cortisol levels that exhibited a normal stress response pattern. Furthermore, this effect of LaX was significantly moderated by gender, with women having lower mean cortisol levels pre-LaX but significantly greater cortisol levels than all other groups post-LaX.

**Conclusions** These results suggest that recent exposure to race-related stress can have a sustained impact on physiological stress responses for African Americans.

**Keywords** Cortisol · Racial Stressors · Identity

## Introduction

Although the wide-ranging health disparities between African Americans and whites in the USA cannot be accounted for by any one variable, race-related stress has been found to contribute significantly to such outcomes. The experience of specific incidents of racial bias is associated with higher levels of psychological distress, depression, anxiety, and multiple indicators of poor physical health [1]. The relationships between racial stressors and health outcomes are consistent and robust but the mechanisms by which these effects occur are still poorly understood.

One potential mechanism underlying this relationship is a physiological dysregulation that happens after exposure to race-related stressors. In a review of the available literature on acute stress reactivity (operationalized by a checklist of recent life events), Gump and Matthews [2] found background stressors that were ongoing and important (as compared to those that were resolved, infrequent, or avoidable) were associated with enhanced acute physiological stress responses and a delayed recovery to baseline. For many, race-related stressors may be a particularly pernicious background stressor that is highly salient, uncontrollable, and instrumental in the appraisal of new stressors. Such alterations in physiological processes can have longer-term adverse effects on health [3].

The complex relationship between how race-related stressors are perceived and experienced and potential moderators such as strength of racial identity is just beginning to be explored. Identity can inform beliefs about interpersonal and institutional interactions, and there is

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evidence that racial identity is an influential construct in the experience of racial discrimination [4–6]. Racial identity has been found to buffer the adverse effects of acute and chronic discrimination on health problems for African Americans [7] perhaps by increasing feelings of social support and thus enhancing an individual's capacity to cope and respond to stressful experiences (e.g., [1]).

Our research was designed to examine stress responses, as measured by salivary cortisol, to a laboratory-induced social evaluative threat and the moderating role of racial identity among African-American college students. Stress is associated with the activation of the hypothalamic–pituitary–adrenocortical (HPA) axis, which results in increased secretion of cortisol from the adrenal glands. Past research has found that cortisol reactivity can be elicited in response to both laboratory stressors and naturally occurring stressors in daily life [8, 9] and that social evaluation stressors are associated with the most reliable and substantial cortisol changes in the laboratory [10].

Based on past research on racial identity (race ID) and responses to discrimination, we predicted that when positive aspects of race ID were activated and race ID was strengthened, the stress response to social evaluative tasks would be attenuated as compared to when a nonrace-related identity (i.e., student identity) was activated. However, midway through data collection, an African-American woman accused white members of the Lacrosse team (LaX) at Duke University of racial derogation, violence, and rape. This was an extremely divisive time on campus (and indeed across the nation) on issues of race, class, and gender [11]. An examination of the student newspaper and public dialogues across campus support the notion that Duke's African-American students and the African-American women in particular experienced high levels of stress and questioned their sense of belonging and safety in the weeks after the alleged incident. Consequently, although this research was not originally designed to test this hypothesis, we were able to analyze whether there were different patterns in cortisol reactivity for our experimental manipulation before the naturally occurring stressor (LaX) and after.

## Materials and Methods

### Participants

Sixteen male and seventeen female African-American participants were recruited from psychology classes, campus organizations, and fliers posted around campus. Participants were excluded from the study if they reported currently taking any antidepressant or anti-anxiety medications, anabolic steroids, nasal sprays, or had mouth

lacerations, gum bleeding, or adrenal hyperplasia, or any other condition that involves the adrenal glands. Women taking oral contraceptives were allowed to participate, and women were sampled randomly through their menstrual cycle. Participants were instructed to refrain from eating or drinking anything except water an hour before the study and caffeine or alcohol 12 h before arriving at the laboratory. In addition, all participants were tested in the afternoon to avoid variability of cortisol responses because of the time of day.

### Procedure

Upon arrival at the laboratory, participants were asked to sit quietly for 10 min in the waiting room. They were then taken into a private room by the experimenter where they were given instructions on how to deposit saliva samples. They were asked to rinse their mouths out with water and then place a cotton dental swab treated with citric acid along their gumline for approximately 30 s or until fully saturated with saliva,<sup>1</sup> following the standard protocol for cortisol measurement [12]. The experimenter observed the participant deposit a saliva sample to ensure accuracy of the procedure. Once completed, the experimenter left the room, and the participants were asked to deposit salivary cortisol samples when prompted by the experimenter over intercom. A sample deposited 30 min after the waiting room rest period was taken as the baseline measurement. Instructions for the rest of the protocol were administered by computer. Participants completed a demographic questionnaire and then were randomly assigned to watch a series of video clips for 5 min. If they were in the student identity (student ID) condition, the video clips were of university basketball games showing cheering fans and game highlights. This video was designed to promote school spirit, pride, and identity. The basketball clip video was pilot tested on a random sample of male and female Duke students who indicated that it, "got them excited about Duke." If study participants were in the racial identity (race ID) condition, they viewed clips of prominent figures and events relevant to their own race and ethnicity, such as video clips of men and women from Civil Rights marches, Martin Luther King's "I Have a Dream" speech, Barack Obama's 2004 Democratic Convention speech, and other clips that were rated as "inspirational" by a focus group of black male and

<sup>1</sup> We validated that saliva with or without citric acid stimulation yield comparable cortisol levels. To accomplish this test, we measured cortisol in ten samples from the current study and ten samples from saliva that was not stimulated by citric acid. We measured samples by themselves and with the addition of 2 ng/ml of cortisol standard. The computed values of cortisol were  $92 \pm 4\%$  (SEM) of what was predicted if the values were simply additive for our sample.

female college students. This video was designed to increase racial identity.

At the conclusion of the video, participants were then given 5 min to prepare and 5 min to deliver a short speech describing a personal experience of discrimination and how they reacted to this event. To maximize a social-evaluative threat, participants in both conditions were asked to present their speech in front of a video camera that would be recording their responses for future evaluation of speech quality. Salivary cortisol samples taken 20, 30, and 40 min after the cessation of the stress task were taken as indicators of the stress response.

After this task, participants indicated perceived threat related to the stressor task (e.g., “Overall, I thought the tasks were threatening”) and completed questionnaires pertaining to their group identity, including the Multidimensional Inventory of Black Identity (MIBI; [6]) and a modified version of the Collective Self-esteem Scale (CSE; Luhtanen and Crocker 1992). The MIBI contained several subscales including: centrality (how much race is a central part of an individual’s self-concept), nationalism (emphasizing the uniqueness of the African-American experience from other groups) and assimilation (emphasizing the commonalities between African Americans and the rest of American society), and private regard (the extent of positivity or negativity toward African Americans and membership in that group). The CSE scale contained items related to importance of membership in the group to self-concept (e.g., “Being Black is an important reflection of who I am”). We added the questionnaires to the protocol partway into data collection, so questionnaire data are only available for 25 participants ( $n=15$  men and 10 women, 11 racial identity and 14 nonrace identity condition). Final salivary cortisol measures were taken, and all participants were thoroughly debriefed.

Cortisol was measured by specific radioimmunoassay (RIA) using high-performance liquid chromatography-purified ligands, antiserum, and standards. Hormones were measured directly in saliva, and bound and free hormones were separated by second antibody precipitation. Samples were counted by a gamma counter, and the sensitivity of the assay was 1 ng/ml. Standards and low and high controls were run in every assay and the inter- and intra-assay coefficient of variation on the assay was less than 10 and 5%, respectively. The mean cortisol level across four measurements (baseline, 20, 30, and 40 min post-stress) for the entire sample was 6.05 ng/ml (range 2.61 to 10.71).

### Statistical Analyses

Cortisol data were analyzed using mixed-effects models. Toeplitz error covariance matrices demonstrated the best fit to the data. ID condition, gender, and LaX were entered in

the model as dichotomous between-subjects variables and time as a repeated measure. Two participants were missing their 40-min post-stressor cortisol sample. Participants who entered the study between April 3rd 2006 and April 29th 2006 were coded as post-LaX ( $n=16$ ); participants who entered the study before this time were coded as pre-LaX ( $n=17$ ). Group differences on race identity measures were analyzed using analysis of variance. Only the most parsimonious models are reported.

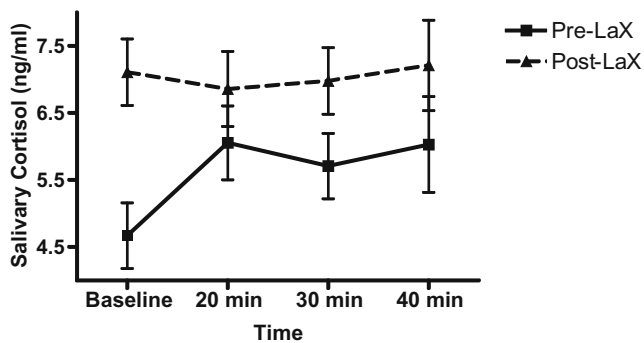
## Results

### Preliminary Analyses

Contraceptive use and menstrual cycle were evenly distributed across conditions: Pre-LaX ( $n=1$  contraceptive user, 6 follicular phase, 5 luteal phase) and post-LaX ( $n=1$  contraceptive user, 3 follicular phase, 4 luteal phase) groups. Significant pre-LaX changes in cortisol levels from the hypothesized baseline ( $M=4.62$ ,  $SD=2.20$ ) to 20 min post-stressor ( $M=5.98$ ,  $SD=2.19$ ;  $t[16]=-2.99$ ,  $d=.62$ ,  $p<0.01$ ) suggest that the stress manipulation was effective in eliciting a cortisol response. In addition, the postmanipulation perception of threat was also associated with higher mean cortisol levels ( $\beta[1, 24]=0.56$ ,  $p=0.004$ ) for both LaX groups, indicating that participants who perceived the experimental tasks to be more threatening exhibited higher cortisol levels.

### Cortisol Responses to Experimental Manipulation and LaX

To examine our primary hypothesis, we tested the effect of the ID condition on cortisol levels across time. In the mixed effects models, the time $\times$ ID interaction effect was not significant,  $F(3, 91)=1.21$ ,  $p=0.31$ , and there was not a main effect of time or ID on mean cortisol level. Participants under the race ID condition did not have a lower cortisol response over time or an overall lower mean level of cortisol as compared to participants under the student ID condition. Post-hoc, we hypothesized that the LaX event may have been affecting our results. Thus, we tested the effect of LaX on cortisol levels across time. These analyses revealed a marginally significant time $\times$ LaX interaction effect on cortisol level,  $F(3, 91)=2.59$ ,  $p=0.057$ , suggesting a difference in the cortisol response among participants pre- and post-LaX. As can be seen in Fig. 1, the pre-LaX group showed a change in salivary cortisol level between baseline and 20 min post-stressor, while the post-LaX group exhibited a continuously elevated and more blunted cortisol response. Cortisol levels of participants post-LaX remained elevated throughout the experimental protocol, while participants in the pre-LaX group exhibited



**Fig. 1** Salivary cortisol levels during laboratory testing sessions conducted before (*Pre-LaX*) and after (*Post-LaX*) the Duke Lacrosse Scandal

resting baseline levels and response patterns indicative of normal physiological regulation. Furthermore, when we included days from the stressor as a variable in our regression model, there was an effect that approached significance on mean levels of cortisol such that the closer in time to the occurrence of the event, the higher the cortisol levels ( $\beta[1, 15] = -0.48, p = 0.06$ ). When gender was entered into the model the three-way  $\text{time} \times \text{LaX} \times \text{gender}$  interaction was not significant. However, a significant  $\text{LaX} \times \text{gender}$  interaction showed that it was primarily the women who experienced elevated cortisol levels post-LaX,  $F(1, 32) = 8.65, p < 0.01$  (Fig. 2). In fact, the mean cortisol level of women post-LaX ( $M = 8.4, SD = 2.3$ ) was significantly greater than all other groups ( $p \leq 0.05$ ; all  $M \leq 6.2, SD \leq 2.04$ ).

### Competing Hypotheses

Because we examined the effects of a real-life stressor, our findings are subject to other explanations for the differences in stress levels between pre- and post-LaX participants. Although we cannot control for the complete range of individual interpersonal stressors, we were able to examine one universally intense source of stress for students: final exams. We examined whether post-LaX participants differed in their baseline cortisol levels from those who participated in the research during or close to exam period. Six students were identified who participated in the study during either the Fall 2005 or Spring 2006 exam period. Participants were categorized as post-LaX if they took part in the study between April 1st 2006 and April 27th 2006 ( $n = 13$ ). Although a  $t$  test showed no significant difference between the groups,  $t(18) = -1.28, p = 0.32$ , the post-LaX participants had higher mean cortisol levels than exam period participants ( $M = 6.69, SD = 2.06$  vs.  $M = 5.22, SD = 2.87$ ), suggesting that the LaX event elicited a stress response beyond students' typical levels of stress. Furthermore, the effect of LaX on perceived threat was nonsignificant, thus discounting the possibility that the cortisol responses post-LaX were mediated by higher perceived threat

of the experimental stressor. In addition, although all participants were tested in the afternoon, there were slight variations in start time of the experiment. We analyzed the data for possible time of day effects (data from one participant was missing on this variable) and found no differences.

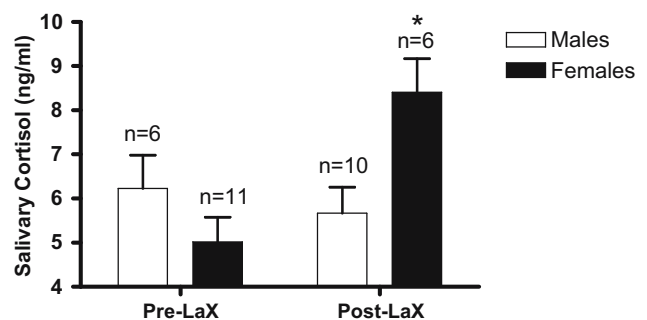
### Racial Identity Effects

Further evidence for the impact of the LaX event can be found in differences in aspects of racial identity before and after the LaX event. On several components of identity, there were significant differences between the pre- and post-LaX groups. Participants were more likely to express assimilation ideologies post LaX ( $t[24] = -2.34, p = 0.03, M = 45.9, SD = 5.32$  pre and  $M = 50.4$  and  $SD = 4.33$  post) and were less likely to express feelings of uniqueness about their group ( $t[24] = 2.15, p = 0.04, M = 33.55, SD = 6.36$  pre and  $M = 28.43$  and  $SD = 5.52$  post) and were marginally lower on collective self-esteem ( $t[24] = 1.86, p = 0.07, M = 14.82, SD = 2.08$  pre and  $M = 13.07$  and  $SD = 2.50$  post).

### Discussion

It is highly unusual to have physiological data in response to a naturally occurring race-related threat. It is particularly unique to have physiological responses to a laboratory stressor paradigm that can be compared for differential responses both before and after the real-life stressor. The LaX event provided an exceptional context to examine identity threat within these combined methods. Overall, these results indicate that for African Americans, the real life racial stressor—the LaX event—was associated with heightened cortisol levels and a blunted stress response pattern during a laboratory stress task, with exaggerated effects among women.

Our findings make several potentially important contributions. The findings suggest that recent exposure to race-



Note: \* indicates that this group is significantly different from all the other groups at  $p < .02$ .

**Fig. 2** Mean (SEM) of salivary cortisol levels before (*Pre-LaX*) and after (*Post-LaX*) the Duke Lacrosse Scandal, by sex



related stress can have a sustained impact on physiological stress responses. Such alterations in physiological processes and adrenocortical responses in particular can have a negative impact on long-term health outcomes. Cortisol hyperreactivity is related to increased susceptibility to infectious diseases [13], and chronic cortisol elevations under long-term stress conditions have been associated with depression [14]. A recent meta-analysis examining chronic stress and cortisol activation concludes that stress that threatens physical integrity, is traumatic in nature, and is largely uncontrollable elicits a high, flat diurnal profile of cortisol secretion [15], consistent with the effects we found. Additionally, the heightened cortisol response for women in our sample warrants further exploration of potential gender differences in HPA responses to certain types of stressors. There is some evidence that particular stressors, such as social rejection, are related to more acute responses for women than for men [9]. Future research should continue to examine gender differences in HPA responses to race-related and other types of stressors and its impact on disease outcomes.

Furthermore, comparisons of measures of racial identity before and after the LaX event indicate that participants identified less with positive aspects of their race and endorsed assimilation ideologies in the post-LaX condition. Identifying with the oppressed in-group in response to racial threat can have protective effects and has been related to enhanced wellbeing (e.g., [7, 16]). We are unable to determine from our data whether perceived legitimacy, fear, or other aspects of the racial stressor and campus climate at the time may have inhibited participants from coping through increased racial identification. Future research would benefit from examining what aspects of the culture can promote or discourage racial identification in response to perceived discrimination [16].

Some caveats are appropriate in interpreting our findings. First, because our research exclusively focused on African Americans, it is unclear whether white participants or another racial group might not have also exhibited higher levels of cortisol during this highly public event. Given the unexpected nature of this research design, we did not have the ability to include such control groups. However, on the basis of our findings, we are able to determine that for African Americans, this event had a significant impact on physiological responses and perceptions of racial identity. Given the emphasis on the black–white racial tension surrounding this event and our findings on group differences in perceptions of racial identity post-LaX, there is reason to believe that this event may have had a unique impact on the African-American students.

Another limitation of this research is the small sample size. The unforeseen event that occurred during the course of what was planned to be a study with a larger sample size created an immutable pre-LaX sample size and, because of

the end of academic semester, a similarly constrained post-LaX population. However, the effects of LaX are consistent and in the expected direction. Further, we have attempted to account for all possible confounds. Hormonal differences among women were controlled for by determining that there were similar numbers of female participants who were on oral contraceptives or in the follicular/luteal phase of their cycle in all groups. In addition, the study controls for time of day influences and our effects remained after accounting for final exam time as another potential source of stress.

Taken together, our results suggest that recent exposure to race-related stress can have a significant impact on physiological stress responses. The sustained effect of such stressors and the way in which coping responses moderate such effects are important avenues for future research.

**Acknowledgments** This work was supported by NIMH grant no. 1K01 MH074942-01 awarded to the first author. We thank Sherman James, Clemons Kirschbaum, and Redford Williams for helpful comments on earlier versions of this article, Gary Bennett for his valuable insights, Jasmin Sukati for her assistance with data collection, and Cynthia Kuhn for her assistance with the cortisol assays.

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