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ORIGINAL RESEARCH

Associations of Everyday Discrimination With Insomnia and Short Sleep Duration Among Older Women

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BACKGROUND: Discrimination may contribute to sleep health disparities among women, yet limited research has investigated the association between discrimination and insomnia with short sleep.

METHODS AND RESULTS: Among a racially and ethnically diverse sample of women (N=25 920; mean age, 72.2±6.1 years), we investigated the relationship of discrimination with insomnia symptoms and sleep duration. Poisson models with robust variance were fit to examine discrimination with insomnia, sleep duration (short <7 hours or long >9 hours versus recommended 7–9 hours), and insomnia short sleep phenotype adjusted for covariates. Insomnia symptoms, short and long sleep, and high discrimination were reported by 53%, 11%, 15%, and 40% of women, respectively. Women reporting high versus low discrimination were more likely to report insomnia, short sleep, and insomnia short sleep phenotype (insomnia: adjusted prevalence ratio, 1.15 [95% CI, 1.13–1.18]; short sleep: adjusted prevalence ratio, 1.24 [95% CI, 1.16–1.34]; insomnia short sleep phenotype: adjusted prevalence ratio, 1.45 [95% CI, 1.31–1.61]). In exploratory analyses, the association between discrimination and insomnia symptoms was present among Asian and White women, whereas the association between discrimination and sleep duration was among Hispanic (long sleep) and White (short sleep) women. Further, the association between discrimination and insomnia symptoms was more pronounced among those with less than a bachelor's degree, whereas women with a bachelor's degree or higher were less vulnerable to the association between discrimination and long sleep.

CONCLUSIONS: Discrimination was associated with insomnia and short sleep, a more severe phenotype for adverse cardiovascular health. Discrimination may be a target for reducing sleep problems among older women.

Key Words: discrimination ■ education ■ income ■ insomnia ■ sleep ■ women ■ Women's Health Study

Heart disease is the leading cause of death among women,[1] thus identifying and addressing modifiable risk factors, such as sleep disorders (eg, insomnia) and patterns are warranted. As evidenced by the American Heart Association's Life's Essential 8,[2] sleep is an important cardiovascular risk factor. Insomnia, characterized as difficulty initiating or maintaining sleep, is highly prevalent and related to high blood pressure and heart disease.[3,4] It is most common among older adults and women.[5,6] In addition to cardiovascular factors, insomnia is associated with absenteeism, higher health care costs, anxiety and depression, and significantly impairs daytime functioning.[7] Similar to insomnia, short sleep duration (<7 hours of sleep) is highly prevalent, affecting 35% to 45% of adults in the United States.[8,9] Short sleep duration is associated with daytime sleepiness, obesity, hypertension, diabetes, and all-cause death.[10–12] Emerging data

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CLINICAL PERSPECTIVE

What Is New?

- Discrimination was associated with higher prevalence of insomnia symptoms, short sleep duration, and insomnia with short sleep duration, a more biologically severe phenotype of cardiovascular health, among a large sample of women.

What Are the Clinical Implications?

- As highlighted in the American Heart Association's Life's Essential 8, sleep is an important marker of cardiovascular health; thus, to target sleep health, it is important to identify the determinants of adverse sleep health, including discrimination.
- Discrimination may be an important stressor experienced by women and associated with insomnia and short sleep.

Nonstandard Abbreviations and Acronyms

aPR	adjusted prevalence ratio
ISSP	insomnia short sleep phenotype
WHS	Women's Health Study

have demonstrated that the combination of insomnia with short sleep duration, referred to as the insomnia short sleep phenotype (ISSP), is associated with a high risk of adverse health outcomes, including subclinical and clinical cardiovascular disease, neurocognitive deficits, and death.[13–16] ISSP may be a target for intervention to improve adverse cardiovascular health, particularly among women, who have higher prevalence and greater severity of insomnia compared with men,[3] but data are needed to understand the determinants of this condition.

A growing literature suggests that psychosocial factors are associated with sleep health and disorders[17–19] and may lead to disparities in sleep and cardiovascular health. Daily experiences of discrimination, a psychosocial stressor, are associated with shorter sleep duration and worse sleep continuity.[20–22] A limited body of research has shown that experiences of discrimination or racism are associated with greater odds of insomnia symptoms and disorder among women.[23,24] Although the mechanism linking discrimination and sleep is unclear, it is plausible that daily experiences of discrimination may lead to both short sleep duration and insomnia through a stress pathway or rumination in the evening,[25] which may interfere with the initiation or maintenance of sleep (insomnia symptoms). There is a clear need to investigate discrimination and insomnia and short sleep duration in efforts to target intervention.

Historically minoritized individuals have shorter sleep duration, and recent data have shown a greater insomnia severity compared with non-Hispanic White adults.[26] Despite evidence suggestive of discrimination as a determinant of sleep disparities, few studies have examined associations between discrimination and insomnia among women (who have the highest prevalence of insomnia) and by race and ethnicity. Historically minoritized women are particularly vulnerable to the intersecting identities of both sex/gender and race,[27] which increases risk of exposure to discrimination. Thus, discrimination may be particularly relevant to the sleep of women and understanding this association by race and ethnicity is warranted.

In addition to race, socioeconomic status (SES) may modify the association between discrimination and insomnia and short sleep duration. Because of the advantages associated with greater SES (higher health literacy, greater resources, and access to care), these resources may buffer the effect of discrimination on sleep. However, higher SES has been associated with worse sleep outcomes among historically minoritized individuals,[28,29] which may be explained by race-salient stressors. Supporting data have shown that the association between psychosocial stress and sleep among Black adults is most pronounced among those of higher education in comparison with lower education.[18] Women of higher education or income may have unique stressors and increased exposure to microaggressions and discrimination with higher social status, particularly in the workplace, evidenced by gaps in salary and mobility.[30] Additionally, historically minoritized individuals of higher income are more likely than their lower income peers to be at elevated risk of experiencing discrimination because they live in neighborhoods and work in environments with fewer members of their own ethnic group. Therefore, research is needed to better understand the contribution of discrimination to insomnia and short sleep among women across racial and ethnic groups and socioeconomic levels.

Among a diverse sample of women in the WHS (Women's Health Study) stress follow-up cohort study, we investigated the relationship between discrimination and insomnia symptoms, sleep duration, and ISSP overall and by race and ethnicity. Because the association between discrimination and health can vary by SES, we also tested education and income as effect modifiers. We hypothesize that (1) discrimination will be associated with insomnia symptoms, short/long sleep, and ISSP overall and among Asian, Black, and Hispanic but not White women; and (2) the associations will be stronger among women with a higher, relative to lower, education and income.

METHODS

This study used data from the follow-up cohort of the WHS. The details of the WHS have previously been published. In brief, the WHS enrolled healthy middle-aged and older women who were health professionals in the United States (N=39 876). The study was initiated in 1993 as a randomized clinical trial testing the effect of aspirin and vitamin E on cardiovascular disease and cancer.[31,32] Following the trial (since 2005), observational follow-up continues annually. The current analysis uses data from the WHS stress follow-up study and was approved by the institutional review board of Brigham and Women's Hospital and the University of California at San Francisco. Participants of the WHS stress follow-up study (2012–2013) provided informed consent and data on psychosocial stress, sleep, and cardiovascular disease health. This analysis includes Asian, Black, Hispanic, and White women (n=25 920) with complete data on discrimination, sleep, and insomnia. Because of the sensitive nature of the data collected for this study, requests to access the data set from qualified researchers trained in human subject confidentiality protocols may be sent to the Women's Health Study at Brigham and Women's Hospital and Harvard Medical School (https://whs.bwh.harvard.edu/Forms.html).

Discrimination

Participants completed a brief version of the Everyday Discrimination Scale, which measured perceptions of everyday discrimination without attribution to the source (eg, race, gender, socioeconomic status, sexual orientation).[33] Participants were asked questions such as, "How often on a day-to-day basis do you have the following experiences? You are treated with less courtesy or less respect. You receive poorer service than others at restaurants. People act as if they think you are not smart. People act as if they are afraid of you. You are threatened or harassed."[34] A total of 5 items were asked, and responses ranged from 1 ("never") to 5 ("at least once a week"). The mean of the responses was used as the score for the frequency of perceived everyday discrimination. Cronbach's α was 0.70. Consistent with the literature, responses were further categorized into tertiles[35] and analyzed as "high" exposure of perceived discrimination for the upper tertile and "low" exposure corresponded to the lower and middle tertiles.

Insomnia Symptoms, Sleep Duration, and ISSP

Participants self-reported insomnia symptoms by responding to the following questions: "Did you have trouble falling asleep?" and "Did you wake up several times at night?" Responses ranged from "no," "<1 per week," "1 to 2 per week," "3 to 4 per week," and ">5 per week." Insomnia was analyzed as a binary variable (yes or no) and defined as trouble falling asleep *or* waking after sleep onset 3 to 4 or ≥5 times per week. Habitual sleep duration (continuous variable) was calculated on the basis of self-reported bed and wake times on weekdays and weekends. Participants self-reported bedtime (eg, "What time do you usually go to bed on weekdays or workdays [weekends or days off]?") and wake time (eg, "What time do you usually wake up on weekdays or workdays [weekends or days off]?"). Sleep duration was categorized as short <7 hours, recommended ≥7 and ≤9 hours, and long >9 hours, and was analyzed as separate binary variables (short versus recommended and long versus recommended). The ISSP was classified as a binary variable when a participant was classified with both insomnia and short sleep duration.

Socioeconomic Status

Education and income were analyzed as measures of SES. For education, participants were grouped into 6 categories of professional education beyond high school: licensed practical nurse/licensed vocational nurse, 2 year associate's/health professional education, 3-year associate's/health professional education, a bachelor's degree, a master's degree (MS), and a doctoral degree (doctor of philosophy or medical degree). Responses were further categorized as bachelor's degree or higher or less than bachelor's degree. Annual household income was reported in ranges of income, then converted to the midpoint income for the respective reported range yielding 7 categories (<$10 000, $10 000 to $19 999, $20 000 to $29 999, $30 000 to $39 999, $40 000 to $49 999, $50 000 to $99 999, and ≥$100 000). These categories were further categorized as ≥$50 000 and ≤$50 000 for analysis.

Sociodemographics, Health Behaviors, and Health Outcomes

Based on a priori hypotheses, demographic and clinical variables were included as covariates: participants' self-reported age, race and ethnicity, alcohol consumption (yes/no), smoking status (current versus past or never), physical activity, and depression/anxiety symptoms. Physical activity was measured as the total metabolic equivalent of task hours per week. Depression/anxiety symptoms were measured by the 5-item mental health subscale of the 36-item Short Form Survey.[36] Body mass index and type 2 diabetes were self-reported annually on the routine WHS follow-up questionnaire. Height and weight were self-reported to classify body mass index (kg/m^2). Type 2

diabetes was validated using the American Diabetes Association criteria.[37] Hypertension was determined using 1 of the following criteria from the annual questionnaire: self-report of physician diagnosis of hypertension; blood pressure–lowering medication; or systolic blood pressure ≥140 mm Hg or diastolic blood pressure ≥90 mm Hg.[38]

Statistical Analysis

Selected study population characteristics were reported overall and by discrimination categories of high and low. Sample characteristics were examined using χ^2 tests for categorical variables or 2-sample *t* test for continuous variables. To test the associations of discrimination with insomnia symptoms, sleep duration, or ISSP, Poisson models with robust variance were fit to estimate prevalence ratios and 95% CIs. For categorical sleep duration, 2 separate Poisson models were fit with the outcomes of short versus recommended sleep duration and separately, long versus recommended sleep duration. The Poisson method yields less biased estimates[39,40] than logistic regression or log multinomial regression models. These latter methods often produce poor estimates of the prevalence ratio, frequently overestimating the prevalence ratio or resulting in out-of-bound probabilities as much as 50% of the time. Thus, separate Poisson models for short and long sleep duration were fit. A sequential modeling approach was used. Model 1 adjusted for age, race, and ethnicity; model 2 further adjusted for SES (education and income); model 3 further adjusted for health risks/behaviors (physical activity, alcohol consumption, smoking, and body mass index); and model 4 further adjusted for health status (depression, hypertension, and diabetes). Associations were presented overall and stratified by race and ethnicity. Due to differences in sample size by race and ethnicity, formal tests of modification were not conducted to avoid reliance on *P* values for stratified analyses.

Education and income were tested as effect modifiers of the associations between discrimination with insomnia symptoms, sleep duration, and ISSP. Tests for heterogeneity were conducted with $P_{interaction}<0.10$ as significant to display stratified associations. Fully adjusted models included an interaction term between discrimination and education or income. Stratified models by education and income are shown. All analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC).

Although the original study was a randomized trial, inclusion of the randomization arm as a covariate did not change the results; thus, we excluded the randomization arm as a covariate.

RESULTS

The final analytic sample size was 25 920 women. The sample had a mean age of 72.2 (6.1) years and was Asian (n=314), Black (n=445), Hispanic (n=255), and White (n=24 906). Women classified as high exposure to discrimination were more likely to report anxiety and depressive symptoms (Table 1). Overall, 53%, 6%, 11%, and 15% of women reported insomnia symptoms, ISSP, short sleep duration, and long sleep duration, respectively.

The adjusted prevalence ratios (aPRs) for insomnia symptoms, short/long sleep duration, and ISSP are shown in Table 2. High reports of discrimination were associated with 15%, 24%, and 45% higher prevalence of insomnia symptoms (aPR, 1.15 [95% CI, 1.13–1.18]), short sleep duration (aPR, 1.24 [95% CI, 1.16–1.34]), and ISSP (aPR, 1.45 [95% CI, 1.31–1.61]) after adjustment for covariates. There was no observed association between discrimination and long sleep duration in the overall sample.

Associations of discrimination with insomnia symptoms, sleep duration, and ISSP stratified by race and ethnicity are shown in Table 3. Asian women who reported high discrimination compared with low had a 37% higher prevalence of insomnia symptoms after adjustment for covariates (aPR, 1.37 [95% CI, 1.05–1.78]). There was no observed association between discrimination and sleep duration or ISSP among Asian women. Hispanic women who reported high versus low discrimination had higher prevalence of insomnia symptoms (aPR, 1.39 [95% CI, 1.05–1.84]) and long sleep duration (aPR, 1.97 [95% CI, 1.07–3.64]), respectively, after adjustment for sociodemographic characteristics, health behaviors, and body mass index. The association with insomnia symptoms was attenuated after adjustment for health outcomes, but the discrimination and long sleep duration association persisted in the fully adjusted model. White women reporting high discrimination compared with low had a higher prevalence of insomnia symptoms, short sleep, and ISSP after adjustment for covariates (Table 3). There were no observed associations between discrimination and insomnia symptoms or sleep duration among Black women.

Education modified the associations between discrimination and insomnia symptoms ($P_{int}<0.01$) or long sleep duration ($P_{int}=0.02$) (Table 4). The association between discrimination and insomnia symptoms was more pronounced among those with less than a bachelor's degree. Among women with a bachelor's degree or higher, discrimination was associated with a lower prevalence of long sleep duration. Remaining associations were similar across education level. Income did not modify the associations between discrimination and insomnia or sleep duration (Table 5).

Table 1. Selected Study Characteristics by Categories of Discrimination in the Women's Health Study (n=25 920)

	Total sample, mean±SD or %	Discrimination*	
		Low (n=15 486, 60%)	High (n=10 434, 40%)
Age, y, mean±SD	72.2±6.1	72.9±6.2	71.2±5.6
Race, %			
White	96	97	95
Hispanic	1	1	1
Black	2	1	2
Asian	1	1	2
Education, %			
Less than bachelor's	53	55	50
Bachelor's or higher	47	45	50
Family income, %			
<$50 000	41	40	41
≥$50 000	59	60	59
Marital status, %			
Never married	5	5	6
Married	77	79	74
Divorced or separated	13	12	15
Widowed	5	5	4
Exercise, total metabolic equivalent of task hours, mean±SD	18.7±20.2	18.8±20.2	18.7±20.1
Alcohol consumption, %	59	59	58
Current smoker, %	5	5	5
Body mass index, kg/m^2, mean±SD	26.8±5.4	26.5±5.2	27.4±5.7
Anxiety, mean±SD	4.4±1.6	4.1±1.5	4.8±1.7
Depressive symptoms, mean±SD	5.5±2.1)	5.1±1.8	6.1±2.3
Diabetes, %	11	10	12
Hypertension, %	71	71	72
Insomnia symptoms, %	53	50	57
Sleep duration, h, weekday, mean±SD	8.0±1.2	8.1±1.2	7.9±1.2
Sleep duration, h, weekend, mean±SD	8.3±1.2	8.4±1.2	8.3±1.2
Habitual sleep duration, h, mean±SD	8.1±1.1	8.2±1.1	8.1±1.1
Habitual short sleep duration, <7 h, %	11	10	13
Habitual long sleep duration >9 h, %	15	16	14
Insomnia short sleep, %	6	5	7

*"High" exposure of perceived discrimination for the upper tertile and "low" exposure corresponded to the lower and middle tertiles.

In sensitivity analyses, we analyzed discrimination as a continuous variable. The associations were consistent in terms of direction and significance to the models with binary discrimination (Table S1). Associations by race and ethnicity for insomnia symptoms were similar between continuous and binary discrimination (Table S2). However, there was no association between discrimination and short sleep duration (White women only) or long sleep duration (Hispanic women only) observed. There was also no association between discrimination and ISSP among White women. In general, the results for SES as an effect modifier of the associations between discrimination and insomnia symptoms or sleep duration were consistent (Tables S3 and S4). However, the association between discrimination and long sleep duration was no longer observed among women with a bachelor's degree or higher. Additionally, a second sensitivity analysis examined the effect of using a log multinomial model to estimate the prevalence ratio for sleep duration overall and stratified by race (Table S5). Results were mainly consistent, and the CIs from the log multinomial model tended to be slightly wider, especially in models with smaller sample sizes.

DISCUSSION

This study examined discrimination with 3 sleep outcomes: insomnia symptoms, sleep duration, and ISSP (an increasingly recognized cardiovascular risk factor),

Table 2. aPRs for Insomnia Symptoms, Sleep Duration, and ISSP for Categories of Discrimination (High Versus Low) in the Women's Health Study (n=25 920)

	Model 1		Model 2		Model 3		Model 4	
	Low (Reference)	High	Low (Reference)	High	Low (Reference)	High	Low (Reference)	High
		aPR (95% CI)		aPR (95% CI)		aPR (95% CI)		aPR (95% CI)
Insomnia symptoms	1.0	1.17 (1.15, 1.20)**	1.0	1.16 (1.14, 1.20)**	1.0	1.16 (1.13, 1.19)**	1.0	1.15 (1.13, 1.18)**
Sleep duration								
Short sleep vs recommended sleep (Reference)	1.0	1.24 (1.16, 1.33)**	1.0	1.26 (1.17, 1.35)**	1.0	1.24 (1.16, 1.34)**	1.0	1.24 (1.16, 1.34)**
Long sleep vs recommended sleep (Reference)	1.0	0.99 (0.93, 1.05)	1.0	0.99 (0.93, 1.06)	1.0	0.98 (0.92, 1.04)	1.0	0.95 (0.89, 1.01)
ISSP	1.0	1.46 (1.32, 1.61)**	1.0	1.48 (1.33, 1.64)**	1.0	1.46 (1.31, 1.61)**	1.0	1.45 (1.31, 1.61)**

Model 1: age and race; model 2: model 1+education and income; model 3: model 2+physical activity, alcohol consumption, current smoker, and body mass index; model 4: model 3+diabetes, hypertension, and depression. aPR indicates adjusted prevalence ratio; and ISSP insomnia with short sleep phenotype.
*P<0.05.
**P<0.01.

among a large sample of older women. Overall, the findings demonstrated an association between discrimination and insomnia symptoms, short sleep duration, and the ISSP. In general, the associations were most consistent among White women, who comprised the largest proportion of the study sample, but the associations were in a similar direction in other groups. Associations between discrimination and insomnia symptoms and discrimination and long sleep duration were found among Asian and Hispanic women, respectively. It is important to interpret the race-stratified analyses with caution due to the differences in sample size. Further, education but not income modified the explored associations. The association between discrimination and insomnia symptoms was more pronounced among those with less than a bachelor's degree, whereas women with a bachelor's degree or higher were less vulnerable to the association between discrimination and long sleep duration. Overall, there was a high prevalence of insomnia symptoms (53%), thus suggesting opportunities for intervention. This research has important implications for addressing discrimination among women to reduce the risk for insomnia and short sleep duration.

To our knowledge, this is the first study to show discrimination as associated with the ISSP. We found that experiences of discrimination were associated with not only insomnia symptoms and short sleep duration, but the combination of both, referred to as the ISSP. In fact, the magnitude of the association for discrimination and ISSP was larger than those for insomnia symptoms or short sleep alone. This finding is of importance as the ISSP represents a more biologically severe phenotype that is associated with arousals[13] and may capture insufficient sleep better than insomnia symptoms or short sleep alone. Thus, our results point to the importance of addressing both insomnia symptoms and short sleep duration.

The results of this study are consistent with the literature showing that discrimination is associated with insomnia symptoms and short sleep duration.[21–24] Our race-specific findings, which should be interpreted with caution, were unexpected and inconsistent with the literature; however, there are several unique aspects of our study that could explain this discrepancy. It is important to note the prior studies of discrimination and insomnia assessed racial discrimination, while our study assessed discrimination without attribution to race. Discrimination was more commonly reported by Black and Asian women. Consistent with the literature, Asian women were more vulnerable to the association between discrimination and insomnia symptoms.[22,41] Unexpectedly and contrary to the literature, discrimination was associated with insomnia symptoms, short sleep duration, and ISSP among White women, but not Black women, which may be reflective of our sample size given that the associations were in a similar direction, particularly for ISSP. This result may be attributable to the lack of specificity of our definition of discrimination, which is a limitation of the study. However, although the measure of discrimination was not specifically attributed to race, the experience of discrimination likely varies across racial and ethnic groups so the same measure (ie, experience) of discrimination reflected in this study may represent a different experience of discrimination across the racial and ethnic groups. In our sample of older health professional women, gender-based discrimination may have been more common and relevant, which may explain the stronger association among White women. Thus, understanding the source of discrimination may be important. Lee and colleagues reported that perceived

Table 3. Race- and Ethnicity-Stratified Models of aPRs for Insomnia Symptoms, Sleep Duration, and ISSP for Categories of Discrimination in the Women's Health Study, n=25920

	Model 1		Model 2		Model 3		Model 4	
	Low (Reference)	High aPR (95% CI)	Low (Reference)	High aPR (95% CI)	Low (Reference)	High aPR (95% CI)	Low (Reference)	High aPR (95% CI)
Asian race								
Insomnia symptoms	1.0	1.32 (1.02–1.71)*	1.0	1.37 (1.05–1.79)*	1.0	1.36 (1.04–1.77)*	1.0	1.37 (1.05–1.78)*
Sleep duration								
Short sleep vs recommended sleep (Reference)	1.0	0.98 (0.65–1.46)	1.0	0.96 (0.63–1.44)	1.0	0.90 (0.59–1.36)	1.0	0.92 (0.60–1.41)
Long sleep vs recommended sleep (Reference)	1.0	0.7 (0.32–1.73)	1.0	0.78 (0.33–1.85)	1.0	0.63 (0.28–1.43)	1.0	0.62 (0.26–1.49)
ISSP	1.0	1.00 (0.55–1.84)	1.0	0.92 (0.49–1.73)	1.0	0.88 (0.47–1.65)	1.0	0.92 (0.49–1.74)
Black race								
Insomnia symptoms	1.0	1.06 (0.84–1.34)	1.0	1.05 (0.82–1.34)	1.0	1.04 (0.81–1.33)	1.0	1.02 (0.80–1.30)
Sleep duration								
Short sleep vs recommended sleep (Reference)	1.0	0.93 (0.67–1.29)	1.0	0.85 (0.61–1.18)	1.0	0.88 (0.63–1.23)	1.0	0.90 (0.64–1.26)
Long sleep vs recommended sleep (Reference)	1.0	0.85 (0.55–1.30)	1.0	0.77 (0.50–1.19)	1.0	0.76 (0.49–1.19)	1.0	0.73 (0.47–1.13)
ISSP	1.0	1.59 (0.86–2.95)	1.0	1.39 (0.76–2.56)	1.0	1.60 (0.87–2.94)	1.0	1.68 (0.91–3.14)
Hispanic ethnicity								
Insomnia symptoms	1.0	1.46 (1.10–1.93)**	1.0	1.43 (1.08–1.90)*	1.0	1.39 (1.05–1.84)*	1.0	1.32 (0.99–1. 75)
Sleep duration								
Short sleep vs recommended sleep (Reference)	1.0	1.39 (0.88–2.19)	1.0	1.42 (0.90–2.25)	1.0	1.41 (0.89–2.24)	1.0	1.44 (0.90–2.31)
Long sleep vs recommended sleep (Reference)	1.0	1.82 (1.01–3.30)*	1.0	2.02 (1.10–3.71)*	1.0	1.97 (1.07–3.64)*	1.0	1.96 (1.03–3.70)*
ISSP	1.0	1.41 (0.702–2.82)	1.0	1.43 (0.71–2.90)	1.0	1.28 (0.61–2.66)	1.0	1.20 (0.59–2.63)
White race								
Insomnia symptoms	1.0	1.17 (1.14–1.20)**	1.0	1.16 (1.14–1.19)**	1.0	1.16 (1.13–1.19)**	1.0	1.15 (1.12–1.18)**
Sleep duration								
Short sleep vs recommended sleep (Reference)	1.0	1.26 (1.18–1.36)**	1.0	1.28 (1.19–1.38)**	1.0	1.26 (1.17–1.36)**	1.0	1.27 (1.18–1.37)**
Long sleep vs recommended sleep (Reference)	1.0	0.99 (0.93–1.05)	1.0	0.99 (0.93–1.06)	1.0	0.98 (0.92–1.04)	1.0	0.95 (0.89–1.01)
ISSP	1.0	1.47 (1.33–1.63)**	1.0	1.50 (1.35–1.67)**	1.0	1.47 (1.32–1.64)**	1.0	1.47 (1.32–1.63)**

Model 1: age; model 2: model 1+education and income; model 3: model 2+physical activity, alcohol consumption, current smoker, and body mass index; model 4: model 3+diabetes, hypertension, and depression. aPR indicates adjusted prevalence ratio; and ISSP, insomnia with short sleep phenotype.

*$P<0.05$.

**$P<0.01$.

job discrimination due to sex, race, age, health conditions, or sexual orientation were associated differently with dimensions of sleep health including insomnia and sleep duration.[24] Thus, identifying the attribution of the discrimination and more thoroughly evaluating the role of discrimination on sleep within each racial and ethnic group may be important for understanding the associations with sleep to better target intervention strategies.

In the current study, experiences of discrimination were not associated with long sleep duration (>9 hours) in the overall sample. Among Hispanic women, high versus low discrimination was associated with long sleep duration. In general, long sleep duration is

Table 4. Adjusted Prevalence Ratios for Insomnia Symptoms, Sleep Duration, and ISSP With Discrimination Stratified by Education Level in the Women's Health Study (n=25 920)

	Less than bachelor's degree	Bachelor's degree or higher
	High vs low discrimination	High vs low discrimination
Insomnia symptoms	1.18 (1.14–1.22)**	1.12 (1.08–1.16)**
Sleep duration		
Short sleep vs recommended sleep (Reference)	1.25 (1.14–1.39)**	1.23 (1.11–1.37)**
long sleep vs recommended sleep (Reference)	1.00 (0.92–1.09)	0.89 (0.81–0.98)
ISSP	1.46 (1.28, 1.68)**	1.43 (1.22, 1.67)**

Adjusted for race, age, income, physical activity, alcohol consumption, current smoker, body mass index, diabetes, hypertension, and depression. ISSP indicates insomnia with short sleep phenotype.

**$P<0.01$.

associated with worse health outcomes including depression.[42] However, long sleep duration is a heterogeneous measure and could connote greater propensity for sleeping, poorer sleep quality, and greater opportunities to sleep. Future studies should further research the long sleep subphenotypes and its relationship with discrimination.

Education but not income did modify some of the associations between discrimination and insomnia symptoms or long sleep duration. We found that the association between discrimination and insomnia symptoms were more pronounced among women with less than a bachelor's degree than among those with higher than a bachelor's degree. Further, a bachelor's degree was seemingly protective against the association between discrimination and long sleep duration. This finding was contrary to our hypothesis that that the associations would be stronger among those with higher SES. However, it is important to note that our hypothesis was based on data suggesting that higher SES minoritized groups have worse sleep relative to those with lower SES.[43] Our study sample comprised predominantly White health professionals and may be more reflective of the expected SES gradient of higher SES as more protective against adverse health. In general, the associations were similar across income. Additionally, our sample consisted only of health professionals. Future studies should explore the sources of discrimination in more socioeconomically diverse samples of women.

Table 5. aPRs for Insomnia Symptoms, Sleep Duration, and ISSP With Discrimination Stratified by Income in the Women's Health Study (n=25 920)

	<%50 K	≥%50 K
	High vs low discrimination	High vs low discrimination
Insomnia symptoms	1.15 (1.10–1.18)**	1.16 (1.12–1.20)**
Sleep duration		
Short sleep vs recommended sleep (Reference)	1.26 (1.13–1.40)**	1.24 (1.12–1.36)**
Long sleep vs recommended sleep (Reference)	1.01 (0.92–1.10)	0.91 (0.83–0.98)*
ISSP	1.49 (1.27–1.73)**	1.43 (1.24–1.64)**

Adjusted for race, age, education, physical activity, alcohol consumption, current smoker, body mass index, diabetes, hypertension, and depression. aPR indicates adjusted prevalence ratio; and ISSP, insomnia with short sleep phenotype.

*$P<0.05$.

**$P<0.01$.

Despite the evidence suggesting discrimination is associated with insomnia and sleep duration, the mechanisms are unclear. Discrimination can lead to chronic stress[44] and result in hyperstimulation of the hypothalamic–pituitary adrenal axis and disrupt the normal sleep/wake process.[45] Research among women demonstrates that experiences of race-based discrimination (ie, racism) is associated with rumination and worse sleep quality.[25] While our study did not assess race-based discrimination, we expect that rumination is on the pathway and should be further explored as a mechanism.

Although there are significant strengths of this study, including a large sample size and inclusion of multiple dimensions of sleep, there are also limitations to consider. The study sample is predominantly White health professionals; thus, similar work should be conducted in diverse populations, including racial and ethnic US minoritized individuals. This is particularly important because racial minoritized individuals are disproportionately exposed to discrimination. While it was a strength to examine the ISSP, short sleep was measured by self-report, which tends to be an overestimate of actual sleep.[46] This is a cross-sectional study; therefore, it is subject to temporal ambiguity. Despite these limitations, this study expands the epidemiologic literature by demonstrating that discrimination is associated with insomnia symptoms and short sleep duration among women.

In conclusion, this study supports existing data that discrimination is associated with sleep duration, and new data demonstrating an association between discrimination and ISSP, a more severe cardiovascular risk factor compared with insomnia or sleep duration alone, and associations were evident in White women. Hispanic women may be more vulnerable to the association between discrimination and long sleep duration, a potential marker for depression. Our findings suggest the importance of additional research that

seeks to identify the extent to which discrimination may be an important target for both insomnia symptoms and suboptimal sleep duration.

ARTICLE INFORMATION

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Disclosures

None.

Supplemental Material

Tables S1–S5

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