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Chronic Exposure to Everyday Discrimination and Sleep in a Multi-Ethnic Sample of Middle-Aged Women

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Abstract

Objectives—Researchers have suggested that poor sleep may play a role in the association between discrimination and health, but studies linking experiences of discrimination to sleep are limited. The authors examined associations between reports of everyday discrimination over four years (chronic everyday discrimination) and subjective and objective indicators of poor sleep.

Methods—Participants were 368 African-American, Caucasian, and Chinese women from the Study of Women's Health Across the Nation (SWAN) Sleep Study. Everyday discrimination was assessed each year from baseline through the third follow-up exam via questionnaire with the Everyday Discrimination Scale (Intraclass Correlation Coefficient over four years=.90). Subjective sleep complaints were measured beginning in year 5 with the Pittsburgh Sleep Quality Index. Objective indices of sleep continuity, duration, and architecture were assessed via in-home polysomnography (PSG), beginning in year 5.

Results—In linear regression analyses adjusted for age, race/ethnicity and financial strain, chronic everyday discrimination was associated with more subjective sleep complaints (Estimate =1.52, $p<.001$) and PSG-assessed wakefulness after sleep onset (Estimate=.19, $p<.02$), a marker of sleep continuity. Findings did not differ by race/ethnicity and remained significant after adjusting for menopausal status, body mass index, medication use and depressive symptoms.

Conclusions—Experiences of chronic everyday discrimination are independently associated with both subjective and objective indices of poor sleep. Findings add to the growing literature linking discrimination to key markers of biobehavioral health.

Keywords

Discrimination; depression; polysomnography; sleep; stress; psychological; African-Americans; Chinese

Introduction

Over the past few decades, there has been an increasing focus on examining the association between psychosocial stressors in the form of discrimination and physical health outcomes (Pascoe & Richman, 2009; Williams & Mohammed, 2009). Early work in this area focused primarily on major experiences – overt, relatively infrequent occurrences of discrimination – while more recent work has focused on subtler, “everyday” phenomenon. “Everyday” experiences of discrimination are conceptualized as relatively minor, or even trivial, day-to-day slights and insults (Essed, 1990, 2002; Williams, Yu, Jackson, & Anderson, 1997). Unlike major instances of discrimination (e.g. being fired from a job or denied a bank loan), everyday experiences are considered to be ongoing, fairly routine, and more common in daily life (Essed, 2002; Williams & Mohammed, 2009).

Across studies, everyday experiences of discrimination have been linked to a variety of different physiological indicators of poor health including dysregulated blood pressure (Beatty & Matthews, 2009; Smart Richman, Pek, Pascoe, & Bauer, 2010; Tomfohr, Cooper, Mills, Nelesen, & Dimsdale, 2010), inflammation (Friedman, Williams, Singer, & Ryff, 2009; Lewis, Aiello, Leurgans, Kelly, & Barnes, 2010), atherosclerosis (Lewis, et al., 2006; Troxel, Matthews, Bromberger, & Sutton-Tyrrell, 2003) and excess adiposity (Hunte & Williams, 2009; Hunte, 2011; Lewis, Kravitz, Janssen, & Powell, 2011). Associations have also been found between everyday experiences of discrimination and overall mortality (Barnes, et al., 2008). Initial findings linking everyday experiences of discrimination to indices of disease were observed primarily among African-Americans (Guyll, Matthews, & Bromberger, 2001; Lewis, et al., 2006; Troxel, et al., 2003), but recent studies have found associations among other racial/ethnic minority groups and Caucasians as well (Friedman, et al., 2009; Gee, Spencer, Chen, & Takeuchi, 2007; Hunte & Williams, 2009). This is noteworthy because although initially thought of as a stressor unique to African-Americans (and perhaps the experience of racism) (Essed, 1990; Feagin & Sikes, 1995; Lewis, et al., 2006), recent studies suggest that the experience of everyday discrimination may be relatively common, not solely limited to racism, and extend to individuals of other races/ethnicities --including Caucasians (Shariff-Marco, et al., 2011). Given the growing body of research in this area (Pascoe & Richman, 2009; Williams & Mohammed, 2009), studies have also begun to explore potential pathways through which these experiences might ultimately lead to negative health outcomes (Friedman, et al., 2009; Hunte & Williams, 2009; Lewis, et al., 2010; Lewis, et al., 2011) across racial/ethnic groups.

Several researchers have suggested that sleep may play a role in the association between experiences of discrimination and health (Beatty & Matthews, 2009; Tomfohr, et al., 2010). Sleep disturbance has emerged as a significant risk factor for poor health, associated with both early markers of disease (King, et al., 2008; Knutson, et al., 2009; Patel, et al., 2009) and incident events (mostly cardiovascular) (Ayas, et al., 2003; Ikehara, et al., 2009), particularly among women (Cappuccio, et al., 2007; Ikehara, et al., 2009; Meisinger, Heier, Lowel, Schneider, & Doring, 2007). Poor sleep has also been linked to psychosocial processes, including negative life events (Cartwright & Wood, 1991; Mezick, et al., 2009), depressive symptoms (Hall, et al., 2000; Tsuno, Besset, & Ritchie, 2005) and financial strain (Hall, et al., 2008; Hall, et al., 2009), and is significantly more common among African-Americans, compared with Caucasians (Hale & Do, 2007; Hall, et al., 2009; Lauderdale, et al., 2006). Although it is plausible to assume that experiences of discrimination might also negatively impact sleep, few studies have examined this association (Steffen & Bowden, 2006; Thomas, Bardwell, Ancoli-Israel, & Dimsdale, 2006).

The current analyses were designed to examine the association between self-reported experiences of everyday discrimination and indices of sleep (both subjective and objective)

in a sub-sample of African-American, Caucasian and Chinese women from the Study of Women's Health Across the Nation (SWAN), an ongoing cohort study of middle-aged women (Sowers, et al., 2000). We were particularly interested in examining the role of persistent, or *chronic*, exposure to everyday discrimination and sleep, because research suggests that chronic stressors are more strongly linked to health outcomes than acute stressors (Cohen, et al., 1998). However, despite the potential importance of chronic stressors for sleep outcomes, to our knowledge no study has examined the association between chronic exposure to discrimination and sleep.

We hypothesized that self-reported experiences of chronic everyday discrimination (assessed over the course of four years) would be associated with poorer sleep. The emphasis on assessments over time was a key component of our approach, because while the everyday discrimination measure is conceptualized as a measure of chronic, or ongoing, exposure (Williams & Mohammed, 2009), few studies have been able to fully capture this phenomenon methodologically. For outcomes, we focused specifically on measures of subjective sleep complaints and "gold standard", polysomnography (PSG)-assessed indices of sleep continuity, as these measures have been most reliably associated with psychosocial stressors (Cartwright & Wood, 1991; Hall, et al., 2008; Hall, et al., 2009; Kim & Dimsdale, 2007; Mills, et al., 2009). In secondary analyses, we also examined associations between everyday discrimination and sleep outcomes less commonly linked to psychosocial stress, including sleep duration and sleep architecture (percentage of Stage 3–4 and rapid eye movement (REM) sleep). Further, although our primary aim was to examine associations between everyday discrimination and sleep *across* race/ethnicity, we also examined whether associations between everyday discrimination and sleep differed for women from different racial/ethnic backgrounds as some (but not all studies) have found stronger associations between experiences of everyday discrimination and health for African-Americans compared to Caucasians (Beatty & Matthews, 2009; Lewis, et al., 2009; Troxel, et al., 2003), while there is very little known about whether associations differ for Asian-American populations compared to other racial/ethnic groups.

Finally, we were interested in understanding whether any observed associations between everyday discrimination and indices of sleep would be partially, or fully, explained by depressive symptoms. It has been hypothesized that exposure to day-to-day experiences of discrimination and mistreatment could potentially lead to feelings of disempowerment, marginalization and hopelessness (Essed, 1990). These feelings, in turn, could lead to an increase in depressive symptoms. Numerous studies have documented associations between everyday discrimination and depressive symptoms (Barnes, et al., 2004; Schulz, et al., 2006), and depressive symptoms have been linked to sleep (particularly subjective sleep) in prior research (Taylor, Lichstein, Durrence, Reidel, & Bush, 2005; Tsuno, et al., 2005). Thus, in addition to examining the main effect of everyday discrimination on subjective and objective sleep outcomes we also examined the role of depressive symptoms as a potential mediator of any significant associations.

Methods

Participants

Participants were from the SWAN Sleep Study, a cross-sectional study of sleep in a subset of women from the SWAN cohort. Details of the overall SWAN study and the SWAN Sleep Study design have been published previously (Hall, et al., 2009; Sowers, et al., 2000). Briefly, SWAN is a seven-site, community-based, longitudinal study of the menopausal transition that began in 1996. The SWAN Sleep Study was conducted between 2003–2005 (SWAN visits 5–7) at four of the seven sites: Chicago, IL, Pittsburgh, PA, Detroit, MI and Oakland, CA.

Because one of the aims of the SWAN Sleep Study was to examine the effects of natural menopause on sleep, women were ineligible for the SWAN sleep study if they had undergone surgical menopause. Other exclusion criteria included factors known to affect sleep such as: undergoing chemotherapy/radiation, use of oral corticosteroids, regular night shift-work, or consumption of >4 alcoholic drinks per day. Women were also ineligible if they had missed more than 50% of annual SWAN visits and/or refused the annual visit blood draw. Seventy-percent of eligible women agreed to participate, resulting in a final sample of 368.

Procedures

Beginning with the baseline SWAN examination in 1996 and annually thereafter, women underwent a standard protocol that included interviewer- and self-administered questionnaires and clinical tests. Participants in the SWAN Sleep Study also completed the SWAN Sleep Study protocol (Hall, et al., 2009), which was conducted across one menstrual cycle or 35 days, whichever was shorter. The current analyses used sleep data from the SWAN Sleep Study questionnaires (subjective sleep complaints) and the unattended, in-home PSG sleep studies, which were conducted on the first three nights of the protocol.

The Institutional Review Board at each site approved the study protocol and all participants provided written, informed consent.

Measures

Chronic Everyday Discrimination—Everyday Discrimination was assessed with a modified version of the Everyday Discrimination Scale (Williams, et al., 1997). This 10-item scale asked participants about experiences with various forms of interpersonal mistreatment in their day-to-day lives over the previous 12 months. Examples include: “You are treated with less respect than other people” and “You are treated as if you are not smart”. Items on the scale are framed in the context of general mistreatment, without reference to race/ethnicity, gender, *etc.* Responses were assessed with a 4-point scale (1=never, 2=rarely, 3=sometimes, 4=often), which was summed and averaged, resulting in a final score of 1 to 4. The everyday discrimination scale has been widely used across samples with African-American, Caucasian and Chinese participants (Barnes, et al., 2004; Brown, Matthews, Bromberger, & Chang, 2006; Gee, et al., 2007; Hunte & Williams, 2009), and has shown high levels of internal consistency and convergent and divergent validity (Barnes, et al., 2004; Taylor, Kamarck, & Shiffman, 2004).

Everyday discrimination was assessed in the overall SWAN cohort beginning with the baseline assessment, continuing through the third year of follow up, resulting in four years of data. Reports of everyday discrimination were fairly consistent during these years (presented by race/ethnicity in Table 1) and the within-person stability estimates across time were quite high, with intraclass correlation coefficients of .85 for African-American women, .90 for Caucasian women, .91 for Chinese women and .90 (95% CI=.88–.91; $p < .0001$) for the full sample. As in a previous report (Lewis, et al., 2006), scores over the four years were averaged, to create a *chronic* everyday discrimination score. Consistent with everyday discrimination scores at each time point, the chronic discrimination score had a possible range of 1 to 4.

Primary Sleep Outcomes

Subjective Sleep Complaints: Global subjective sleep quality was measured with the 19-item Pittsburgh Sleep Quality Index (PSQI) (Buysse, Reynolds Iii, Monk, Berman, & Kupfer, 1989), which asks about aspects of sleep over the previous month. Scores range

from 0–21, and higher scores indicate poorer sleep. The PSQI was administered at the beginning and end of the sleep study protocol; the average score was used in analyses.

Polysomnographic (PSG) Sleep Continuity: Indices of sleep continuity in the form of Sleep Latency and Wakefulness After Sleep Onset (WASO) were assessed via PSG. PSG sleep data were collected in participants' homes using Vitaport-3 (TEMEC VP3) ambulatory monitors. SWAN Sleep Study staff visited women in their homes each night of the sleep study to apply electrodes and calibrate monitors. Women slept in their own beds, under their usual circumstances. Upon awakening in the morning, women removed study equipment and turned off the recorder. PSG signals collected on each study night included bilateral central referential EEG channels (C3 and C4, referenced to A1 linked to A2), electro-oculogram (EOG), submental is electromyogram (EMG), and electrocardiogram (EKG). Trained PSG technologists with established reliability conducted visual sleep stage scoring in 20-sec epochs using standard scoring criteria (Rechtschaffen & Kales, 1968). Sleep variables used in the current analyses were averaged over nights 2 and 3 to reduce possible "first-night" effects on sleep (Edinger, Marsh, McCall, Erwin, & Lininger, 1991). *Sleep Latency* was defined as the time from beginning of the recording period to the first of 10 consecutive minutes of stage 2 or stage 3–4 sleep interrupted by no more than 2 minutes of stage 1 or wakefulness. *WASO* was calculated as total minutes of wakefulness between sleep onset and good morning time (reported awakening from sleep with confirmation of PSG signals consistent with increased activity).

Secondary Sleep Outcomes

Sleep Duration and Sleep Architecture: Using the PSG methodology described above, *Total Sleep Time* was assessed as a marker of sleep duration and calculated as total minutes of any sleep stage after sleep onset. Measures of sleep architecture were also obtained via PSG and defined as percent time spent asleep in NREM stages 3+4, and percent of time spent in REM sleep.

Covariates—Covariates in the current study were well-established correlates of sleep and/or discrimination including age, race/ethnicity, financial strain, body mass index (BMI), menopausal status, depressive symptoms and use of medications that might impact sleep. Education was also assessed, for descriptive purposes only; it was not included as a covariate in analyses as it was not associated with sleep in prior research with this cohort (Hall, et al., 2009).

Sociodemographics: Race/Ethnicity was self-reported as African-American, Caucasian, or Chinese. Age in years and highest level of education were also self-reported. Financial strain was assessed with a three-item question asking participants to rate their difficulty paying for "basics" such as food, housing and medical care. Responses were dichotomized into "somewhat hard"/"very hard" versus "not hard at all."

Health Status Characteristics: Use of prescription or over-the-counter medications that might impact sleep (including opioids, antiepileptics, anxiolytics, hypnotics and sedatives, antidepressants, and antihistamines), was recorded at the start of the sleep study protocol and coded as a presence/absence variable. BMI (kg/m^2) was calculated as (measured) weight in kilograms divided by (measured) height in meters squared and modeled continuously. Menopausal status was assessed using bleeding criteria (WHO, 1996) and categorized as pre- or early perimenopausal (referent) versus late perimenopausal, postmenopausal, or use of hormone therapy.

Depressive symptoms: Depressive symptoms were assessed with the Center for Epidemiological Studies Depression scale (CES-D) (Radloff, 1977), with the single item assessing sleep removed. Possible scores ranged from 0–57.

Timing of Assessments

Measures of race/ethnicity, financial strain and education were taken from the SWAN baseline examination. Yearly measures of everyday discrimination were taken from SWAN baseline through the third follow-up visit (SWAN visits 0, 1, 2 and 3). Sleep outcomes were assessed during the SWAN Sleep Study exam (SWAN visit 5, 6, or 7), and covariates (BMI, menopausal status, medication use and depressive symptoms) were taken from the SWAN visit prior to the Sleep Study exam. Age at the time of the sleep study was used in all analyses.

Statistical Analysis

Descriptive statistics were used to characterize the study sample. Analysis of Variance (ANOVA) and chi-square tests were conducted to examine differences in participant characteristics by race/ethnicity. Sleep variables with skewed distributions (sleep latency, WASO, %Stage 3–4) were transformed prior to analysis.

Linear regression analyses were used to model relationships between chronic everyday discrimination and our primary outcomes of interest: subjective sleep complaints and PSG measures of sleep latency and WASO. In order to reduce the number of overall analyses, preliminary analyses were run to examine basic associations between everyday discrimination and sleep. Because race/ethnicity has been found to be strongly associated with both reports of everyday discrimination and sleep in the SWAN cohort (Brown, et al., 2006; Hall, et al., 2009),¹ we examined these basic discrimination-sleep associations after adjusting for race/ethnicity. This was done to reduce the likelihood of observing spurious associations between discrimination and sleep that were primarily due to the effects of race/ethnicity. Preliminary models also examined race/ethnicity X discrimination interactions.

Outcomes found to be significant in preliminary models were used in multivariable analyses. Multivariable linear regression analyses examined associations between everyday discrimination and indices of sleep after adjusting for relevant covariates. Model 1 adjusted for race/ethnicity and financial strain as demographic characteristics. Model 2 added terms for relevant health status characteristics – medication use that might impact sleep, menopausal status, and BMI. All preliminary and multivariable models were repeated for secondary analyses with total sleep time and measures of sleep architecture as outcomes of interest.

Analyses examining the role of depressive symptoms as a potential mediator of any observed chronic everyday discrimination and sleep associations were conducted following procedures outlined by Baron and Kenny (1986). Based on this model, depressive symptoms would function as a mediator if: 1) chronic everyday discrimination was associated with depressive symptoms (path a); 2) depressive symptoms were associated with sleep (path b); and 3) when both chronic everyday discrimination and depressive symptoms were controlled for, a previously significant relationship between chronic everyday discrimination and sleep would be reduced or eliminated (path c). Consequently, in instances where both paths a and b were significant, we added a third set of models (Model 3), with a term for depressive

¹These associations have been previously reported; however the current study is the first to examine associations between everyday discrimination and sleep in the SWAN cohort. Prior studies of discrimination and health in SWAN have not examined sleep, while prior studies of sleep in SWAN have not examined discrimination.

symptoms. Finally, in order to determine whether any of the potential mediated associations were statistically significant, Sobel tests were conducted (MacKinnon, Lockwood, Hoffman, West, & Sheets, 2002).

Following our primary and secondary analyses, we also conducted additional, sensitivity analyses to determine whether our results would be similar using an everyday discrimination score from a single time-point (rather than our averaged, chronic score). We used the time-point closest to the assessment of sleep outcomes (Year 3) as well as Years 1 and 2.

Results

Participant Characteristics

Women were approximately 51 years of age ($SD=2.14$), and highly educated, with 51% of the sample reporting a college degree or higher. Twenty-seven percent of participants reported it was “somewhat” or “very” hard to pay for basics. Depressive symptoms were low, with a mean of 6.5 ($SD=7.56$). The average BMI was in the overweight/obese range (29.85; $SD=7.47$), and 27% of women reported taking medications that might impact sleep.

Racial/Ethnic differences in participant characteristics are presented in Table 1. Women were similar in age, reports of depressive symptoms and use of medications that might impact sleep. However, African-American women were significantly less likely to have a college degree or higher, and significantly more likely to report having a somewhat or very difficult time paying for basics compared to Caucasian and Chinese women. There were significant differences in BMI, with African-American women having the highest BMIs, followed by Caucasian women, while Chinese women had significantly lower BMIs than women from the two other racial/ethnic groups. There were also significant racial/ethnic differences in reports of chronic (and yearly) everyday discrimination, with African-American and Chinese women reporting comparable levels of everyday discrimination and Caucasian women reporting significantly lower levels (Table 1).

Finally, as previously reported in the SWAN Sleep Study cohort (Hall, et al., 2009), African-American women reported more subjective sleep complaints, had longer sleep latencies and more WASO than Caucasian and Chinese women (Table 1). There were racial/ethnic differences in secondary sleep outcomes as well, such that African-American women had less total sleep time compared to Caucasian and Chinese women ($p<.0001$) and both African-American and Chinese women had less stage 3–4 sleep compared to Caucasian women ($p<.001$). African-American women had less REM sleep than Chinese women only ($p<.05$) (detailed descriptive data on secondary outcomes not shown).

Primary Analyses: Chronic Everyday Discrimination and Indices of Subjective Sleep Quality and PSG-Assessed Continuity

Results from preliminary linear regression models adjusted for race/ethnicity revealed a significant association between chronic everyday discrimination and subjective sleep complaints (Estimate=1.76, $SE=.39$, $p<.0001$), and one measure of sleep continuity, WASO (Estimate=.17, $SE=.07$, $p=.03$). Chronic experiences of everyday discrimination were not associated with sleep latency (Estimate=−.03, $SE=.10$, $p=.76$), and there were no significant race/ethnicity X discrimination interactions for subjective sleep complaints $p=.47$, sleep latency $p=.15$, or WASO $p=.18$.

In order to determine the nature of the association between reports of chronic everyday discrimination and sleep, we graphed significant associations from our preliminary analyses (Figure 1). For descriptive purposes only, chronic everyday discrimination was categorized into approximate tertiles, as low, moderate and high. Figure 2a depicts the association

between chronic everyday discrimination and subjective sleep complaints, measured by the PSQI. A dose-response association was observed, such that each higher level of chronic everyday discrimination was associated with more subjective sleep complaints (Figure 1a). Further, women with moderate or high levels of chronic everyday discrimination had scores >5 on the PSQI, indicative of clinically significant sleep problems (Buysse, et al., 1989). The association between chronic everyday discrimination and WASO is depicted in Figure 2b. Because the initial WASO values were log-transformed, geometric means are presented. Similar to findings with subjective sleep complaints, a dose-response association was observed between everyday discrimination and WASO (Figure 1b), with each higher level of chronic everyday discrimination associated with more minutes spent awake after initially falling asleep for the night. Consequently, compared to women who reported low levels of chronic everyday discrimination, women reporting high levels spent an additional 7 (8.5 in non-transformed units) minutes awake each night.

In models adjusted for race/ethnicity, age and financial strain (Table 2, Model 1), reports of chronic everyday discrimination remained significantly associated with both subjective sleep complaints and WASO. Associations were reduced, but still significant after further adjustments for medication use, menopausal status and BMI (Table 2, Model 2).

Secondary Analyses: Chronic Everyday Discrimination and Indices of Sleep Duration and Architecture

In secondary preliminary linear regression models adjusting for race/ethnicity, experiences of everyday discrimination were not associated with total sleep duration (Estimate = -2.79 , $SE = 7.5$, $p = .71$) or indices of sleep architecture in the form of %REM sleep (Estimate = $-.08$, $SE = .68$, $p = .91$) or %Stage 3–4 sleep (Estimate = $-.10$, $SE = .14$, $p = .48$). Because these basic associations were not observed, further analyses using multivariable models were not conducted.

Depressive Symptoms as a Potential Mediator of Associations Between Chronic Everyday Discrimination and Sleep

In both unadjusted linear regression analyses (data not shown) and analyses adjusted for covariates in Model 2, chronic everyday discrimination was significantly associated with depressive symptoms (Estimate = 4.49 , $SE = 1.03$, $p < .0001$) and depressive symptoms were significantly associated with subjective sleep complaints (Estimate = $.13$, $SE = .02$, $p < .0001$). Depressive symptoms were significantly associated with WASO in unadjusted (data not shown), but not adjusted (Estimate = $.01$, $SE = .005$, $p = .10$) linear regression analyses. As shown in Table 2, Model 3, adding depressive symptoms to our multivariable models reduced the estimate of the association between everyday discrimination and subjective sleep complaints, but it remained significant. Because depressive symptoms were associated with WASO in unadjusted analyses, we also examined fully adjusted multivariable models with WASO as the outcome. However, adding depressive symptoms did not alter the association between everyday discrimination and WASO (Table 2, Model 3). Consistent with results from the multivariable models, the Sobel test statistic for mediation was significant for subjective sleep complaints ($z = 3.62$, $SE = .16$, $p < .0002$), but not WASO ($z = 1.82$, $SE = .02$, $p = .07$).

Additional Analyses

Recent Everyday Discrimination and Indices of Sleep—In supplemental analyses we also examined associations between more recent reports of everyday discrimination and sleep in our cohort of women. We did not have concurrent measures of everyday discrimination, so used the measure administered during the third follow-up exam in SWAN (Year 3), which was 2–4 years prior to the sleep assessments. In preliminary models

adjusted for race/ethnicity, associations between everyday discrimination at Year 3 and sleep were similar, but less robust than those using the “chronic” everyday discrimination score for both subjective sleep (Estimate=1.14, SE=.33, $p=.001$) and WASO (Estimate=.11, SE=.07, $p=.09$). Additional adjustments for covariates and depressive symptoms did not substantively alter this pattern of results. Further, there were also no associations between Year 3 everyday discrimination and sleep latency, or secondary sleep outcomes. Additional analyses using everyday discrimination scores from Year 2 and Year 1 of SWAN revealed stronger, but similar associations (data not shown).

Discussion

To our knowledge, this study is the first to examine the association between chronic everyday discrimination and sleep, and the first to examine associations between discrimination and sleep in a multi-ethnic sample. In a sample of middle-aged African-American, Caucasian and Chinese women, we found that reports of everyday discrimination averaged over the course of four years were associated with poorer subjective sleep and one measure of objective sleep --increased WASO, a marker of sleep continuity. Descriptive findings revealed that moderate and high levels of chronic everyday discrimination were associated with clinically significant levels of subjective sleep complaints. Further, there was an 8.5-minute difference in WASO between women reporting low versus high levels of chronic everyday discrimination, which may not be considered a large difference in a single night but could potentially have a cumulative effect over time (Petersen, 2011), resulting in an hour of sleep loss per week and up to 52 hours of sleep loss per year. Reports of chronic everyday discrimination were not associated with an additional measure of sleep continuity – sleep latency -- or other objective measures of sleep examined in secondary analyses including sleep duration and indices of sleep architecture. Findings were independent of a number of potential confounding variables and as expected, were less robust in additional analyses with a more recent measure of everyday discrimination.

As previously reported in SWAN (Brown, et al., 2006; Hall, et al., 2009), there were notable racial/ethnic differences in both reports of everyday discrimination and measures of sleep. Despite these differences, the observed associations between reports of discrimination and indices of sleep did not differ by race/ethnicity, suggesting that experiences of everyday discrimination impact sleep similarly for African-American, Caucasian and Chinese women. Thus, although early research in this area hypothesized that everyday discrimination might be a particularly relevant stressor for women of color (and less so for Caucasian women) (Lewis, et al., 2006), the current findings provide additional support for the more recently postulated notion that discrimination may be an important psychosocial stressor for everyone, irrespective of racial/ethnic background (Pascoe & Richman, 2009). Further, the effect of race/ethnicity on sleep remained significant after including discrimination in the model (data not shown), indicating that experiences of chronic everyday discrimination do not completely explain the association between race/ethnicity and sleep. Taken together, these findings suggest that while everyday discrimination may not be the only important factor to consider in understanding racial/ethnic disparities in sleep, it does contribute to poor sleep *across* race/ethnicity and may therefore be important to consider in a broader “psychosocial stress and sleep” context for all racial/ethnic groups.

In keeping with prior studies, our PSG findings were limited to sleep continuity, and more specifically, WASO. This was not surprising. Although a number of other sleep outcomes have been associated with psychosocial factors (Cartwright & Wood, 1991; Mezick, et al., 2009), in a 2007 review of psychosocial stress and PSG-measured sleep, Kim and Dimsdale (2007) observed the most consistent associations between psychosocial stressors and WASO --particularly for experimental and traumatic/severe stressors. There were fewer studies

examining the link between “daily life stressors” and PSG-assessed sleep (Kim & Dimsdale, 2007); however, more recent studies have documented associations between *chronic* “daily life stressors” (e.g. financial strain, caregiving) and WASO (Hall, et al., 2008; Hall, et al., 2009; Mills, et al., 2009). In this respect, our findings linking chronic everyday discrimination to WASO are consistent with previous research.

In final models, we examined the role of depressive symptoms as a potential mediator of our observed associations. As expected, reports of everyday discrimination were associated with depressive symptoms and depressive symptoms were associated with both subjective sleep complaints and WASO. However, the associations between everyday discrimination and these outcomes persisted even after adjusting for depressive symptoms, indicating that pathways other than depressed mood likely play a role. Future studies should begin to examine additional psychosocial, physiological, and behavioral processes that might contribute to everyday discrimination and sleep associations across racial/ethnic groups.

Our findings from secondary analyses differed from those reported by Thomas et al. (2006), who found a significant association between reports of discrimination and stage 4 delta sleep (a component of sleep architecture) in a small sample of African-American and Caucasian adults. Because Thomas et al (2006) used a measure of discrimination that primarily assessed reports of discrimination against one’s ethnic group as a whole (e.g. “My ethnic group does not have the same opportunities as other ethnic groups”, (Malcarne, Chavira, Fernandez, & Liu, 2006)) rather than individual experiences of discrimination, this could potentially be due to measurement differences. Or, because women in the current cohort were 13–16 years older than participants in Thomas’ sample, and stage 3–4 sleep decreases with age (Hume, Van, & Watson, 1998; Sahlin, Franklin, Stenlund, & Lindberg, 2009), it is also possible that there was not enough variability in stage 3–4 sleep in our sample to detect associations. Future studies should examine whether discrimination-sleep associations differ by the nature of discrimination reported (personal vs. group) or by age.

It is noteworthy that reports of everyday discrimination in our cohort were relatively stable over the course of four years. This may simply be an accurate reflection of exposure. Irrespective of race/ethnicity, if individuals work, live and play in the same environments from year-to-year, their exposure to routine interpersonal mistreatment on a yearly basis may be somewhat similar. It is also possible that reports of everyday discrimination are stable over time because they are more reflective of personality or dispositional characteristics than actual exposure. In keeping with this notion, in exploratory analyses we examined the role of hostility as a potential confounder of our observed associations between chronic everyday discrimination and sleep². Hostility was correlated with reports of chronic everyday discrimination, but none of our observed associations were explained by hostility. Nonetheless, it is possible that other personality characteristics could potentially play a role. To date however, little is known about how personality characteristics might contribute to reports of everyday discrimination (and also impact sleep). Additional research in this area is warranted.

Findings from the current study should be interpreted in the context of limitations. Our measure of everyday discrimination focused on overall, rather than cause-specific (e.g. racial/ethnic, gender) discrimination. In exploratory analyses (data not shown) we examined whether reports of racial/ethnic discrimination were more strongly associated with observed sleep outcomes than reports of other types of discrimination and findings were non-significant. Although these results should be interpreted with caution due to small cell sizes (only women who answered “sometimes” or “often” were asked to identify a main reason

²Details available from the authors upon request.

for their experiences); research to date has not found consistent differences in the health consequences of attributions for one type of everyday discrimination vs. another (Lewis, et al., 2006; Roberts, Vines, Kaufman, & James, 2008; Troxel, et al., 2003). Thus it is unclear whether a more cause-specific measure would have altered our results. An additional limitation is the demographic composition of our sample. Although much of the original conceptual work on everyday discrimination was based on the experiences of middle-class women (Essed, 1990, 1991); findings based on a sample of fairly educated African-American, Caucasian and Chinese women may not generalize to other groups. Finally, we only included assessments of sleep at one timepoint; consequently, it is difficult to determine the temporality of our observed associations among everyday discrimination, depressive symptoms, and sleep. Longitudinal research with multiple assessments of sleep over time is needed.

Despite these limitations, this study has a number of important strengths. The SWAN sleep cohort is unique, in that it features a community sample of women from three different racial/ethnic groups. Reports of everyday discrimination were assessed over multiple years, which allows for a more precise estimate of overall, in addition to chronic, exposure to discriminatory events. Sleep outcomes were measured with a well-validated self-report measure, as well as the current “gold standard” methodology, polysomnography.

In sum, we found that higher self-reported exposure to chronic everyday discrimination was associated with poorer subjective sleep quality and greater PSG-assessed wakefulness after sleep onset in a sample of middle-aged African-American, Caucasian and Chinese women. These associations were independent of other factors that might impact sleep, including depressive symptoms. Although factors underlying the observed associations remain undetermined, these findings add to a growing body of literature documenting the adverse impact of day-to-day discriminatory stressors on indices of health across racial/ethnic groups.

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Figure 1a. Subjective Sleep Complaints by level of Chronic Everyday Discrimination

Figure 1b. Wakefulness After Sleep Onset (WASO) by level of Chronic Everyday Discrimination

*Values are are geometric means from back-transformed log units.

Figure 1. Associations between Measures of Sleep by level of Chronic Everyday Discrimination

Note: Everyday discrimination was modeled continuously in all analyses to preserve power. Approximate tertiles are presented here for descriptive purposes only.

Table 1

Participant Characteristics by Race/Ethnicity

	African-American (N=138)	Caucasian (N=171)	Chinese (N=59)	p-value *
Age	50.94 (2.1)	51.18 (2.16)	51.68 (2.14)	.09
College Education, %	35.1 _a	60.4 _b	61 _b	<.0001
"Somewhat" or "Very" hard to pay for basics, %	43.1 _a	20.6 _b	13.6 _b	<.0001
Chronic Everyday Discrimination **	1.92 (.42) _a	1.63 (.38) _b	1.85 (.40) _a	<.0001
<i>Everyday Discrimination, Year 0</i>	<i>1.97 (.51)_a</i>	<i>1.64 (.40)_b</i>	<i>1.91 (.47)_a</i>	<i><.0001</i>
<i>Everyday Discrimination, Year 1</i>	<i>1.98 (.47)_a</i>	<i>1.69 (.45)_b</i>	<i>1.85 (.45)_a</i>	<i><.0001</i>
<i>Everyday Discrimination, Year 2</i>	<i>1.90 (.49)_a</i>	<i>1.63 (.42)_b</i>	<i>1.82 (.44)_a</i>	<i><.0001</i>
<i>Everyday Discrimination, Year 3</i>	<i>1.85 (.53)_a</i>	<i>1.56 (.45)_b</i>	<i>1.83 (.44)_a</i>	<i><.0001</i>
Depressive symptoms	7.19 (7.84)	6.33 (7.66)	5.59 (6.57)	.36
BMI kg/m ²	33.34 (7.41) _a	29.85 (7.02) _b	23.29 (2.77) _c	<.0001
Sleep Medication use, %	26.9	29.4	27.3	.58
Subjective Sleep Complaints (PSQI)	6.69 (3.56) _a	5.05 (2.58) _b	5.12 (2.64) _b	<.0001
Sleep Latency (minutes) ***	24.51 (24.11) _a	17.52 (15.46) _b	14.36 (11.11) _b	<.001
WASO (minutes) ***	62.54 (43.69) _a	46.66 (25.27) _b	43.39 (27.30) _b	<.0001

Note: Values are mean $\pm$ SD or percentage.

* P-values from ANOVA and Chi-squared tests for racial/ethnic differences. Variables with differing subscripts within rows are significantly different at the $p < .05$ level based on post-hoc comparisons.

** Average of Everyday Discrimination scores from Year 0 (baseline) through Year 3.

*** Log-transformed prior to analyses.

Linear Regression Models Examining Associations between Chronic Everyday Discrimination and Measures of Sleep

Table 2

	Chronic Everyday Discrimination					
	Model 1 ^a		Model 2 ^b		Model 3 ^c	
	Estimate (SE)	p-value	Estimate (SE)	p-value	Estimate (SE)	p-value
Subjective Sleep						
<i>Sleep Complaints (PSQI)</i>	1.52 (.39)	<.0001	1.33 (.39)	.001	.84 (.39)	.03
Objective Sleep						
<i>Wakefulness After Sleep Onset</i>	.19 (.08)	.02	.17 (.08)	.04	.18 (.09)	.04

^a Adjusted for race, age, financial strain.
^b Adjusted for race, age, financial strain, medication use, menopausal status and BMI.
^c Adjusted for race, age, financial strain, medication use, menopausal status, BMI and depressive symptoms.