

Day-to-Day Fluctuations in Experiences of Discrimination: Associations With Sleep and the Moderating Role of Internalized Racism Among African American College Students

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Objectives: Studies of discrimination and sleep have largely focused on between-person differences in discrimination as a correlate of sleep outcomes. A common criticism of this research is that standard questionnaire measures of discrimination may be confounded by personality and identity and are subject to recall bias. Partially addressing these limitations, the current study examined within-person, day-to-day fluctuations in perceived discrimination as a predictor of day-to-day fluctuations in sleep. The role of internalized racism as a moderator of the within-person association between discrimination and sleep was also considered. **Method:** Participants were African American college students attending a predominantly White institution ($N = 124$, 26% male, $M_{\text{age}} = 20.1$, $SD = 1.6$). Each student was asked to complete a baseline questionnaire and a 9-day diary. Experiences of discrimination were assessed in the questionnaire and daily diary format. Sleep problems were measured each day using self-report measures focusing on sleep quality. Internalized racism was assessed with the miseducation scale, which captures the degree to which individuals associate negative characteristics such as laziness and criminality with their racial/ethnic group. Established measures of racial identity were considered as covariates. **Results:** Multilevel analyses indicated that on days when participants experienced more discrimination, subsequent sleep problems increased ($B = .037$, $SE = .017$, $p = .034$). Furthermore, this within-person association was moderated by internalized racism such that the effects of daily discrimination on sleep were stronger among those who scored higher on miseducation ($B = .046$, $SE = .021$, $p = .033$). **Conclusions:** Overall, results suggest that ongoing efforts to reduce discrimination, support the adjustment of racial/ethnic minority students, and address internalized racism are warranted.

Public Significance Statement

This study suggests that the sleep quality of African American college students suffers on days when more discrimination is experienced. The effects of daily discrimination on sleep were also most pronounced among those with high levels of internalized racism. Overall, the findings suggest that ongoing efforts to reduce discrimination, support the adjustment of racial/ethnic minority students, and address internalized racism are warranted.

Keywords: perceived discrimination, sleep problems, daily diary, racial identity, internalized racism

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Experiences of subtle and blatant racial discrimination are pervasive in the lives of African Americans (Fuller-Rowell, Cogburn, et al., 2011; Kessler, Mickelson, & Williams, 1999; Ong, Fuller-Rowell, & Burrow, 2009). While a range of studies have shown that perceived discrimination is associated with sleep and other health outcomes, the vast majority of these studies have been cross-sectional and have not considered fluctuations in day-to-day experiences of discrimination using repeated assessments (Fuller-Rowell, Curtis, & Duke, 2018; Fuller-Rowell, Curtis, El-Sheikh, Duke, et al., 2016). Furthermore, the role of internalized racism has rarely been examined in research on discrimination and health or health behavior outcomes, despite its central importance in theoretical perspectives on racism and racial health disparities (Jones, 2000). Addressing these salient gaps in current knowledge, the current study had two primary aims: (a) to examine within-person fluctuations in perceived discrimination as a predictor of day-to-day fluctuations in sleep problems and (b) to consider the degree to which the association between discrimination and sleep is moderated by internalized racism. As operationalized herein, sleep problems includes established daily diary measures of latency problems (difficulty falling asleep) and nonrestorative sleep problems (not feeling well rested after sleep; Åkerstedt, Hume, Minors, & Waterhouse, 1994; Buysse et al., 2008; Carney et al., 2012).

Discrimination and Sleep

Associations between social stress and sleep problems are well established (De Lange et al., 2009; Kim & Dimsdale, 2007) and have been documented in adolescent and college student samples (Lund, Reider, Whiting, & Prichard, 2010), as well as at other points in the life span (El-Sheikh et al., 2013). Experiences of discrimination are one form of social stress frequently and disproportionately experienced by African Americans (Kessler et al., 1999), particularly African American college students attending predominantly White institutions (Ancis, Sedlacek, & Mohr, 2000; Cabrera, Nora, Terenzini, Pascarella, & Hagedorn, 1999; Fuller-Rowell, Curtis, El-Sheikh, Duke, et al., 2016; Solórzano, Ceja, & Yosso, 2000). Experiences of racial discrimination (unfair treatment attributed specifically to race/ethnicity) and general experiences of discrimination (unfair treatment not specifically attributed to any characteristic of the individual) are both consistently experienced at higher levels by African Americans than any other racial/ethnic group (Slopen & Williams, 2014).

Several studies have considered the link between discrimination and sleep (Slopen, Lewis, & Williams, 2016). The majority of these studies have found that individuals reporting higher levels of racial discrimination (Grandner et al., 2012; Slopen & Williams, 2014; Tomfohr, Pung, Edwards, & Dimsdale, 2012) or general unfair treatment (Beatty et al., 2011; Lewis et al., 2013) also experienced more sleep disturbance. For example, one study found that experiences of racial discrimination were associated with greater sleep problems relating to both duration and quality in a college student sample and accounted for a portion of the disparity in sleep problems between African American and White students (Fuller-Rowell, Curtis, El-Sheikh, Duke, et al., 2016). However, nearly all these studies have considered between-person measures of discrimination as predictors of sleep. Notable exceptions include one study of daily racial discrimination among Asian American college students (Ong, Cerrada, Lee, & Williams, 2017) and two studies of daily general unfair treatment among adolescents

between the ages of 11 and 15 (Goosby, Cheadle, Strong-Bak, Roth, & Nelson, 2018; Yip et al., 2019). All three of these studies found some evidence that daily discrimination is associated with poorer sleep quality. However, to our knowledge, no studies of African American college students or adults have considered the within-person association between discrimination and sleep. This is surprising given well-documented racial disparities in sleep and the high levels of discrimination experienced by African Americans (Fuller-Rowell et al., 2018).

Although the between-person approach is one important level of analysis, this approach has specific limitations when examining the effects of perceived discrimination. Between-person differences on standard questionnaire measures are primarily interpreted as indicators of frequency of exposure to discriminatory events. However, these measures are limited by the fact that between-person differences in personality and identity influence the degree to which everyday unfair treatment is perceived as such and reported as discrimination on questionnaire measures (Costa & McCrae, 1990; Lemola, Räikkönen, Gomez, & Allemand, 2013; McCrae, 1990; Sellers & Shelton, 2003). Personality and identity variables therefore operate as potential confounders in the association between perceived discrimination and sleep. Within-person daily diary approaches help to address this limitation by using each person as their own control (Hoffman & Stawski, 2009; Ohly, Sonnentag, Niessen, & Zapf, 2010). In particular, because daily diary studies ask individuals to report discrimination each day, analyses are able to examine fluctuations in perceived discrimination from each person's own mean level. This allows the correlates of between-person differences in discrimination to be considered separately from the sequelae of within-person change.

Daily diary measures of discrimination—which ask participants to report events that occurred on a single day—can also reduce measurement error inherent to standard questionnaire measures, which ask participants to recall the frequency of discrimination over periods of weeks, months, or years (Coughlin, 1990; Utsey, 1998; Zwerling et al., 1995). Furthermore, daily diary approaches allow for examination of more proximal within-person, day-to-day impacts of stress exposure, which cannot be examined using standard survey measures of discrimination or between-person measurement approaches (Bolger, Davis, & Rafaeli, 2003; Ohly et al., 2010). For these reasons, we hypothesize a significant within-person association between discrimination and sleep problems among African American college students.

The Moderating Role of Internalized Racism

Drawing on foundational theoretical perspectives (Allport, 1954; Bell, 2016; Fanon, 1968; Freire, 1970), racism can not only be understood to exist within social institutions and interpersonal interactions (Gee, 2002) but also as internalized negative messages within the psyche of oppressed groups (Bailey, Chung, Williams, Singh, & Terrell, 2011; Cross & Cross, 2007; Jones, 2000; Watts-Jones, 2002). For the purposes of the current study, internalized racism is defined as the acceptance of negative messages by members of stigmatized racial/ethnic groups about their own abilities and intrinsic worth (Jones, 2000). The process of internalization is conceptualized herein as resulting from persistent exposure to negative stereotypes, pervasive discrimination, and the presence of racial inequality at the societal level. In an additive fashion,

without substantial active countervailing forces, such as racial socialization (messages about race or racism communicated by elders) or social support (Hughes, Watford, & Del Toro, 2016; Neblett, Chavous, Nguyễn, & Sellers, 2009), these exposures are thought to lead to internalization of messages about the inferiority of an individual's stigmatized group.

Internalized racism has frequently been discussed alongside theoretical perspectives on racial identity. In particular, a closely related but distinct identity construct is private regard, defined as the degree to which an individual feels positively (or negatively) about being part of their racial/ethnic group (Sellers, Smith, Shelton, Rowley, & Chavous, 1998). Individuals who report feeling more negatively about their group membership (i.e., report lower private regard) would be expected to also hold more disparaging beliefs about African Americans (i.e., score higher on measures of internalized racism). However, because these constructs are defined and measured differently, we expect that they capture different underlying psychological phenomenon and thus will demonstrate divergent validity in empirical analyses (Vandiver, Cross, Worrell, & Fhagen-Smith, 2002). Otherwise put, we expect that any effects of internalized racism will not be fully accounted for after adjusting for private regard. Other racial identity constructs such as centrality (a person's proclivity to define her or his self with regards to race) and public regard (the extent to which an individual feels that others view their racial group positively or negatively), although conceptually distinct from internalized racism, are also important to consider to establish divergent validity of internalized racism (Sellers & Shelton, 2003; Sellers et al., 1998). We expect that effects of internalized racism will not be fully accounted for after adjusting for these measures of racial identity.

Although the concept of internalized racism has been central within theoretical discussions of race, very few studies have considered the role of internalized racism in the association between perceived discrimination and health or health behavior outcomes. Furthermore, to our knowledge, no studies have done so in the context of sleep outcomes or using a within-person analytic approach. Additionally, no studies have considered the degree to which any effects of internalized racism are explained by other measures of racial identity. The added utility of internalized racism beyond established racial identity constructs is therefore unknown. A handful of studies using between-person approaches have, however, considered the moderating role of internalized racism. These studies have yielded mixed results. One study reported that the association between discrimination and hypertension was stronger among those reporting higher levels of anti-Black bias (Chae, Nuru-Jeter, & Adler, 2012). Two other studies found that a measure of internalized racism (endorsement of negative stereotypes about African Americans) did not exacerbate the association between discrimination and health outcomes (Chae, Lincoln, Adler, & Syme, 2010; Molina & James, 2016). Due to the reduced bias in daily diary measures of discrimination—and the increased precision of the within-person analytic approach—we hypothesized that internalized racism will play a significant moderating role in the association between perceived discrimination and sleep problems such that the association will be stronger among those with more internalized racism. Furthermore, we hypothesized that this effect will be largely independent of other established racial identity measures (private regard, public regard, and centrality) and thus will remain significant after adjusting for these measures as competing moderators.

Method

Design and Participants

Participants were African American undergraduate students from two large research universities in the northeastern United States. Both universities are predominantly White student institutions, contained 11% underrepresented minorities, and were 5% and 7% African American, respectively. Participants in the current study were part of a larger longitudinal study of 324 African American students, which involved a survey administered twice each academic year for 2 consecutive years (Fuller-Rowell, Burrow, & Ong, 2011). After the third wave of the study, participants were invited to participate in a 9-day daily diary component, which consisted of a short online questionnaire. Students were asked to complete the daily diary each evening before going to sleep. Recruitment into the daily diary study stopped after 150 students were enrolled. Each daily survey was closed at 6 a.m. on the following day. This cutoff time was chosen based on pilot data so that even students staying up very late could still complete the survey before going to sleep, and early risers would not generally be up early enough to complete the survey after waking.

The analytic sample for the current study focused on those who participated in the daily diary and the adjacent wave (third assessment) of the longitudinal study ($N = 124$, 26% male, $M_{\text{age}} = 20.1$, $SD = 1.6$). All survey measures used in the analyses presented are from the third assessment of the longitudinal study. On average, participants completed 6.98 out of 9 daily surveys ($SD = 1.84$). Women completed slightly fewer daily diaries than men ($p = .032$). No other study variables were associated with the number of days completed/missing. Final lagged analyses included 634 days of data from 124 individuals.

Those who participated in the diary study were slightly older than those who only participated in the longitudinal component of the study (M_{age} difference = .58 years, $p < .05$). No other differences were found between the larger sample and the diary subsample on any of the study variables. As would be expected in a college sample, the socioeconomic backgrounds of participants were above the national average, with 62% of participants having at least one parent who completed a 4-year degree.

Questionnaire Measures

Perceived racial discrimination. Experiences of discrimination were assessed in each wave of the longitudinal study using the Racism and Life Experiences Scale (RaLES; Harrell, 1994, 2000). Respondents indicated how often they had experienced 20 types of unfair treatment because of their race/ethnicity (e.g., "How often have you been treated as if you were stupid or talked down to?"). Response options were on a 6-point scale ranging from *never* to *several times a day*. The RaLES has been used extensively in research on perceived discrimination, and psychometric properties have been well documented (Sellers & Shelton, 2003; Utsey, 1998). Items from the adjacent wave of the longitudinal study (third assessment) were averaged to create a composite score, with higher values indicating higher levels of racial discrimination ($\alpha = .90$).

Internalized racism. Internalized racism was assessed using the miseducation subscale of the Cross Racial Identity Scale (Vandiver et al., 2002). The five miseducation items assess the degree

to which individuals associate negative stereotypic characteristics such as laziness and criminality with their racial/ethnic group (e.g., “Many African Americans are too lazy to see opportunities that are right in front of them”). Response options for all items were on a 7-point scale ranging from *strongly disagree* to *strongly agree* ($\alpha = .84$). Prior research suggests that miseducation is a unique construct, distinct from other measures of racial identity (Vandiver et al., 2002). Examination of adjusted item-total correlations in the current study also indicated discriminant validity of the miseducation construct. Specifically, all miseducation items were more highly correlated with the miseducation construct than with other measures of racial identity (see online supplemental materials, Table S1).

Racial identity. The Multidimensional Inventory of Black Identity (MIBI) was used to assess private regard, public regard, and centrality (Sellers, Rowley, Chavous, Shelton, & Smith, 1997, 1998). Private regard ($\alpha = .89$; e.g., “I am happy that I am Black”) and public regard ($\alpha = .88$; e.g., “Society views Black people as valuable”) were each assessed with 6 items, and centrality ($\alpha = .81$; e.g., “In general, being Black is an important part of my self-image”) was assessed with 8 items. Response options for all items were on a five-point scale ranging from “strongly disagree” to “strongly agree” with “neither agree nor disagree” as the neutral point.

Depressive symptoms. The Center for Epidemiological Studies Depression Scale was used to assess depressive symptoms (Radloff, 1977). Consistent with prior research, one item relating to sleep problems from the original 20-item scale was excluded to avoid conceptual overlap with the sleep measure (Fuller-Rowell, Curtis, El-Sheikh, Chae, et al., 2016; Matthews et al., 2018). The revised scale had good internal consistency ($\alpha = .75$). Because sleep problems and depressive symptoms are closely linked, depression was included as a control in all analyses (Nutt, Wilson, & Paterson, 2008). Sensitivity analyses excluding depression symptoms yielded equivalent results.

Daily Diary Measures

Sleep problems. Sleep problems were assessed each day and were scored as the average of two items: “How difficult was it to get to sleep last night?” and “How well rested did you feel this morning?” Both items are established daily diary measures of sleep and have been consistently associated with global sleep quality and efficiency (Åkerstedt et al., 1994; Buysse et al., 2008; Carney et al., 2012). Response options were on a 5-point scale ranging from *very easy* to *very difficult* for the first item and from *well rested* to *poorly rested* for the second item. The mean within-day correlation between the two items was .33 ($SD = .11$). Self-report daily diary measures of sleep have established validity and are known to be effective for handling intraindividual variability in problems relating to sleep quality (Åkerstedt et al., 2012; Blunden & Galland, 2014; O’Brien et al., 2011).

Daily discrimination. The 20-item RaLES was modified to assess daily experiences of discrimination (Harrell, 1994, 2000; Utsey, 1998). For each item, instead of reporting the frequency of occurrence, participants reported whether each form of racial discrimination happened that day (e.g., “you were treated as if you were stupid or talked down to”). Response options were dichotomously coded (no = 0, yes = 1), and a sum score was created to

indicate the number of discriminatory events experienced. The average number of daily discriminatory events experienced was .96 ($SD = 1.15$), or approximately one per day. The intraclass correlation for daily discrimination was .32, indicating substantial variability in the number of events reported across days.

Substance use. Alcohol and caffeine use were adjusted in all analyses. These measures have established associations with sleep and are frequently controlled in research considering psychosocial predictors of sleep problems (Bartel, Gradisar, & Williamson, 2015; Roehrs & Roth, 2008; Thakkar, Sharma, & Sahota, 2015). Number of alcohol and caffeinated drinks consumed each day was assessed in the daily diary and was coded to reflect no use (0), moderate use (1), and heavy use (2). For caffeine, moderate use on a given day was defined as one to two caffeinated beverages, and heavy use was defined as three or more caffeinated beverages or any use of caffeinated energy drinks. Alcohol use was coded to reflect the U.S. Departments of Health and Human Services and Agriculture 2015–2020 dietary guide, with moderate use defined as one drink per day for women and up to two drinks per day for men (DeSalvo, Olson, & Casavale, 2016). Heavy alcohol use was defined as two or more drinks per day for women and three or more drinks for men. A mean score across the 9 days was then created for each substance to index average levels of use for each individual.

Analysis Plan

A series of multilevel models were estimated in HLM V7 to test the stated hypotheses. An initial unconditional model with no predictors was fit to partition within- and between-person variability in sleep. All substantive models included methodological controls for day and weekend at level 1 to adjust for any linear time trend relating to repeated assessment of sleep and for changes in sleep that occur on weekends (Bolger et al., 2003). At level 2, controls for substance use (caffeine, alcohol) and depressive symptoms were included, alongside demographic controls for age and sex. Because experiences on a given day were expected to influence sleep that night (reported in the next day’s diary), lagged models were estimated for all analyses. Specifically, daily reports of discrimination at time T were considered as a predictor of sleep at time $T + 1$. The form of the level 1 equation is as follows:

$$\text{Sleep Problems}_{T+1} = \pi_0 + \pi_1 * \text{Daily Discrimination}_T + \pi_2 * \text{Day} + \pi_3 * \text{Weekend} + e_{ij}$$

The following are the general equations for level 2:

$$\pi_0 = \beta_{00} + \beta_{01} * \text{Person Level Predictor} + u_0$$

$$\pi_1 = \beta_{10} + \beta_{11} * \text{Person Level Predictor} + u_1$$

Model 1 entered perceived discrimination at level 2 (RaLES) to examine whether between-person differences in discrimination predicted between-person differences in sleep. Model 2 entered the daily measure of discrimination as a level 1 predictor to test our primary hypothesis regarding whether within-person fluctuations in experiences of discrimination were associated with day-to-day changes in sleep. Model 3 added miseducation at level 2 as a moderator of the within-person association between discrimination and sleep. The main effect of miseducation was also included in Model 3. In an identical manner, Model 4 considered private

regard as a moderator of the within-person association between discrimination and sleep (without miseducation in the model). Model 5 then entered both miseducation and private regard simultaneously to consider them as competing moderators. This model tested our hypothesis regarding whether the within-person fluctuations in experiences of discrimination and sleep are moderated by internalized racism after adjusting for the effects of private regard. Additional models were then estimated to do the same for public regard and centrality. Perceived discrimination and all other continuous person-level predictors were grand mean centered. Daily discrimination was group mean centered so that values represent fluctuations in experiences of discrimination from each participant's average level (Bolger et al., 2003).

Results

Descriptive statistics and correlations between study variables are shown in Table 1. Participants who reported higher levels of perceived discrimination in the survey questionnaire also reported more discrimination in the daily diary, $r = .495, p < .001$. All measures of racial identity were significantly correlated with the survey questionnaire measure of perceived discrimination, but only public regard and centrality were significantly associated with daily diary experiences of discrimination. Miseducation, our measure of internalized racism, was not significantly correlated with the questionnaire measure of perceived discrimination, $r = .137, p = .123$, but was marginally associated with the daily diary measure of discrimination, $r = .170, p = .056$.

Multilevel Models

Results from an initial empty model yielded an intraclass correlation coefficient of .30, indicating that 30% of the overall variability in sleep problems arises from between-person differences and 70% arises from within-person fluctuations across days. Full results for Models 1–5 are shown in Table 2. Parameter estimates for Model 1 indicated that between-person differences in perceived discrimination were not significantly associated with sleep problems ($B = -.023, SE = .134, p = .865$). However,

Model 2 estimates indicated that day-to-day fluctuations in discrimination were significantly associated with changes in sleep ($B = .037, SE = .017, p = .034$). Specifically, for each additional experience of discrimination over and above an individual's own average, participants experienced a .06 standard deviation unit increase in sleep problems that night. Although relatively small in magnitude, the cumulative impact of repeated exposure is likely to be substantial (Funder & Ozer, 2019).

Parameter estimates for Models 3 and 4 indicated that miseducation moderated the association between daily discrimination and sleep ($B = .046, SE = .021, p = .033$), but private regard did not ($B = -.021, SE = .019, p = .283$). Furthermore, in Model 5, when private regard was considered as a competing moderator alongside miseducation, the moderating effect of miseducation was attenuated by only 2% ($B = .044, SE = .022, p = .047$), and the moderating effect of private regard remained nonsignificant ($B = -.01, SE = .023, p = .654$). An interaction plot based on estimates from Model 3 is shown as Figure 1. The plot shows the association between daily discrimination and sleep at high and low levels of miseducation. At high levels of internalized racism (+1 *SD*), the within-person association between daily discrimination and sleep problems was positive and statistically significant ($B = .081, SE = .027, p = .003$). At low levels of internalized racism (–1 *SD*), the association between discrimination and sleep was not significantly different from zero ($B = -.039, SE = .038, p = .297$).

Analyses were conducted to examine the degree to which reported results remained after adjusting for two other measures of racial identity: public regard and centrality. Results of these analyses indicated that the moderating effects of internalized racism were largely unchanged after adjusting for each racial identity construct. Specifically, models adjusting for centrality as a competing moderator did not attenuate the moderating effects of miseducation. Models adjusting for public regard attenuated the effects by only 3%. Complete results for models adjusting for public regard and centrality are included in the online supplemental materials (Tables S2 and S3).

Table 1
Bivariate Correlations and Descriptive Statistics

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. Sex (male = 1, female = 0)	—											
2. Age	-.007	—										
3. Perceived discrimination	-.012	.047	—									
4. Miseducation	.277**	.037	.137	—								
5. Private regard	.069	.001	-.243**	-.391***	—							
6. Public regard	.192*	-.106	-.448***	-.052	.311***	—						
7. Centrality	-.017	-.076	.203*	-.251**	.533***	-.035	—					
8. CES-D	-.030	.157†	.427***	.210*	-.123	-.055	.024	—				
9. Avg. daily discrimination	.120	.060	.495***	.170†	.061	-.210*	.278**	.257**	—			
10. Avg. daily sleep problems	-.145	-.060	.072	.086	-.182*	-.067	-.035	.176*	.005	—		
11. Avg. daily caffeine use	-.011	.050	.055	-.032	-.085	-.120	.004	.144	.093	.118	—	
12. Avg. daily alcohol use	.194*	.230**	.190*	.094	.030	-.040	.086	.086	.115	.006	.115	—
<i>M (SD)</i>	0.26 (0.44)	19.11 (1.6)	1.56 (0.55)	3.36 (1.33)	6.01 (1.04)	3.26 (1.11)	4.67 (1.13)	2.08 (0.38)	0.96 (1.15)	2.53 (0.66)	0.42 (0.48)	0.13 (0.23)

Note. CES-D = Center for Epidemiological Studies Depression Scale.

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Table 2
 Parameter Estimates for Multilevel Models Examining Predictors of Daily Sleep Problems

Model parameters	Model 1		Model 2		Model 3		Model 4		Model 5	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Average level of sleep problems, π_0										
Intercept, β_{00}	2.835***	.102	2.828***	.101	2.838***	.104	2.824***	.101	2.828***	.104
Age, β_{01}	-.035	.039	-.035	.039	-.032	.041	-.034	.039	-.033	.040
Sex, β_{02}	-.198	.123	-.196	.122	-.249 [†]	.131	-.186	.119	-.219	.134
Caffeine use, β_{03}	.196	.124	.197	.125	.210 [†]	.124	.174	.130	.189	.129
Alcohol use, β_{04}	.129	.213	.139	.212	.129	.214	.150	.215	.142	.217
Depression, β_{05}	.291	.184	.277 [†]	.159	.224	.159	.246	.163	.217	.164
Discrimination, β_{06}	-.023	.134	—	—	—	—	—	—	—	—
Miseducation, β_{07}	—	—	—	—	.065	.043	—	—	.041	.053
Private regard, β_{08}	—	—	—	—	—	—	-.089 [†]	.046	-.068	.056
Daily discrimination slope, π_1										
Intercept, β_{10}	—	—	.037*	.017	.020	.017	.038*	.017	.022	.018
Miseducation, β_{11}	—	—	—	—	.046*	.021	—	—	.044*	.022
Private regard, β_{12}	—	—	—	—	—	—	-.021	.019	-.010	.023
Day slope, π_2										
Intercept, β_{20}	-.035*	.017	-.033*	.017	-.032	.017	-.033*	.017	-.032	.017
Weekend slope, π_3										
Intercept, β_{30}	-.298***	.073	-.296***	.073	-.293***	.075	-.294***	.073	-.292***	.075
Variance components										
Initial status, u_0	.281		.274		.274		.271		.274	
Daily discrimination slope, u_1	—		.001		.001		.001		.001	
Residual, e	.682		.669		.661		.668		.662	

Note. At level 1, all models control for day of study (coded 0–8) and weekend (weekday = 0, weekend = 1); daily discrimination is group mean centered. At level 2, sex is dichotomously coded (female = 0, male = 1). Other level 2 predictors are grand mean centered.

[†] $p < .10$. * $p < .05$. *** $p < .001$.

Additional Analyses

Supplemental analyses were also conducted to examine the two items assessing daily sleep quality separately. Results of these analyses indicated a similar pattern of results for both items consistent with the findings reported above. However, as expected, p values varied (some larger, some smaller) in item-specific anal-

yses. Complete tables showing full results of analyses for each sleep item are included in the online supplemental materials (Tables S4 and S5). Longer lags were also considered in additional analyses to examine the effects of discrimination on day T as a predictor of sleep on day $T + 2$ and day $T + 3$. Results of these analyses (not shown) indicated that daily experiences of discrim-

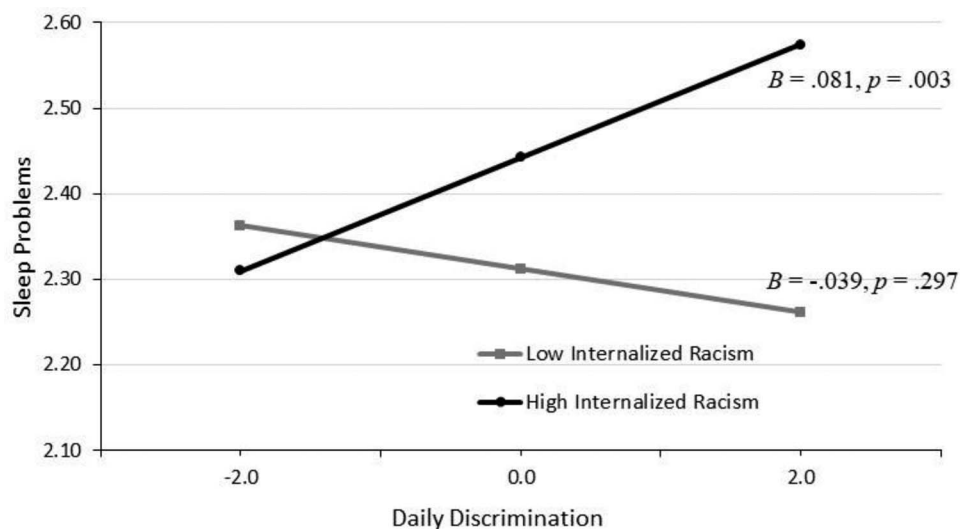


Figure 1. Fitted interaction plot showing the within-person association between daily discrimination and sleep problems at low (-1 SD) and high ($+1$ SD) levels of internalized racism. Daily discrimination is person centered; the scale on the x-axis therefore represents deviations from each person's mean level of reported discrimination.

ination were not significantly associated with subsequent sleep quality beyond the 1-day lag reported in primary analyses.

Sex was also examined as a moderator of the within-person association between discrimination and sleep. No significant differences between men and women were evident ($B = -.021$, $SE = .048$, $p = .668$). However, due to the relatively small number of men in the analytic sample, this study was not optimally suited to addressing questions relating to sex differences, and thus our findings in this regard should be considered preliminary.

Last, although not a primary substantive focus of this study, because substance use has been conceptualized as a mediator of the day-to-day effects of stressors on outcomes in prior research (Jackson, Knight, & Rafferty, 2010), supplemental analyses were conducted to consider whether daily fluctuations in substance use (caffeine, alcohol) attenuated the within-person association between discrimination and sleep. Due to missing data on participants' report of substance use, this lagged analysis included 614 days of data from the 124 individuals. Results of these analyses indicated that the within-person association between discrimination and sleep was attenuated by only 3% ($B = .034$, $SE = .017$, $p = .051$) after adjusting for caffeine and alcohol use. Additional analyses excluding substance use controls from analyses altogether also yielded equivalent results with respect to the reported substantive findings.

Discussion

Disparities in sleep quality between Black and White adults in the United States are well documented and known to play an important role in cardiometabolic health disparities (Curtis, Fuller-Rowell, El-Sheikh, Carnethon, & Ryff, 2017). Understanding the social determinants of sleep among African Americans is therefore a salient topic with implications for racial health disparities and efforts to address these inequities. Using a daily diary approach, the current study examined within-person associations between discrimination and sleep quality. Results indicated that on days when participants experienced more discrimination, their sleep problems increased. These results build on prior work showing that between-person differences in perceived discrimination are associated with sleep problems among African Americans (Fuller-Rowell, Curtis, El-Sheikh, Duke, et al., 2016; Slopen et al., 2016) and extend this research in important ways. In particular, our results suggest that previous studies based on between-person differences hold up to the within-person analytic approach. This finding is of interest because the within-person approach is inherently less subject to recall bias and the confounding effects of personality and identity (Cervone, 2005; Coughlin, 1990; Mischel & Shoda, 1995; Shoda, Mischel, & Wright, 1994; Zwerling et al., 1995). Results of this study therefore suggest that previously reported associations are unlikely to be entirely driven by these factors.

With respect to effect size, analyses revealed that each additional experience of discrimination was associated with a .06 standard deviation unit increase in sleep problems that night. On its face, this effect size may look relatively small. However, the cumulative impact of repeated exposure across a period of weeks or months is likely to be substantial (Funder & Ozer, 2019), with important economic and public health consequences (Institute of Medicine Committee on Sleep Medicine & Research, 2006; Sho-

chat, Cohen-Zion, & Tzischinsky, 2014; Tavernier & Willoughby, 2014).

In contrast to our within-person results, between-person differences in perceived discrimination were not found to be associated with sleep problems. Although unexpected, these results are consistent with some prior research. Specifically, a handful of published studies examining the cross-sectional associations between perceived discrimination and health outcomes have found no significant association or nonlinear effects such that those reporting moderate levels of perceived discrimination were found to have better health outcomes than those reporting very low levels of discrimination (Krieger, 1990; Krieger & Sidney, 1996). We interpret these results in relation to the confounding effects of personality or racial identity, which may serve to attenuate the association between perceived discrimination and health in cross-sectional studies (Fuller-Rowell, Doan, & Eccles, 2012; LaVeist, Sellers, & Neighbors, 2001; Sellers & Shelton, 2003). By reducing the potential for recall bias and confounding effects of personality and identity, the within-person approach may provide a more accurate assessment of variability in stress exposure and thus assist researchers in clarifying the relationship between discrimination and health outcomes.

Additional research will be needed to replicate the findings of this study and compare the results of within- and between-person approaches. Examination of methodological controls that yield more accurate effect sizes in between-person analyses will be an important consideration. Methods that allow for greater synchrony between the within- and between-person effects are an important area of inquiry given the dominance of between-person methodologies and the substantial additional costs of collecting the repeated assessments needed for within-person analyses. The development of more nuanced methodological approaches for between-person analyses should therefore be a priority in future research examining the health consequences of discrimination (Seaton, Gee, Neblett, & Spanierman, 2018; Williams, 2018).

An additional important direction for future research will be to explicate mechanisms for effects of discrimination on sleep. Daily diary studies will be helpful in considering whether more proximal factors such as rumination, psychological distress, or specific patterns of emotional or physiologic reactivity mediate the day-to-day association between discrimination and sleep. Examination of protective factors such as social support, sense of belonging, or racial socialization may also be informative within the daily diary framework.

Another important point of discussion relates to the frequency of daily discrimination events captured by our daily diary measure. Prior studies using different measures of daily perceived racial discrimination have tended to find lower frequencies (e.g., Huynh & Fuligni, 2010). We believe that the 20-item measure employed in this study, which included both subtle and blatant forms of racial discrimination, was particularly effective at capturing participant experiences of unfair treatment. Moreover, African American college students are known to experience higher levels of unfair treatment than other racial/ethnic minority groups (Ancis et al., 2000).

The focus of the current investigation was on the association between interpersonal discrimination and sleep. However, other factors such as adverse childhood experiences, socioeconomic disadvantage, and exposure to neighborhood adversity may also

disproportionately influence the sleep of African Americans relative to other racial ethnic groups (Curtis, Fuller-Rowell, Doan, Zgierska, & Ryff, 2016; Oshri, Kogan, Liu, Sweet, & Mackillop, 2017; Van Dyke, Vaccarino, Quyyumi, & Lewis, 2016). For example, recent research suggests that neighborhood disadvantage accounts for a portion of racial disparities in sleep problems, even after adjusting for individual-level socioeconomic status (Fuller-Rowell, Curtis, El-Sheikh, Chae, et al., 2016). Additional work is needed to bring the findings of this study together with other studies of social determinants at the interpersonal and structural levels of analysis influencing racial disparities in sleep. Because structural racism and institutional discrimination have played a significant role in creating the contexts of adversity to which Black children and adults in the United States are disproportionately exposed, consideration of macrolevel factors alongside individual-level experiences will be one important next step.

A second focus of this study was to examine the moderating role of internalized racism, as assessed by the miseducation scale. Results of these analyses add to prior work by showing that, among African American college students, the association between discrimination and sleep was stronger among those who scored higher on the miseducation scale. These results are consistent with research focusing on implicit measures of racial bias, which indicate that a pro-Black orientation may be protective (Chae et al., 2012). As the first study to examine these associations using a within-person analytic approach, and the first to consider the role of internalized racism in the association between discrimination and sleep, our findings extend this research. Although preliminary, our results suggest that internalized racism—conceptualized here as the level of agreement with negative messages about one's racial/ethnic group—is an important construct in understanding the deleterious consequences of discrimination experienced by African American college students. Importantly, our results are largely unchanged after adjusting for private regard, suggesting that our operational definition of internalized racism is distinct from this established racial identity construct. Results were also largely unchanged when adjusting for public regard and centrality. Our findings are therefore consistent with prior research suggesting that miseducation is a unique construct, which is at the same time distinct and conceptually related to established measures of racial identity (Vandiver et al., 2002).

Several limitations and future directions should be noted. First, although self-report daily diary measures of sleep quality are well validated and important (Åkerstedt et al., 1994, 2012; Blunden & Galland, 2014; Carney et al., 2012; O'Brien et al., 2011), objective measures offer additional insight and should be considered in future work (Sadeh, 2015). Furthermore, given the specific focus of this study on sleep quality, the degree to which race-related stressors have similar or differential within-person effects on sleep duration among African Americans will be another important area of inquiry.

A second potential limitation relates to our assessment of sleep in an evening rather than a morning diary. Although evening diaries have been used to assess sleep in prior research (e.g., Fuligni & Hardway, 2006), asking about sleep later in the day may introduce some recall bias. However, such bias is likely to be less than that of standard questionnaire measures of sleep, which ask participants to recall over a period of weeks or months.

Third, because this study focused on a sample of African American students attending one of two predominantly White universities in the northeastern United States, the findings do not necessarily generalize to other contexts. The demographics of the student body and the degree to which a university actively cultivates an inclusive climate and provides support to students from underrepresented groups is likely to influence the experience of African American students (Lett & Wright, 2003). An important direction for future research will be to directly consider this contextual variability and its determinants. For example, other types of university environments, such as historically Black colleges, will offer a valuable comparison.

Fourth, because both discrimination and sleep were assessed using self-report measures, common rater effects remain a potential threat to validity and thus a limitation of this research (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). However, this limitation is partially mitigated by the within-person analytic approach (which minimizes the effect of trait-based reporting biases by using individuals as their own control) and by the lagged association between the predictor and the outcome (which decreases possible mood-state effects). Lastly, because this study was not experimental, untested third variable explanations cannot be ruled out. However, the results were robust to controls for depression and health behaviors and were consistent with hypothesized associations.

Efforts to reduce racism and discrimination in contexts of higher education are likely to be of substantial importance in the movement to eliminate racial health disparities. Though broader implementation remains needed, examples of such efforts that have shown promise on some college campuses include bias mitigation programs (Frieze, Marculescu, Quesenberry, Katilius, & Reynolds, 2018; Thakral et al., 2016), formalized discrimination reporting policies (LePeau, Morgan, Zimmerman, Snipes, & Marcotte, 2016; Worthington, Stanley, & Lewis, 2014), and targeted outreach counseling services for vulnerable students (Banks, 2018). This point is underscored by evidence that reducing racial discrimination may not only improve campus climate and sleep but also the enrollment, retention, and graduation rates of minority students (O'Hara, Gibbons, Weng, Gerrard, & Simons, 2012; Wei, Ku, & Liao, 2011). Overall, the findings of this study suggest that experiences of discrimination are associated with sleep disturbance among African American college students and that the adverse effects of discrimination are more pronounced among those with higher levels of internalized racism.

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