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Racial Discrimination Mediates Race Differences in Sleep Problems: A Longitudinal Analysis

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Objectives: To examine changes in sleep problems over a 1.5-year period among Black or African American (AA) and White or European American (EA) college students and to consider the role of racial discrimination as a mediator of race differences in sleep problems over time. ***Method:*** Students attending a large, predominantly White university ($N = 133$, 41% AA, 57% female, mean age = 18.8, $SD = .90$) reported on habitual sleep characteristics and experiences of racial discrimination at baseline and follow-up assessments. A latent variable for sleep problems was assessed from reports of sleep latency, duration, efficiency, and quality. Longitudinal models were used to examine race differences in sleep problems over time and the mediating role of perceived discrimination. Covariates included age, gender, parent education, parent income, body mass index, self-rated physical health, and depressive symptoms. Each of the individual sleep measures was also examined separately, and sensitivity analyses were conducted using alternative formulations of the sleep problems measure. ***Results:*** AAs had greater increases in sleep problems than EAs. Perceived discrimination was also associated with increases in sleep problems over time and mediated racial disparities in sleep. This pattern of findings was similar when each of the sleep indicators was considered separately and held with alternative sleep problems measures. ***Conclusions:*** The findings highlight the importance of racial disparities in sleep across the college years and suggest that experiences of discrimination contribute to group disparities.

Keywords: African American, sleep quality, health disparities, perceived discrimination, stress

Sleep is a fundamental biological process that plays a critical role in the maintenance of mental and physical health. In adult and college student samples, measures of sleep problems have been linked to declines in psychosocial functioning (Tavernier & Willoughby, 2014), poor health behaviors (Shochat, Cohen-Zion, & Tzischinsky, 2014), and diminished self-regulatory abilities (Yoo, Gujar, Hu, Jolesz, & Walker, 2007). Insufficient or low-quality sleep has also been consistently associated with subsequent obesity (El-Sheikh, Bagley, Keiley, & Erath, 2014), metabolic disease (Knutson, 2010), and other morbidity sequelae (Cappuccio, Cooper, D'Elia, Strazzullo, & Miller, 2011). Sleep problems are a significant impediment across multiple dimensions of health and well-being that collectively carry an economic burden of hundreds of billions of dollars each year in the United States alone (Colten & Altevogt, 2006).

Recent meta-analyses reveal that individuals who are categorized as Black or African American (AA) show consistently poorer sleep than those who are categorized as White or European American (EA; Petrov & Lichstein, 2015; Ruiter, DeCoster, Jacobs, & Lichstein, 2011). In particular, studies indicate shorter sleep duration, poorer sleep efficiency, greater onset latency, and worse overall sleep quality among AAs relative to EAs (Petrov & Lichstein, 2015; Ruiter, DeCoster, Jacobs, & Lichstein, 2010; Ruiter et al., 2011). Reviews of the literature reveal that longitudinal analyses of racial disparities in sleep are sorely needed and that mechanisms for group differences are not well understood (Petrov & Lichstein, 2015). Furthermore, several studies indicate that race differences in sleep measures endure after measures of socioeconomic status are controlled (Grandner et al., 2013; Whinnery, Jackson, Rattanaumpawan, & Grandner, 2014).

Studies of racial disparities in sleep among college students are scarce. However, such studies may be of particular importance

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because of the known stressors experienced by minority students attending predominantly White universities, such as overt and covert racism and lack of support in classrooms and residence halls (Ancis, Sedlacek, & Mohr, 2000; Nora & Cabrera, 1996). Additionally, because sleep is robustly associated with academic performance and the ability to manage stress (Killgore et al., 2008; Taylor, Vatthauer, Bramoweth, Ruggero, & Roane, 2013; Yoo, Hu, Gujar, Jolesz, & Walker, 2007), identifying psychosocial predictors of race differences in sleep among college students is a needed area of research with important implications for the reduction of racial disparities.

Associations between social stress and sleep are well established (De Lange et al., 2009; Kim & Dimsdale, 2007) and have been documented among 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). As a social stressor disproportionately experienced by AAs, racial discrimination is a likely candidate mechanism for racial disparities in sleep. Several studies have considered the link between discrimination and sleep (Slopen, Lewis, & Williams, 2015) and have found that perceived discrimination or unfair treatment is associated with sleep disturbance among both AA and EA adults (Beatty et al., 2011; Grandner et al., 2012; Lewis et al., 2013; Tomfohr, Pung, Edwards, & Dimsdale, 2012). Associations between discrimination and sleep have also been found in other ethnic groups (Huynh & Gillen-O'Neel, 2013; Steffen & Bowden, 2006). However, none of these studies have considered the effects of discrimination on sleep longitudinally, and there is a lack of research examining the link between discrimination and sleep among college students.

The current study brings together the aforementioned lines of research in the context of advanced education. Specifically, we examined changes in sleep problems among AA and EA students attending a large, predominantly White university and considered perceived racial discrimination as a mediator of expected group differences in sleep problems over time. Clarification of mechanisms of effects is key for understanding why individuals of different races may be more or less susceptible to sleep disturbance. To our knowledge, this is the first study to consider racial disparities in the longitudinal sleep patterns of college students and the first study to examine perceived discrimination as a mediator of racial or ethnic differences in sleep over time.

Experiences of discrimination vary in severity and can range from covert and subtle to overt and blatant (Sue, 2010; Williams & Mohammed, 2013). The majority of studies have used one of two types of approaches to assess perceived discrimination (Krieger, 2014). The first approach focuses on reports of general unfair treatment that are not tied to any one domain or category (Krieger, Smith, Naishadham, Hartman, & Barbeau, 2005; Williams, Yu, Jackson, & Anderson, 1997). The second approach involves specifying the domain or type of discrimination (e.g., racial or ethnic) in the stem of the question (Fisher, Wallace, & Fenton, 2000; Ong, Fuller-Rowell, & Burrow, 2009). Both approaches have been commonly used and have demonstrated predictive validity in AA and EA samples (Fuller-Rowell, Evans, & Ong, 2012; Kessler, Mickelson, & Williams, 1999; Sellers, Caldwell, Schmeelk-Cone, & Zimmerman, 2003; Williams et al., 2012). The latter approach allows for the possibility of a specific interpretation with respect to the domain of discrimination and was adopted for the current investigation with racial discrimination defined as unfair treatment due to one's race or ethnicity.

Sleep is a complex and multifaceted construct, and assessment of various sleep parameters is imperative (Sadeh, 2015). In this study, sleep problems are indicated by reported sleep duration, efficiency (percentage of time in bed spent sleeping), latency (number of minutes between going to bed and falling asleep), and overall quality; such sleep assessments do not refer to clinically significant problems (e.g., apnea, restless leg syndrome). Toward explication of effects, the various sleep parameters were examined both individually and as a latent construct. The overarching hypotheses were (a) that AA students would show greater increases in sleep problems than EAs over time and (b) that perceived racial discrimination would mediate this race difference.

Method

Participants and Design

The analytic sample for the current study included 133 college students (mean age at baseline = 18.8, *SD* = 0.9; 41% AA, 57% female) who participated in baseline and follow-up assessments of a longitudinal study. The study was conducted at a large, Midwestern university in the United States with a predominantly White or EA student body (3% AA, 4% Asian, 4% Hispanic or Latino, 1% American Indian). Approval was obtained from the relevant institutional review board for all aspects of this research. All first- and second-year AA students and an equally sized stratified random sample of first- and second-year EA students were initially invited to participate by mailing information about the study. EA students without a parent who had graduated from college (first generation) were oversampled to ensure that race and parent education were not confounded. Recruitment was stopped when the target sample size of 150 students had enrolled in the study.[1] The initial assessment (T1) took place in the clinical research unit of an on-campus university hospital in 2012. During the study visit, physiologic measures were taken by researchers and nursing staff, and self-report measures were administered on a laptop computer. Respondents received $75 for participation. Out of the 150 students in the baseline sample, 133 (89%) also participated in a brief follow-up survey assessment (T2) administered 1.5 years later, for which participants received $15. The final analytic sample included those who participated in both waves of data collection. Individuals lost to attrition were more likely to be AA ($p < .001$). However, controlling for race, attrition was not associated with any other demographic or substantive variables. Furthermore, compared to AAs who remained in the study, AAs lost to attrition showed no differences on any demographic or substantive variables. Thus, differences in attrition on the basis of race, although a limitation, are not expected to introduce significant bias to the reported results.

[1] It should be noted that although the EA students targeted for recruitment were a stratified random sample, because recruitment was stopped when the target sample size was reached, the sample of actual participants is no longer completely random.

Measures

Sleep problems. Sleep characteristics were measured using the Pittsburgh Sleep Quality Index (PSQI), a reliable self-administered questionnaire that is widely used to assess the following seven sleep domains: duration, efficiency, onset latency, quality, sleep disturbances, daytime dysfunction, and use of sleeping medication (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989). The PSQI has demonstrated validity across various populations, including college students, and has been associated with emotional and physical health as well as academic outcomes (Lund et al., 2010; Orzech, Salafsky, & Hamilton, 2011). The full PSQI questionnaire was administered at T2, and items from the PSQI relating to sleep duration, efficiency, latency, and quality were also assessed at the T1 baseline assessment. Because our main interest was in considering prospective associations with sleep, primary analyses focused on measures of sleep problems that were parallel across time, and additional sensitivity analyses were conducted to consider the full PSQI global score at T2. Duration was assessed as the number of hours of actual sleep each night and was coded on a 4-point scale, with higher scores indicating more *duration problems*: *7 to 9 hr* (coded as 0), *6 to 6.99 hr* (coded as 1), *5 to 5.99 hr* (coded as 2), and *less than 5 hr* (coded as 3). Because long sleep duration (>9 hr) has established associations with ill health (Patel, Malhotra, Gottlieb, White, & Hu, 2006), three individuals with durations greater than 9 hr were given a score of 1. This method for coding sleep duration is based on the current recommendation of 7 to 9 hr for young adults (Hirshkowitz et al., 2015), with an equal scoring penalty applied for each hour outside of the recommended range in either direction.[2] *Efficiency* is the percentage of time in bed spent sleeping and was calculated from reports of number of hours in bed and number of hours spent sleeping. *Latency* was measured as the number of minutes taken to fall asleep each night. *Quality* was assessed with ratings of overall sleep quality on a 4-point scale: *very bad* (coded as 0), *bad* (coded as 1), *good* (coded as 2), and *very good* (coded as 3). These four sleep indicators were assessed at T1 and T2 and were included as observed indicators of latent constructs for sleep problems at each wave.[3] The measurement model demonstrated good fit ($\chi^2/df = 1.32$; confirmatory fit index [CFI] = .95; root mean square error of approximation [RMSEA] = .049; 90% confidence interval [CI] [.000, .092]), and all indicators significantly loaded onto the hypothesized constructs ($ps < .001$), with standardized factor loadings between .53 and .69 in magnitude. Each of the four sleep indicators was also considered separately in additional analyses.

Perceived discrimination. Perceived discrimination was assessed using 13 items drawn from the Racism and Life Experiences Scales (RaLES; Harrell, 2000). Respondents indicated how often they had experienced each type of unfair treatment because of their race or ethnicity (e.g., *How often have you been treated as if you were stupid or talked down to?* and *How often have you been left out of conversations or activities?*). Response options were on a 6-point scale ranging from *never* (coded as 1) to *several times a day* (coded as 6). The RaLES has been used extensively in research on perceived discrimination, and psychometric properties have been documented (Sellers & Shelton, 2003; Utsey, 1998). In this study, all items loaded onto a single factor, and the scale demonstrated good internal consistency ($\alpha = .91$). Items were therefore averaged to create a composite score, with higher values indicating higher levels of racial discrimination.

Demographic and control variables. All demographic variables were assessed at T1. Race or ethnicity was taken from university records and confirmed by student self-reports. Sex, age, parent education, and parent income were also assessed from student self-reports. Parent education—assessed for each parent on a 7-point scale ranging from *eighth grade or less* (coded as 1) to *graduate degree* (coded as 7)—was scored as the mean education level for students from two-parent families and as a single item for students from single-parent families. Parents' combined household income was assessed on a scale from *less than $5,000* to *more than $200,000* with 28 possible response categories.

Measures of physical health (body mass index, self-rated health) and mental health (depressive symptoms) were also assessed at T1 and were considered in analyses as covariates. Body mass index (kg/m^2) was calculated from measures of height and weight taken by trained nursing staff. Self-ratings of overall physical health were assessed on a 5-point scale ranging from *poor* to *excellent*. This single-item measure of health has been shown to be a robust predictor of subsequent morbidity and mortality and is widely used in current research (DeSalvo, Bloser, Reynolds, He, & Muntner, 2006; Schnittker & Bacak, 2014). Depression was assessed with the Beck Depression Inventory—II (A. T. Beck, Steer, & Brown, 1996). Two items relating to sleep problems from the original 21-item scale were excluded to avoid conceptual overlap between the depression and sleep measures. The revised scale had good internal consistency ($\alpha = .79$).

Analysis Strategy

Structural equation models were estimated to test the specified hypotheses, and full information maximum likelihood was used to deal with missing data on observed variables. Of the 133 individuals included in analyses, 97% had complete sleep-related data, and 95% had complete data on parents' household income. All other variables had no missing data. Maximum likelihood estimation with robust standard errors was used, and model fit was evaluated using the chi-square:degrees of freedom ratio, Bentler's CFI, RMSEA, and the 90% CI of the RMSEA. Values of approximately 2 or less for χ^2/df, .95 or greater for the CFI, .06 or less for the RMSEA, and .10 or less for the upper bound of the RMSEA CI are indicative of good model fit (Hu & Bentler, 1999). Mediation was tested using the product of coefficients method with a bootstrapping procedure that estimates bias-corrected CIs (Hayes & Scharkow, 2013; MacKinnon, Fairchild, & Fritz, 2007). Standardized parameter estimates are shown in Figure 1 and unstandardized

[2] A continuously coded measure of duration was also considered as an alternative specification; the substantive findings using this measure were comparable to those reported in the following, but the magnitude of the race difference in sleep problems over time was smaller (both for duration and for the latent sleep problems construct).

[3] Following best practices for longitudinal analysis of latent variables, factor loadings and intercepts of identical sleep indicators were constrained to be equal across time in all models. This ensures that latent factors are comparable across time. Residual variances between T1 and T2 latency and between T1 and T2 duration were allowed to covary. Error covariances within each time point were also allowed between latency and duration because short durations may lead to artificially short latencies.

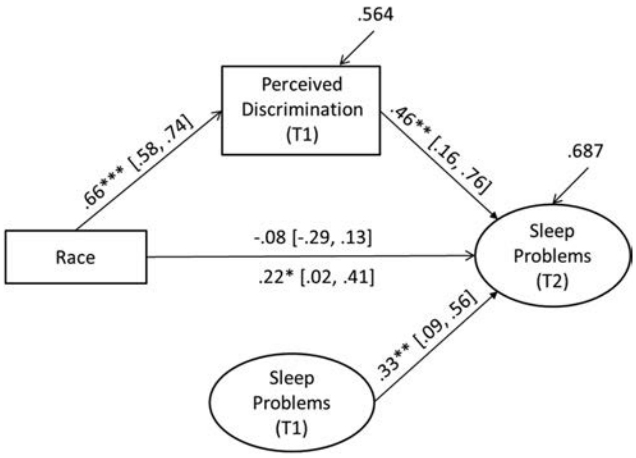

Figure 1. Model results showing longitudinal race differences in sleep problems, as mediated by perceived discrimination. Standardized coefficients are shown with 95% confidence interval (CI) in brackets. Direct effects of race before mediation are shown on underside of path. Race is coded as White = 0 and Black = 1. * $p < .05$. ** $p < .01$. *** $p < .001$.

(β) and standardized coefficients are reported in the text unless otherwise specified.

Results

Preliminary Analyses

Table 1 shows descriptive statistics for AAs and EAs for all key variables, and bivariate correlations are shown in Table 2. No significant differences in parent education were present between AAs and EAs. Parents' income was, however, greater among EAs than AAs ($M_{\text{difference}} = 5.48$, 95% CI [2.86, 8.11], $p < .001$), equivalent to approximately $27,000 more per year. Levels of racial discrimination ($M_{\text{difference}} = 0.80$, 95% CI [.60, 1.00], $p < .001$) were higher among AAs than EAs.

At T1, AAs had more sleep problems than EAs relating to duration ($p = .004$). Findings were in the same direction but were not significant for perceived overall sleep quality ($p = .30$) and latency ($p = .13$). Levels of sleep efficiency showed no differences across groups ($p = .65$). At the follow-up assessment, AAs showed greater sleep problems than EAs, as indexed by perceived quality ($p = .024$), duration ($p = .005$), and efficiency ($p = .025$). Findings were in the same direction but nonsignificant for efficiency ($p = .12$).

Changes in sleep problems during the 1.5-year period were investigated using structural equation models, with the four indicators of sleep problems creating latent factors at each wave. Results indicated that participants reported experiencing more sleep problems at T2 than at the baseline ($M_{\text{difference}} = .10$, $SE = .04$, $p = .013$), equivalent to .32 *SD* units.

Primary Analyses

To test the first hypothesis, an initial model (Model 1) was estimated to assess the main effect of race on sleep problems at T2, controlling for sex, age, and sleep problems at T1. As hypothesized, results indicated that AAs had larger increases in sleep problems over the 1.5-year period than did EAs ($B = .17$, $p = .033$, 95% CI [.01, .32]; $\beta = .22$). The magnitude of the estimated race difference was equivalent to a .56 *SD* greater increase in sleep problems among AAs than EAs (based on standard deviation units of sleep problems at T1).

An additional model (Model 2) was then estimated to test the mediating effect of perceived discrimination (Hypothesis 2). The full model (depicted in Figure 1 with standardized coefficients)

Table 1
Descriptive Statistics for African American (N = 54) and European American (N = 79) College Students

	African American		European American		Race difference[a]	
Variables	*M* (%)	*SD*	*M* (%)	*SD*	Cohen's *d*	*p*
Male (%)	(38.9)		(45.6)			.45
Age (years; T1)	18.8	.89	18.9	.91	.11	.43
Parents' education (T1)	4.76	1.33	4.93	1.20	.13	.44
Parents' income (T1)	14.39	7.78	19.87	6.93	.74	<.001
Perceived discrimination (T1)	2.01	.70	1.21	.23	1.54	<.001
Depressive symptoms (T1)	6.56	4.46	4.25	3.74	.56	.002
Self-rated health (T1)	3.57	.86	3.78	.78	.26	.144
Body mass index (T1)	25.03	4.88	23.40	2.80	.41	.030
Sleep quality (T1)	1.96	.58	2.06	.51	.18	.30
Sleep duration problems (T1)	.59	.76	.24	.51	.54	.004
Sleep latency (T1)	23.80	16.67	19.74	14.06	.26	.15
Sleep efficiency (T1)	.89	.08	.89	.09	.08	.65
Sleep quality (T2)	1.79	.63	2.05	.64	.41	.024
Sleep duration problems (T2)	.81	.92	.39	.63	.53	.005
Sleep latency (T2)	29.79	23.45	21.45	18.59	.39	.025
Sleep efficiency (T2)	.87	.11	.90	.10	.29	.12

[a] For continuous variables, Cohen's *d* statistic is reported to indicate the magnitude of the race difference. Independent samples *t* tests and chi-squared tests were used to determine the statistical significance of group differences.

Table 2
Bivariate Correlations Among Study Variables

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Race (Black = 1, White = 0)	—															
2. Gender (male = 1, female = 0)	−.07	—														
3. Age (T1)	.07	.23	—													
4. Parents' education (T1)	−.07	−.02	−.15	—												
5. Parents' income (T1)	−.35	−.03	−.15	.44	—											
6. Perceived discrimination (T1)	.66	−.15	.12	.04	−.14	—										
7. Depressive symptoms (T1)	.27	−.07	.10	−.24	−.33	.19	—									
8. Self-rated health (T1)	−.13	.25	.01	.20	.15	−.08	−.21	—								
9. Body mass index (T1)	.21	.01	−.03	−.12	−.17	.10	.06	−.15	—							
10. Sleep quality (T1)	−.09	−.09	−.07	.03	−.02	−.07	−.32	.15	−.02	—						
11. Sleep duration problems (T1)	.27	−.11	−.02	−.12	−.08	.20	.30	−.22	.26	−.37	—					
12. Sleep latency (T1)	.13	.06	.09	.05	−.05	.02	.33	−.01	−.08	−.34	−.02	—				
13. Sleep efficiency (T1)	−.04	.12	.02	.14	.08	.03	−.21	.08	.03	.25	−.28	−.30	—			
14. Sleep quality (T2)	−.20	.10	−.13	.14	.09	−.28	−.28	.10	−.01	.31	−.26	−.17	.16	—		
15. Sleep duration problems (T2)	.26	−.06	.08	.06	−.11	.38	.12	−.08	.08	−.17	.38	−.05	−.04	−.38	—	
16. Sleep latency (T2)	.20	.03	.06	−.01	−.11	.31	.20	−.14	−.11	−.14	.04	.36	.00	−.37	.30	—
17. Sleep efficiency (T2)	−.14	−.01	−.15	.08	.15	−.16	−.24	.08	−.01	.26	−.24	−.20	.14	.32	−.48	−.31

Note. Bivariate correlations greater than .17 are significant at $p < .05$.

showed good fit: $\chi^2/df = 1.13$; CFI = .97; RMSEA = .031; 90% CI [.000, .066]. As hypothesized, race was associated with perceived discrimination such that AAs reported higher levels than EAs ($B = .77$, $p < .001$, 95% CI [.60, .95]; $\beta = .66$). Furthermore, perceived discrimination was associated with changes in sleep problems ($B = .31$, $p = .011$, 95% CI [.07, .55]; $\beta = .46$) and accounted for race differences in sleep such that they became nonsignificant and close to zero after perceived discrimination was included in the model ($B = -.07$, $p = .47$, 95% CI [−.24, .11]; $\beta = -.08$). For each standard deviation unit increase in perceived discrimination, the associated increase in sleep problems was .59 *SD* units. The indirect effect of race on sleep problems through perceived discrimination was found to be significant: $B = .25$, $p = .021$, 95% CI [.09, .46]; $\beta = .31$.

Due to known associations with race and sleep (A. N. Beck, Finch, Lin, Hummer, & Masters, 2014; Magee, Caputi, & Iverson, 2011; Vorona et al., 2005), additional analyses were conducted to consider the findings when parent education, body mass index, self-rated physical health, and depressive symptoms were included as covariates. When all covariates were added as predictors of T2 sleep problems, the race effect remained similar and significant ($B = .18$, $p = .033$). Mediation findings also remained similar, with the effects of perceived discrimination on sleep being significant and of a similar magnitude ($B = .32$, $p = .010$) and the indirect effect of race on sleep problems via perceived discrimination remaining unchanged ($B = .25$, $p = .019$). In models that were further adjusted for family income, the race effect on changes in sleep problems in Model 1 was attenuated by 7% but remained marginally significant ($p = .098$). Analyses were also conducted to consider whether any of our model paths (i.e., direct or indirect effects) were moderated by background socioeconomic status (parents' income or education). However, no such moderation effects were found.

Additional Analyses

Sensitivity analyses were also conducted to consider whether the aforementioned findings would hold under three alternative formulations of the sleep problems measures: (a) using composite scores for sleep problems at T1 and T2 instead of latent variables, (b) using the PSQI global score at T2 controlling for the sleep problems composite at T1, and (c) for each of the four sleep measures considered separately. All models included age, gender, and baseline sleep measures as controls.

Composite scores. Nonlatent composite scores were calculated separately at T1 and T2 as the mean of the four standardized sleep measures (latency, duration, efficiency, and quality), with higher scores indicating greater sleep problems. Results of the models with composite scores showed that AAs had greater changes in sleep problems from T1 to T2 ($B = .29$, $p = .016$, 95% CI [.05, .52]; $\beta = .20$). Racial discrimination was also a significant predictor of changes in sleep ($B = .47$, $p < .001$, 95% CI [.22, .72]; $\beta = .38$) and accounted for the race difference ($B = -.07$, $p = .64$). Moreover, the indirect effect of race on sleep problems through perceived discrimination was significant: $B = .37$, $p = .017$, 95% CI [.10, .81]; $\beta = .25$. These findings are therefore consistent with those reported previously for the latent variable models.

PSQI global score. A sleep problems global score was calculated using established PSQI scoring procedures, which involves summing sleep problems across seven domains: latency, duration, efficiency, quality, sleep disturbances, use of sleep medication, and daytime dysfunction (Buysse et al., 1989). Models were then estimated with the global score as the outcome and the T1 composite score for sleep problems included as a control. Although a measure of sleep problems at T1 is included as a control, because there is not measurement equivalence across time periods, analyses for these models cannot be interpreted in relation to "change" in sleep problems. Results of these models showed the same pattern of findings as reported previously. Specifically, controlling for T1 sleep problems, AAs had higher PSQI global scores (i.e., more sleep problems) at T2 ($B = 1.18$, $p = .012$, 95% CI [.26, 2.10]; $\beta = .20$). Racial discrimination was also a significant predictor of PSQI at T2 ($B = 1.32$, $p = .012$, 95% CI [.29, 2.34]; $\beta = .26$) and accounted for the race difference ($B = 0.20$, $p = .74$). The indirect effect of race on sleep problems through perceived discrimination was as follows: $B = 1.02$, $p = .13$, 95% CI [−.21, 2.33]; $\beta = .35$.

Individual sleep problems measures. In models considering each of the sleep measures separately, the overall pattern of findings was comparable across the four measures, with some variability in the magnitude of effects. Full support for the mediation model was found for sleep duration. AAs had greater increases in duration problems over the 1.5-year period than EAs ($B = .30$, $p = .036$; $\beta = .19$). Discrimination was also associated with increases in duration problems ($B = .45$, $p = .013$; $\beta = .34$), and the race difference became nonsignificant when discrimination was accounted for ($B = -.04$, $p = .79$). A significant indirect effect of race on sleep problems via perceived discrimination was found ($B = 0.35$, $p = .017$, 95% CI [.06, .64]; $\beta = .23$). The findings were very similar, but some paths were marginally significant for latency and perceived overall quality. AAs had marginally greater increases in sleep latency ($B = 6.42$, $p = .095$; $\beta = .15$) and decreases in quality ($B = -.20$, $p = .061$; $\beta = -.15$). Discrimination was also associated with increases in latency ($B = 13.47$, $p = .036$; $\beta = .37$) and was marginally associated with decreases in perceived overall quality ($B = -.27$, $p = .092$; $\beta = -.24$). Additionally, the race difference was attenuated for both latency ($B = -3.71$, $p = .46$) and quality ($B = .01$, $p = .97$) when discrimination was accounted for. With respect to unstandardized estimates, indirect effects did not reach statistical significance (latency: $B = 10.40$, $p = .061$, 95% CI [.13, 1.47]; $\beta = .25$; quality: $B = 0.21$, $p = .13$, 95% CI [−.06, .50]; $\beta = .16$). However, the standardized estimate and CI did indicate a significant indirect effect of race on sleep latency ($p = .031$). Findings for sleep efficiency were in the same direction, but path estimates were not significant. In particular, changes in sleep efficiency were not significantly different across racial groups ($B = -.03$, $p = .16$; $\beta = -.12$), nor was the association between racial discrimination and changes in efficiency ($B = -.02$, $p = .29$; $\beta = -.13$).

Discussion

Racial disparities in health and wealth remain substantial in the United States (Williams, 2012). Illuminating mechanisms for the differential financial and health consequences of educational advancement across racial or ethnic groups may provide important insight into how such disparities endure and reveal potential barriers to upward mobility for marginalized groups (Fuller-Rowell, Curtis, Doan, & Coe, 2015; O'Hara, Gibbons, Weng, Gerrard, & Simons, 2012). For example, differential exposure to stressors during the college years may limit the extent to which individuals derive benefits from higher education. Herein, we examined changes in sleep problems among AA and EA college students attending a large, predominantly White university and the mediating role of perceived discrimination. Results indicated that AA students had greater increases in sleep problems than EAs over a 1.5-year period. Additionally, perceived racial discrimination predicted changes in sleep problems and accounted for race differences in sleep problems over time.

The findings extend previous cross-sectional research on racial disparities in sleep (Ruiter et al., 2011) and build on prior work indicating that AA students experience higher levels of racial discrimination than EA students across the college years (Nora & Cabrera, 1996; Priest et al., 2013). In particular, the findings show that perceived discrimination for AA students is impacting their sleep in ways that lead their sleep to diverge from that of their White majority peers. By documenting racial group differences in sleep over time, the findings suggest that experiences during the early years of college contribute to discrepancies in a fundamental bioregulatory system needed for good health and cognitive functioning—namely, sufficient and high-quality sleep. The finding that experiences of racial discrimination mediate this effect underscores the idea that the process of pursuing higher education—a prerequisite for future life advancement—may be uniquely stressful and health compromising for underrepresented minorities (Ancis et al., 2000; Smedley, Myers, & Harrell, 1993; Walton & Cohen, 2011).

The psychological and biological mechanisms linking discrimination to sleep remain to be elucidated (Slopen et al., 2015). However, extant research indicates that experiences of discrimination are associated with subsequent rumination, psychological distress, and substance use (Fuller-Rowell et al., 2012; Lewis, Cogburn, & Williams, 2015; Miranda, Polanco-Roman, Tsypes, & Valderrama, 2013). Such experiences, in turn, have physiologic consequences that, when repeated over time, can lead to dysregulation of biological systems, including those associated with sleep (Juster & McEwen, 2015; Merritt, Bennett, Williams, Edwards, & Sollers, 2006). One important direction for future research will therefore be to explicate mechanisms for the effects of discrimination on sleep, of which there are likely to be several (e.g., perceived stress, physiologic dysregulation). Studies considering whether changes over time in reported levels of discrimination account for changes in sleep problems will also be an important extension of extant research.

An additional contribution of this study is to extend cross-sectional research on perceived discrimination and sleep in AA and EA samples (Grandner et al., 2012; Lewis et al., 2013; Tomfohr et al., 2012). In particular, the findings indicate a prospective effect of perceived discrimination on sleep problems and suggest that perceived discrimination accounts for race differences in sleep over time. The findings also add to this work by showing that perceived discrimination is prospectively associated with sleep disruption. The finding that race-related experiences in college are linked to group differences in sleep over time suggests that additional or different university-level programming to address the root causes of group disparities may be needed.

In addition to considering overall sleep problems, each of the four sleep indicators (duration, latency, quality, and efficiency) was considered separately. The pattern of findings was comparable across the four measures, with some variability in the magnitude of effects. Full support for the mediation model was found for sleep duration, and the findings were very similar but slightly reduced in magnitude for latency and quality. Findings for sleep efficiency were in the same direction, but the magnitude of the race difference in efficiency was two thirds that of duration, and the magnitude of the association between discrimination and efficiency was one third that of duration. Assessment of multiple sleep parameters allows for explication of effects and facilitates comparison of findings with extant literature. Overall, the results appear to be largely consistent across the sleep parameters, and interpretation of the differences that were found in this study, in the context of this relatively young literature, would be overly speculative.

Some limitations should be noted. First, although subjective measures of sleep are useful, objective measures should also be considered in future work (Sadeh, 2011). Second, because this study focused on a sample of students at one large, predominantly White university in the Midwestern United States, the findings are not easily generalized to other contexts. Variability is likely to exist across colleges depending on the demographics of the student body and the degree to which the institution actively cultivates an inclusive climate and provides support to students from underrepresented groups. Examination of this contextual variability and its determinants is an important avenue for future research. Furthermore, AA students in other types of university environments, such as historically Black colleges, would offer a valuable comparison. Students in such contexts may be insulated from the race-related stresses that influence sleep at predominantly White universities and thus may experience lower levels of discrimination and associated increases in sleep problems across the college years. Alternatively, if being Black in America is the operative variable, then experiences of discrimination and declines in sleep duration and quality similar to those found in this study would be expected among students attending historically Black institutions.

Common rater effects are also a threat to validity and are thus a limitation in all studies that consider associations between self-report measures. However, this limitation is decreased when considering changes over time (minimizing the effect of trait-based reporting biases) and when the mediator and the outcome are assessed at different time points (avoiding 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 socioeconomic status, body mass index, self-rated health, and depression.

Overall, the findings suggest that studies identifying factors that reduce experiences of racial discrimination for African Americans—or mitigate its damaging consequences—are warranted. Reducing racial discrimination may improve not only the campus climate and sleep but also the enrollment, retention, and graduation rates of minority students (O'Hara et al., 2012; Wei, Ku, & Liao, 2011). Identifying specific programs on college campuses that can reduce racism and discrimination or improve the campus climate is therefore likely to be of paramount importance in the broader movement to eliminate racial inequities in health and wealth. Furthermore, considering the relative impact of various types of initiatives to improve the college experience for minority students will be essential for illuminating the most impactful and cost-effective mechanisms for the reduction of group disparities.

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