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The Impact of Daily Discrimination on Sleep/Wake Problem Trajectories Among Diverse Adolescents

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Abstract

This study examines how everyday discrimination is associated with 6-day trajectories of sleep/wake problems, operationalized as sleep disturbance and daytime dysfunction, among 350 diverse adolescents (M_{age} = 14.27, SD = 0.61, 69% female; 22% African American, 41% Asian American, 37% Latinx; 24% multiethnic/racial; across participating schools, 72% of students eligible for free/reduced price lunch) in the Northeastern United States. Adolescents encountering discrimination experienced changes in sleep/wake problem trajectories (i.e., significant increases in same-day sleep/wake problems), whereas adolescents reporting no discrimination experienced no changes in trajectories (Cohen's ds = .51–.55). Multiethnic/racial (compared to monoethnic/racial) adolescents experiencing everyday discrimination reported greater same-day sleep/wake problems, yet steeper decreases in sleep/wake problems suggesting stronger impact coupled with faster return to baseline levels.

Research documents the pernicious effects of discrimination on adolescent physical, psychological, behavioral, and academic domains (Hughes, Del Toro, Harding, Way, & Rarick, 2016; Pascoe & Richman, 2009; Schmitt, Branscombe, Postmes, & Garcia, 2014). Sleep is an important biobehavioral health indicator linked to a host of developmental outcomes, such as academic performance (Gillen-O'Neel, Huynh, & Fuligni, 2013), cognitive function (Buckhalt, El-Sheikh, & Keller, 2007), emotions, and behaviors (El-Sheikh, Kelly, Buckhalt, & Hinnant, 2010). Sleep is not immune to the negative effects of discrimination for adolescents, young adults, and middle-aged adults (Fuller-Rowell et al., 2021; Priest, Chong, et al., 2020; Slopen, Lewis, & Williams, 2016). However, existing research relies primarily on cross-sectional data (Huynh & Gillen-O'Neel, 2016; Majeno, Tsai, Huynh, McCreath, & Fuligni, 2018; Priest, Chong, et al., 2020; Slopen & Williams, 2014); how daily experiences of discrimination are associated with more immediate changes in sleep patterns is less clear. Building upon recent intensive longitudinal research focusing

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on discrimination and sleep (Fuller-Rowell et al., 2021; Goosby, Cheadle, Strong-Bak, Roth, & Nelson, 2018; Yip et al., 2020; Zeiders, 2017), this study examines how everyday discrimination is associated with trajectories of sleep/wake problems, operationalized as sleep disturbance (e.g., waking up at night) and daytime dysfunction (e.g., difficulty staying awake during the day), among ethnically/racially diverse adolescents.

Sleep has been primarily operationalized as duration, quality, and sleep/wake problems. Sleep is impacted by daily stress, and discrimination is a form and source of stress that disproportionately impacts ethnic/racial minorities (Clark, Anderson, Clark, & Williams, 1999). Discrimination is conceptualized as "means of expressing and institutionalizing social relationships of dominance and oppression" (Krieger, 1999, p. 301) via unfair treatment pertinent to social group membership, specifically ethnicity/race, gender, nationality, sexual orientation, and other socioeconomic factors (Williams, Lavizzo-Mourey, & Warren, 1994). Although much of the extant literature examining the detrimental effects of discrimination relies on adult samples (Schmitt et al., 2014), ethnic/racial minority adolescents are not immune to the negative impact of discrimination (Benner et al., 2018; Hughes et al., 2016). This study focuses on everyday discrimination broadly defined (i.e., differential treatment due to social group membership; see Slopen et al., 2016; Slopen & Williams, 2014) experienced by ethnically/racially diverse adolescents.

A biopsychosocial perspective (Clark et al., 1999) theorizes that racism, unfair treatment, and discrimination trigger biological and psychological stress responses, which in turn, contribute to health disparities among ethnic/racial groups. More recently, proposing a contextual model of race-based disparities in stress and sleep, Levy, Heissel, Richeson, and Adam (2016) further explicated the pernicious impact of discrimination on sleep outcomes, such as short sleep duration or poor sleep quality, as mediating pathways to health and educational disparities. Cross-sectional research suggests that discrimination is associated with shorter sleep duration and more sleep/wake disturbances among diverse adolescents and adults (Huynh & Gillen-O'Neel, 2016; Majeno et al., 2018; Priest, Chong, et al., 2020; Slopen & Williams, 2014). Longitudinal studies observe chronic negative effects of discrimination on both self-reported and objective (i.e., polysomnography) sleep outcomes (Fuller-Rowell et al., 2017; Lewis et al., 2013). More recently, intensive longitudinal methods (e.g., daily diaries) link discrimination with poorer same-day sleep quality (Fuller-Rowell et al., 2021; Goosby et al., 2018; Yip et al., 2020; Zeiders, 2017). This study focuses specifically on sleep/wake problems, which are consistently associated with school performance and health (El-Sheikh, Philbrook, Kelly, Hinnant, & Buckhalt, 2019).

Integrative developmental models (Garcia-Coll et al., 1996; Vélez-Agosto, Soto-Crespo, Vizcarrondo-Oppenheimer, Vega-Molina, & García-Coll, 2017) posit that sociocultural position attributes (e.g., gender, ethnicity/race, multiethnic/racial status) and the associated social mechanisms of racism and discrimination uniquely contribute to daily experiences and developmental competencies of ethnically/racially diverse adolescents. As such, the impact of everyday discrimination on sleep may differ across social groups, given the unique sociohistorical experiences of each ethnic/racial group. Despite gender and ethnic/racial differences in sleep duration and quality (Huynh & Gillen-O'Neel, 2016; Slopen & Williams, 2014; Yip et al., 2020), little research examines whether the effects of

everyday discrimination on sleep/wake problems differ by gender and ethnicity/race. Daily diary research suggests that female (compared to male) adolescents' sleep quality was less impacted by discrimination (Yip et al., 2020); however, some cross-sectional research has not observed gender differences between discrimination and sleep (Huynh & Gillen-O'Neel, 2016). Moreover, the effects of discrimination may differ by ethnic/racial groups. For example, research on ethnic/racial socialization observes that African American parents are more likely than Asian American and Latinx parents to engage in practices preparing their children for potential bias and coping with discrimination (Else-Quest & Morse, 2015). Meta-analysis studies also indicate a stronger negative association between discrimination and psychosocial well-being for Asian Americans and Latinx compared to African Americans (Benner et al., 2018; Schmitt et al., 2014). As such, it is possible that Asian American and Latinx (relative to African American) adolescents have stronger sleep/wake problem responses related to everyday discriminatory experiences.

Multiethnic/racial individuals are also underrepresented in discrimination and sleep research. Multiethnic/racial individuals share common developmental experiences that are distinct from those of their monoethnic/racial counterparts, given that they have to handle challenges of interacting with diverse individuals (e.g., parents and extended families from ethnically/racially and culturally diverse backgrounds) even from an early age (Nishina & Witkow, 2020), and that they need to navigate multiple ethnic/racial heritages and contend with ethnic/racial ambiguity (Shih & Sanchez, 2005). Multiethnic/racial adolescents likely encounter more discrimination, possibly associated with the additional marginalized group they identify (Johnston & Nadal, 2010). Multiethnic/racial youth may be more vulnerable to the detrimental impact of discrimination compared to their monoethnic/racial peers, an observation made among multiethnic/racial college students who reported stronger ethnicity/race-related stress responses (Albuja, Gaither, Sanchez, Straka, & Cipollina, 2019). As such, despite the heterogeneity among multiethnic/racial youth, it is important to investigate how discrimination experiences may be similar or different for the multiethnic/racial group (Dunham & Olson, 2016; Nishina & Witkow, 2020). Together, this study considers if the impact of everyday discrimination on sleep/wake problem trajectories differs by gender, ethnicity/race, and multi/monoracial youth.

Factors that are independently or jointly related to discrimination and sleep are also important to consider. Multiple (vs. single) discriminatory experiences are associated with poorer physical health (e.g., increased BMI, systolic blood pressure; see Priest, Truong, et al., 2020) and compromised sleep duration and quality (Lewis et al., 2013; Slopen & Williams, 2014). Sleep also differs systematically according to the day of the week; both survey and actigraphy-assessed sleep yield shorter duration on weekdays (vs. weekends) in college and community samples (Roepke & Duffy, 2010; Vitale et al., 2015). Moreover, adolescents likely experience different sources of discrimination on weekdays (e.g., school-based peers) versus weekends (e.g., neighborhood-based adults), and prior studies have observed distinct effects of peer and adult discrimination on adolescents' academic performance, socioemotional outcomes, and physical well-being (Benner & Graham, 2013; Hughes et al., 2016; Huynh & Fuligni, 2010). Weekday versus weekend differences are also considered in current analyses.

The Present Study

This study contributes to research on the concurrent and longer term impact of discrimination on sleep (Fuller-Rowell et al., 2017; Goosby et al., 2018; Majeno et al., 2018), by investigating these associations at the daily level using 14 daily diary reports. The study uses latent growth curve models (LGCMs; Grimm & Ram, 2012) to examine how everyday discrimination impacts sleep/wake problem trajectories among a sample of ethnically/racially diverse adolescents from relatively low socioeconomic backgrounds. First, we hypothesize that everyday discrimination interrupts sleep/wake problem trajectories by increasing same-day sleep disturbance and daytime dysfunction. Second, we hypothesize that Asian American and Latinx (relative to African American) and multiethnic/racial (relative to monoethnic/racial) adolescents have stronger responses to everyday discrimination (i.e., sharper increases in sleep disturbance and daytime dysfunction after discrimination), as suggested by prior research examining ethnic/racial group differences in discrimination (Albuja et al., 2019; Benner et al., 2018; Schmitt et al., 2014). Finally, given limited (and mixed) findings regarding differences in discrimination and sleep by gender, weekdays (vs. weekends), and multiple (vs. single) discriminatory incidents, the examination of the moderating effects of these variables is exploratory.

Method

Participants and Procedures

Adolescents participated in a longitudinal study examining daily stress and sleep. The sample was 350 ethnically/racially diverse adolescents (69% female, M_{age} = 14.27 years old, SD = 0.61, ages 13–17), including 76 African Americans, 145 Asian Americans (74% Chinese), and 129 Latinx (25% Dominican, 22% Mexican, and 24% South American) youth. Furthermore, 24% of the sample (n = 85, 68% female) identified with a primary and secondary ethnic/racial group (i.e., multiethnic/racial); primary groups included Latinx (49%), African American (31%), and Asian American (20%). Among multiethnic/racial adolescents identifying with Latinx as their primary race, secondary races included another Latinx ethnicity (43%), White (19%), and African American (14%). Among multiethnic/racial adolescents identifying primarily with African American, secondary races included Latinx (27%), African American (23%), Indian/Native American or Alaska Native (15%), and White (8%). Among multiethnic/racial adolescents identifying primarily with Asian American, secondary races included another Asian American ethnicity (70%), Latinx (17%), African American (6%), and White (6%).

Participants were recruited from five public high schools in a diverse urban area in New York State in the United States. Sampling occurred at the school level to ensure diversity. The average Simpson's (1949) Diversity Index = 0.47 (from 0.29 to 0.62, higher scores reflecting greater diversity) indicated that there was a 47% chance of randomly selecting two students from different ethnic/racial groups. Reflecting a socioeconomically segregated educational system, most participants were from relatively low socioeconomic backgrounds; across participating schools, 72% of students (ranging from 52% to 87%) were eligible for free/reduced price lunch. One third of respondents not knowing their parents' highest level of education (mothers = 30%, fathers = 40%), and one quarter reporting that their parents

completed high school (mothers = 24%, fathers = 23%). A large portion of the sample (76%) was born in the United States.

All African American, Asian American, and Latinx ninth graders at each participating school were invited to participate. Participants first completed an online demographic survey. Next, they completed daily diaries each night before going to bed for 14 consecutive days (average 10.60 diaries, SD = 3.44). Self-reported discrimination and sleep from the first wave of the 4-year longitudinal study collected across successive school years from 2014 to 2018 are analyzed here. All surveys in this study, including demographic and daily diary questionnaires, were conducted in English. Parental consent forms were available in English and other languages (i.e., Chinese and Spanish) and administered based on parents' preference. Methodological details are reported in other studies using the same data set (Yip et al., 2020).

Measures

Everyday Discrimination—An abbreviated five-item version of the Everyday Discrimination scale (Williams, Yu, Jackson, & Anderson, 1997) was adapted for daily use, for example, "Today, I was treated with less courtesy or respect than other people," 1 = *yes*, 0 = *no*). Daily scores were summed (0–5). An average of 40% of the participants attributed everyday discriminatory experiences to their ethnicity/race; the remainder (60%) made attributions to other sources. Given the low frequency of everyday discrimination (M = 0.13, SD = 0.07; see also Goosby et al., 2018; Zeiders, Updegraff, Kuo, Umaña-Taylor, & McHale, 2017), the variable was dichotomized (0 = no discrimination, 1 = discrimination, M = 0.09, SD = 0.05; see also Yip et al., 2021). Next, using the daily discrimination measure, adolescents were dichotomized into two non-overlapping groups based on whether they reported any discriminatory incidents over the course of the 14-day study: (a) *No Discrimination Group* (n = 196, 68% female; 20% African American, 47% Asian American, 33% Latinx; 20% multiethnic/racial), and (b) *Discrimination Group* (n = 154, 71% female; 24% African American, 34% Asian American, 42% Latinx; 30% multiethnic/racial). There was one demographic difference between the two groups: *Discrimination Group* had a higher proportion of multiethnic/racial adolescents than *No Discrimination Group*, $\chi^2(1)$ = 4.44, p = .04. In *Discrimination Group*, 45% of adolescents reported more than one discriminatory incident over 14 days (M = 2.26, SD = 1.97, range = 1–12), and 79% of discriminatory experiences occurred on weekdays (vs. weekends).

Daily Sleep/Wake Problems—The Pittsburgh Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) subscales were modified to assess daily sleep disturbance (eight items, "woke up in the middle of the night or early morning," "had to get up to use the bathroom," "could not breath comfortably," "coughed or snored loudly," "felt too cold," "felt too hot," "had bad dreams," and "had pain") and daytime dysfunction (two items, "had trouble staying awake" and "had problems keeping up enough enthusiasm (e.g., energy) to get things done"), ranging from 0 = *not at all* to 3 = *a lot*, with higher scores reflecting more disturbance or dysfunction. The intraclass correlation coefficients (ICC) observed considerable variation in daily sleep disturbance (ICC = .60) and daytime dysfunction (ICC = .40).

Demographics—Five variables were included in the analyses: (a) gender (0 = male, 1 = female); (b) ethnicity/race (African American, Asian American, and Latinx); (c) multiethnic/racial status (0 = monoethnic/racial, 1 = multiethnic/racial); (d) when adolescents reported discrimination (0 = weekends, 1 = weekdays); and (e) whether adolescents reported more than one discriminatory incident over 14 days (0 = no, 1 = yes).

Data Analytic Strategy

Analyses of the impact of everyday discrimination on sleep/wake problem trajectories were confirmatory given that they were driven by the biopsychosocial framework (Levy et al., 2016) and clear study hypotheses (i.e., everyday discrimination is associated with increases in same-day sleep disturbance and daytime dysfunction); analyses of the moderating effects of ethnicity/race were also confirmatory, whereas other moderation analyses (e.g., gender, weekdays/weekends) were exploratory. To isolate the effects of everyday discrimination on daily sleep/wake problems, data were restructured so that the first-day adolescents (in Discrimination Group) reported a discriminatory incident was coded as day T; the three prior days were coded as $T-3$, $T-2$, $T-1$, and the two subsequent days were coded as $T+1$, $T+2$. For adolescents in *No Discrimination Group* (i.e., youth who did not report any discriminatory incidents over the course of the 14-day study), to maximize the availability of analytic data we used Day 2 of the 14-day period as the starting point to map out the 6-day trajectories of sleep/wake problems. Sensitivity analyses included testing alternative models with other days as the starting point (e.g., Days 3, 4, 6, 10), and results indicated that sleep/wake problem trajectories of adolescents in *No Discrimination Group* do not differ from those presented in the following section. Therefore, to analyze and graphically depict the corresponding sleep/wake trajectories of *Discrimination* and *No Discrimination Groups*, the same time stamps (i.e., $T-3$, $T-2$, $T-1$, T, $T+1$, and $T+2$) were used for *No Discrimination Group* using Day 5 as T. Again, alternative models with T set to other days did not produce different results.

LGCMs (Grimm & Ram, 2012) were used to examine: (a) within-person change, and (b) between-person differences in the within-person change in sleep/wake problem trajectories. One advantage of the LGCM approach is that it allows for the examination of the immediate impact of, and recovery from discrimination, on sleep/wake problems and how everyday discrimination interrupts sleep/wake problem trajectories. In this study, within-person effects examine whether experiencing a discriminatory incident changes the sleep/wake problem trajectory for adolescents in Discrimination Group; meanwhile, between-person effects investigate whether sleep/wake problem trajectories differ for adolescents in *Discrimination Group* versus those in *No Discrimination Group*. Unconditional LGCMs modeled trajectories of sleep/wake problems before and after T comparing three types of change in sleep/wake problems: (a) no growth (i.e., no change); (b) linear change; and (c) latent basis (i.e., curvilinear change; see Curran, Obeidat, & Losardo, 2010). To examine the impact of everyday discrimination on sleep/wake problem trajectories, unconditional LGCMs were fit separately to compare trajectories for *No Discrimination* and *Discrimination Groups* before ($T-3$, $T-2$, $T-1$) and immediately after T (T, $T+1$, $T+2$).

First, the model fit for the unconditional sleep/wake problem (i.e., sleep disturbance and daytime dysfunction) LGCM was evaluated. Next, sleep/wake problem trajectories (i.e., no change, linear change, or curvilinear change) were evaluated by examining the statistical significance of the mean slopes (i.e., rate of change). The best fitting and most parsimonious unconditional models were selected for sleep disturbance and daytime dysfunction. We also used spaghetti plots with a randomly selected 20% subsample to visualize the growth trajectories of sleep/wake problems to support the selected model. Adolescent demographics (gender, ethnicity/race, and multiethnic/racial status) and two variables (i.e., whether discrimination occurred on a weekday versus weekend, and whether adolescents experienced multiple discriminatory incidents) were included to predict the random intercept and random slopes of sleep/wake problems. With this specification, we explored and tested the moderating effects between everyday discrimination and adolescent demographics on sleep/wake problem trajectories. Multivariate Wald tests examined differences across the three ethnic/racial groups (Asian Americans, the largest group, served as the reference group).

All LGCMs were fit with M*plus* 8.4 (Muthén & Muthén, 1998–2019). Due to the need to structure the data temporally, the data available for analyses were lower than the overall available data. For example, if discriminatory incidents occurred at the end of the 14-day period, data were treated as missing, resulting in a relatively high missing data rate (M = 22.52%, SD = 14.84%, maximum = 40.9%). Missing data analyses observed associations between demographics and missingness: Asian American (relative to African American and Latinx) adolescents had less missing sleep/wake problem data (rs = .13–.24, ps < .05); Latinx (relative to Asian and African American) and multiethnic/racial (relative to monoethnic/racial) adolescents had more missing sleep/wake problem data (rs = −.11 to −.20, ps < .05). Since missingness was associated with previously measured demographic covariates (e.g., ethnicity/race), we assumed the incomplete data were missing at random (MAR; Enders, 2010). This study handled missing data using full information maximum likelihood (FIML) estimation, given its advantage of yielding appropriate likelihood-based inference to MAR without excluding cases with missing values; the missingness rate of this study (M = 22.52%) is also acceptable for FIML (Enders, 2010; Mazza, Enders, & Ruehlman, 2015). Demographics associated with missingness (i.e., ethnicity/race and multiethnic/racial status) were included in all analyses.

Results

Descriptive Analyses

Extreme values (i.e., three or more SDs away from the mean; n = 22 and 13 for sleep disturbance and daytime dysfunction, respectively) were excluded. Sensitivity analyses including these outlying values were conducted and the results do not differ from those presented in the following section. Descriptive statistics and correlations among study variables are presented in Table S1. Girls reported higher levels of daytime dysfunction than boys. Multiethnic/racial adolescents were more likely than their monoethnic/racial peers to report daily discrimination, lower levels of daytime dysfunction at $T-3$, and higher levels of sleep disturbance at T. *Discrimination Group*, compared to *No Discrimination Group*,

reported greater sleep disturbance and daytime dysfunction after T. Sleep disturbance and daytime dysfunction were higher on weekdays (compared to weekends) after a discriminatory incident. Reporting more than one discriminatory incident was associated with higher levels of sleep disturbance and daytime dysfunction.

LGCM Results: Sleep Disturbance (Figure 1)

No Discrimination Group—$T - 3$ to $T - 1$. The linear model fit the data well (Table S2); however, the estimated average latent change (i.e., the slope) was not significant ($b = -.13$, $SE = 0.07$, $p = .07$; i.e., not significantly different from zero; Table S4), suggesting minimal changes in sleep disturbance over these 3 days. The mean level (i.e., intercept at $T - 3$) was 1.53 ($SE = 0.15$, $p = .00$). There were no significant differences by gender, ethnicity/race, multiethnic/racial status, or weekday/weekend ($ps > .05$; Table S5).

T to $T + 2$. The no growth model was the best fitting and most parsimonious model (Table S2), also suggesting no change in sleep disturbance over these 3 days. The mean level (i.e., intercept at T) was 1.30 ($SE = 0.14$, $p = .00$; Table S4). There were no significant differences by gender, ethnicity/race, multiethnic/racial status, or weekday/weekend ($ps > .05$; Table S5).

Taken together, *No Discrimination Group* did not experience changes in sleep disturbance (i.e., indicating a flat trajectory) in the 6-day period from $T - 3$ to $T + 2$.

Discrimination Group—$T - 3$ to $T - 1$. The linear model was the best fitting and most parsimonious model (Table S2), suggesting a significant linear change in sleep disturbance. The mean level (i.e., intercept at $T - 3$) was 2.57 ($SE = 0.43$, $p = .00$; Table S4). The estimated average latent change (i.e., slope) was $-.50$ ($SE = 0.20$, 95% CI [-0.89, -0.11], $p = .01$), indicating that sleep disturbance decreased an average of .50 points per day in the days before a discriminatory incident (T). The conditional LGCM with demographic variables (Table S5) indicated that the average latent change was not significant ($b = -.81$, $SE = 0.51$, $p = .11$), suggesting no changes in sleep disturbance from $T - 3$ to $T - 1$. There were no significant differences by gender, ethnicity/race, multiethnic/racial status, or weekday/weekend ($ps > .05$; Table S5).

T to $T + 2$. The latent basis model fit the data well (Table S2), suggesting a significant curvilinear change in sleep disturbance. Following Curran et al.'s (2010) approach to fit a latent basis model, we set the coefficients for T, $T + 1$, $T + 2$ as 0, freely estimated, and 1, respectively, such that the latent slope factor is interpreted as the latent change of sleep disturbance from T to $T + 2$. The mean level (i.e., intercept at T) was 2.92 ($SE = 0.30$, $p = .00$; Table S4). The estimated average latent change (i.e., slope) was 1.26 ($SE = 0.25$, 95% CI [1.75, -0.76], $p = .00$), indicating that sleep disturbance decreased an average of 1.26 points from T to $T + 2$. The estimated factor loading for $T + 1$ was .80 ($SE = 0.12$, $p = .00$), suggesting that 80% of the decrease in sleep disturbance occurred between T and $T + 1$ (i.e., the day after a discriminatory incident). The estimated covariance between the intercept and the slope was -3.93 ($SE = 1.06$, $p = .00$), indicating that adolescents who reported higher levels of same-day sleep disturbance at T experienced greater declines (i.e., faster return to baseline levels) from T to $T + 2$. Results of the conditional LGCM (Table S5) indicated

significant group differences: (a) females (compared to males) reported higher levels of sleep disturbance after a discriminatory incident (mean difference = 2.05, SE = 0.60, p = .00), and (b) multiethnic/racial (compared to monoethnic/racial) adolescents reported higher levels of sleep disturbance at T (mean difference = 1.46, SE = 0.62, p = .02) and faster declines from T to T + 2 (mean difference = −1.25, SE = 0.57, p = .03). There were no significant differences by ethnicity/race, weekday/weekend, or multiple discriminatory incidents (ps > .05; Table S5).

Taken together, discriminatory incident interrupted sleep disturbance trajectories by increasing same-day sleep disturbance at T (Cohen's d = .96, 95% CI [0.59, 1.33]; Figure 1), but 80% of this elevation dissipates by the next day (Cohen's d = −.33, 95% CI [−0.57, −0.09]). The effect size was estimated by comparing T for *No Discrimination* (M = 1.35, SD = 2.21) and *Discrimination* groups (M = 2.92, SD = 3.42) and the magnitude was moderate (Cohen's d = .55, 95% CI [0.32, 0.79]).

LGCM Results: Daytime Dysfunction (Figure 2)

No Discrimination Group—T − 3 to T − 1. Similar to sleep disturbance, the linear model fit the data well (Table S3); however, the estimated average latent change (i.e., slope) was not significant (b = −.09, SE = 0.06, p = .12; Table S4), suggesting no changes in daytime dysfunction over these 3 days. The mean level (i.e., intercept at T − 3) was .93 (SE = 0.09, p = .00). There were no significant differences by gender, ethnicity/race, multiethnic/racial status, or weekday/weekend (ps > .05; Table S6).

T to T + 2. The no growth model was the best fitting and most parsimonious model (Table S3), suggesting no change in daytime dysfunction over these 3 days. The mean level (i.e., intercept at T) was .89 (SE = 0.08, p = .00; Table S4). The conditional LGCM (Table S6) indicated significant differences by gender: Females (compared to males) reported higher levels of daytime dysfunction at T (mean difference = .38, SE = 0.16, p = .02). The multivariate Wald test indicated significant ethnic/racial differences: Asian Americans (compared to African Americans) experienced greater daytime dysfunction at T (mean difference = .47, SE = 0.19, p = .02). There were no significant differences by multiethnic/racial status, weekday/weekend, or multiple discriminatory incidents (ps > .05; Table S6).

Taken together, *No Discrimination Group* did not experience changes in daytime dysfunction (i.e., indicating a flat trajectory) in the 6-day period from T − 3 to T + 2; however, there were mean-level differences such that females and Asian Americans reported higher levels of daytime dysfunction.

Discrimination Group—T − 3 to T − 1. The no growth model was the best fitting and most parsimonious model (Table S3), suggesting no change in daytime dysfunction over these 3 days. The mean level (i.e., intercept at T − 3) was .98 (SE = 0.11, p = .00; Table S4). There were no significant differences by gender, ethnicity/race, multiethnic/racial status, or weekday/weekend (ps > .05; Table S6).

T to T + 2. The linear model fit the data well (Table S3), suggesting a significant linear change in daytime dysfunction. The mean level (i.e., intercept at T) was 1.46 (SE = 0.12,

p = .00; Table S4). The estimated average latent change (i.e., slope) was −.28 (SE = 0.07, 95% CI [−0.41, −0.14], p = .00), indicating that daytime dysfunction decreased an average of .28 units per day after a discriminatory incident. The conditional LGCM (Table S6) indicated significant weekday/weekend effects (Figure 3): Adolescents who encountered a discriminatory incident on a weekday (i.e., T = weekday) reported higher levels of daytime dysfunction at T (mean difference = .94, SE = 0.26, p = .00) and significant decreases from T to T + 2 (mean difference = −.59, SE = 0.17, p = .00), whereas adolescents experiencing a discriminatory incident on a weekend (i.e., T = weekend) reported lower levels of daytime dysfunction at T (b = .21, SE = 0.30, p = .49) and increases from T to T + 2 (b = .39, SE = 0.19, p = .04). Multiethnic/racial (compared to monoethnic/racial) adolescents experienced steeper declines in daytime dysfunction from T to T + 2 (mean difference = −.36, SE = 0.14, p = .01). Adolescents experiencing multiple (vs. one) discriminatory incident(s) reported greater daytime dysfunction at T (mean difference = .67, SE = 0.22, p = .00). There were no significant differences by gender and ethnicity/race (ps > .05; Table S6).

Taken together, discriminatory incident interrupted daytime dysfunction trajectories by increasing same-day daytime dysfunction at T (Cohen's d = .40, 95% CI [0.05, 0.75]; Figure 2), but 50% this elevation dissipates by the next day (Cohen's d = −.22, 95% CI [−0.45, 0.02]). Discriminatory incidents on weekdays and multiple discriminatory incidents had stronger effects on daytime dysfunction. Multiethnic/racial (compared to monoethnic/racial) adolescents returned to baseline levels of dysfunction at a faster rate. The effect size was estimated by comparing T for *No Discrimination* (M = 0.82, SD = 1.16) and Discrimination groups (M = 1.47, SD = 1.39) and the magnitude was moderate (Cohen's d = .51, 95% CI [0.28, 0.74]).

To provide additional support for the impact of discrimination on sleep/wake problems, supplemental analyses were conducted for daytime sleepiness (Stanford Sleepiness Scale, 2017), which is another key sleep/wake parameter associated with multiple developmental outcomes in youth (Shimizu, Gillis, Buckhalt, & El-Sheikh, 2020). Daytime sleepiness was highly correlated with sleep disturbance (rs = .13–.41, ps < .05) and daytime dysfunction (rs = .51–.66, ps < .01). LGCM results indicated similar findings (see Supplementary Analyses Tables S7–S10; Figures S1 and S2).

Discussion

This study examined how everyday discrimination interrupts trajectories of sleep/wake problems among ethnically/racially diverse youth. Approximately 44% of the adolescents in this study reported at least one discriminatory incident over the course of the two weeks. In line with a recent systematic review (Slopen et al., 2016), this study contributes to a burgeoning empirical literature on the association between discrimination and sleep (e.g., Fuller-Rowell et al., 2017; Majeno et al., 2018; Yip et al., 2020). Using daily diary methods and sleep data, the study contributes uniquely to the existing research by illustrating how everyday discrimination disrupts sleep disturbance and daytime functioning trajectories. Our findings observe that adolescents reporting discriminatory incidents (i.e., *Discrimination Group*) experienced changes in sleep/wake problem trajectories (i.e., increases in same-day sleep/wake problems when encountering discriminatory incidents and return to the

baseline two days later). Of note, adolescents reporting no discriminatory incidents (i.e., *No Discrimination Group*) experienced no changes in sleep/wake problems (i.e., flat trajectories) during the 6-day period. To our knowledge, this study is the first to query the daily impact of everyday discrimination on sleep disturbance and daytime dysfunction trajectories in a sample of diverse adolescents. By contrasting sleep/wake problem trajectories before and after discriminatory incidents, this study contributes uniquely to the literature by illustrating the immediate impact of, and recovery from, discrimination for minority adolescents' sleep patterns.

Our findings also observe ethnic/racial differences in the association between everyday discrimination and sleep/wake problem trajectories. In particular, Asian American (compared to African American) adolescents in *No Discrimination Group* experienced greater levels of daytime dysfunction, consistent with prior observation on Asian American adolescents having a higher risk of more sleep problems than other ethnic/racial groups (Carnethon et al., 2016; Yip et al., 2020). However, it should also be noted that this ethnic/racial difference dissipated among adolescents in *Discrimination Group* and both Asian American and African American youth reported comparably high levels of daytime dysfunction after a discriminatory incident, suggesting that the mean differences in daytime dysfunction may be partly driven by discrimination experiences. Prior research examining sleep disparities focuses primarily on comparisons between European White and ethnic/racial minority groups (e.g., Black vs. White; see also Fuller-Rowell et al., 2017; Johnson, Jackson, Williams, & Alcantara, 2019); results observe that discrimination mediates ethnic/racial disparities in sleep among Black and White college students (Fuller-Rowell et al., 2017), and that after controlling for discrimination, ethnic/racial differences in sleep duration were attenuated by 65% for Black-White comparisons and 25% for Latinx-White comparisons (Slopen & Williams, 2014). This study extends the extant literature by linking group differences in sleep/wake problems to discriminatory incidents among ethnically/racially diverse adolescents. Future work is needed to elucidate the specific mechanism linking discrimination and sleep disparities among ethnic/racial minority groups.

Moreover, multiethnic/racial (compared to monoethnic/racial) adolescents who experienced everyday discrimination reported greater same-day sleep disturbance and steeper decreases (i.e., stronger impact coupled with faster return to baseline) in sleep disturbance and daytime dysfunction. Multiethnic/racial adolescents in the study identified their primary ethnic/racial group as Latinx (49%), African American (31%), and Asian American (20%). The primary ethnic/racial group represents the ethnic/racial membership with which they were affiliated the most and shared more similarities (see Shih & Sanchez, 2005), usually driven by their family socialization practices (e.g., languages and cultural heritage their family embraced). According to intersectionality perspectives (Collins, 1991; Crenshaw, 1991), by identifying with more than one ethnic/racial group, multiethnic/racial adolescents (in this study, 87% were minority/minority, e.g., Black/Latinx) encounter the unique challenges of intersectionality, which is considered to be an even more marginalized space compared to the oppression faced by monoracial ethnic/racial minority individuals (Bowleg, 2008; Nishina & Witkow, 2020). This added marginality may explain why multiethnic/racial adolescents in this study were more likely to report discriminatory incidents compared to their monoethnic/racial peers. Our findings also observe greater same-day sleep

disturbance among multiethnic/racial adolescents after discriminatory experiences, aligning with research that multiethnic/racial individuals have stronger responses to discrimination-related stressors (Albuja et al., 2019).

However, it should be noted that multiethnic/racial adolescents also reported faster recovery from the negative impact of everyday discrimination on sleep/wake problems (i.e., faster return to baseline levels), an observation possibly explained by *social identity complexity* (Roccas & Brewer, 2002). Having multiple in-group memberships may afford the opportunity to navigate multiple ethnic/racial spaces and interact with diverse individuals, which is associated with positive intergroup attitudes (Brewer & Pierce, 2005; Schmid, Hewstone, Tausch, Cairns, & Hughes, 2009) and more acceptance of ethnic out-groups (Knifsend & Juvonen, 2014). This, in turn, may buffer against the detrimental effects of everyday discrimination on sleep/wake problems. Since school diversity and cross-ethnic peer availability promote high social identity complexity and positive out-group attitudes (Knifsend & Juvonen, 2014), future studies should examine if these contexts moderate the association between discrimination and sleep. Sharper declines in sleep disturbance and daytime dysfunction may also be due to ceiling effects associated with high initial levels (i.e., stronger rebound effects).

Furthermore, although 79% of discriminatory incidents occurred on weekdays, adolescents reported greater daytime dysfunction when they encountered discrimination on weekdays. This study did not measure forms and types of discrimination (e.g., in and out-of-school, in-person vs. online); however, since the data were collected during the academic year, it is likely that adolescents experienced discrimination in school (e.g., from peers and teachers) on weekdays, and other types of discrimination (e.g., from strangers, neighbors; see also Benner & Graham, 2013) on weekends. Prior research examining the impact of sources of discrimination has focused primarily on adolescents' physical, academic, and psychosocial outcomes (Benner & Graham, 2013; Gale & Dorsey, 2020; Hughes et al., 2016; Huynh & Fuligni, 2010). A cross-sectional study observed that discrimination in and out of school was associated with poorer sleep quality and more sleep problems among a population-representative sample of Australian youth (Priest, Chong, et al., 2020). Recognizing that there is a robust difference in sleep on weekdays as compared to weekends (Roepke & Duffy, 2010; Vitale et al., 2015), this study also considered whether the impact of everyday discrimination on sleep/wake problems would differ by the day of the week. It is possible that adolescents had stronger, immediate responses to discriminatory incidents on weekdays coupled with stronger recovery (i.e., decrease in subsequent daytime dysfunction), because school is also a socializing forum in which adolescents obtain social support (Byrd & Ahn, 2020). On the other hand, adolescents may be less susceptible to discrimination on weekends yet experienced a lagged impact of discrimination (i.e., increase in subsequent daytime dysfunction). Adolescents were also likely to have more sleep on weekends (Vitale et al., 2015), which may buffer the detrimental effects of discrimination on sleep quality (Wang & Yip, 2020). Future work should examine the differential impact of in- and out-of-school, and in-person versus online (Tynes et al., 2014) discrimination on sleep/wake problems and adolescent health.

Finally, although not a primary focus of this study, our findings observed that nearly 44% of the sample reported at least one discriminatory incident over the course of the 14-day period, a proportion in the mid-range of other studies of daily discrimination among adolescents. For example, our rate is lower than monoracial samples of African American adolescents (97%; Seaton & Douglass, 2014) and Mexican-origin adolescents (59%; Zeiders, 2017). In fact, African American adolescents living in the northeast United States reported an average of five discriminatory incidents (including offline, online, and vicariously) per day (English et al., 2020). However, our rate is higher than a comparable sample of Asian American and Latinx adolescents in Los Angeles in which 12% of the sample reported daily discrimination (Huynh & Fuligni, 2010). It would be informative for future studies to examine the prevalence of multiple forms and types of discrimination across diverse adolescents.

Limitations, Implications, and Conclusions

Although this study advances research on discrimination and sleep among diverse adolescents, it is not without limitations. The study focused on self-reported sleep/wake problems. Objective sleep measures can reflect complex sleep behaviors such as sleep onset latency (Goosby et al., 2018; Yip et al., 2020) and future work should examine how daily discrimination impacts objective sleep indices such as sleep duration and wake minutes after sleep onset. The predominantly female and U.S.-born sample recruited from a diverse urban area limits generalizability. Unfortunately, the small sample sizes for each multiethnic/racial subgroup (African American = 26, Asian = 17, and Latinx = 42) preclude further group comparisons. Future work examining differences across nontraditionally discrete categories (e.g., multiethnic/racial subgroups, intersex, or transgender individuals; see Dunham & Olson, 2016) would be informative.

Despite these limitations, this study points to important practical implications for intervention programs. These data suggest that discriminatory incidents serve as an acute stressor interrupting trajectories of sleep/wake problems among diverse adolescents. One avenue for intervention is to change school-based social norms (e.g., via the use of media to promote positive intergroup attitudes or social network-based corrective intervention) to reduce discrimination (Paluck, Shepherd, & Aronow, 2016). Others have found success in improving socioemotional and health outcomes by targeting sleep interventions. Longer and better sleep could facilitate positive coping (e.g., greater problem-solving coping and less rumination) with discrimination, which, in turn, promotes subsequent well-being (Wang & Yip, 2020). These findings inform that sleep may be a mechanism in helping marginalized youth navigate discrimination-related stressors.

To conclude, this study contributes uniquely to the literature on discrimination and sleep by elucidating how everyday discrimination disrupts trajectories of sleep/wake problems in a sample of diverse adolescents. The inclusion of multiethnic/racial youth addresses the empirical need for further inquiry into the distinct effects of discrimination on sleep disparities across ethnically/racially diverse subgroups (Slopen et al., 2016). This study also contributes to developmental research more broadly by focusing on adolescents' sleep-related problems, a physical health indicator that is not well documented in developmental

research on discrimination (Benner et al., 2018). By querying how discrimination impacts daily sleep/wake problem trajectories, this study maps the impact of stress on adolescents' biobehavioral development. Investigating these associations for more protracted periods of time may prove fruitful for investigating how discrimination is related to longer term development and social bases of health and academic disparities.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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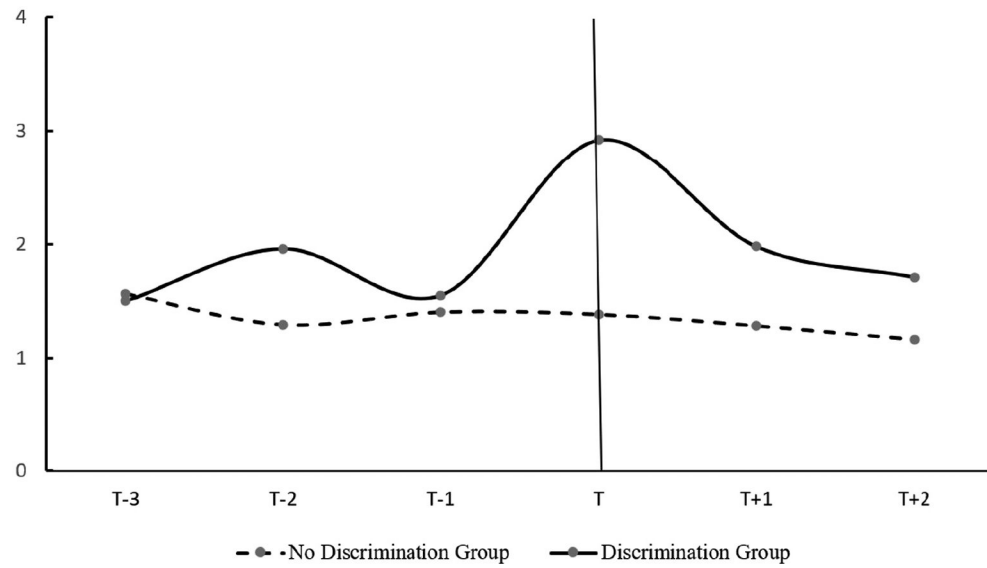
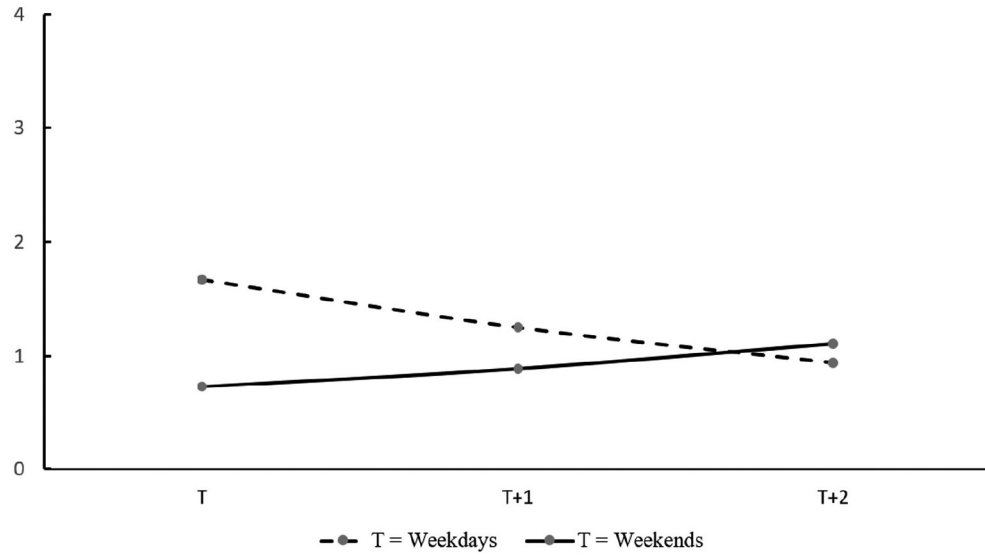**Figure 1.**

Trajectories of Sleep Disturbance (Raw Scores).

Note. For *Discrimination Group, T* represents the day adolescents reported a discriminatory incident; for *No Discrimination Group*, the same time stamps are used to have parallel comparison with *Discrimination Group.*
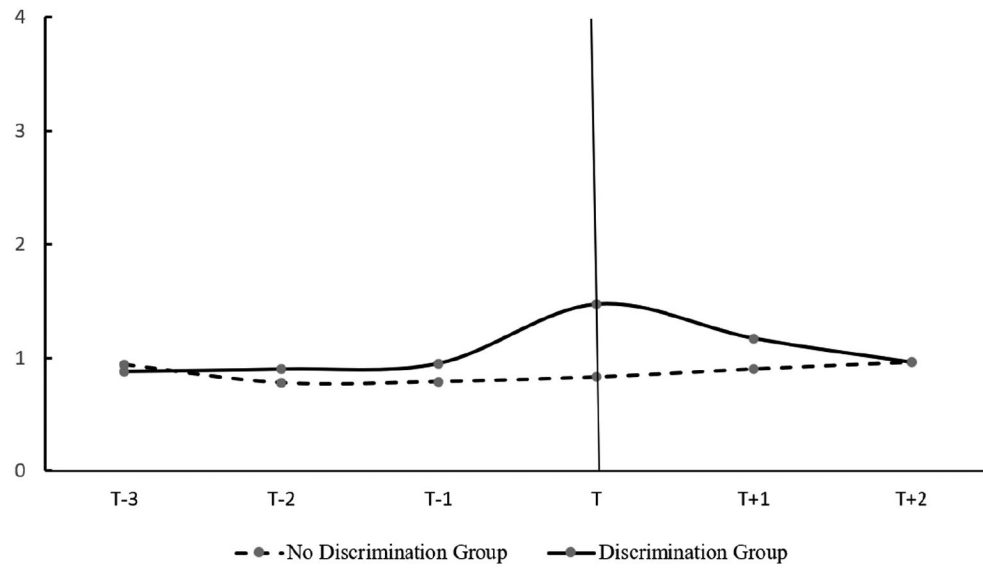
Figure 2.

Trajectories of Daytime Dysfunction (Raw Scores).

Note. For *Discrimination Group, T* represents the day adolescents reported a discriminatory incident; for *No Discrimination Group*, the same time stamps are used to have parallel comparison with *Discrimination Group*.

Figure 3.
Trajectories of Daytime Dysfunction (Discrimination Group), T to $T + 2$ (Raw Scores).