RESEARCH

Joint Effects of Workplace and Everyday Discrimination on Sleep Disturbances: A 9-Year Prospective Cohort Study in U.S. Employees

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Abstract

Background Poor sleep quality is linked to increased risk for cardiometabolic complications and mortality. Previous research suggested workplace and everyday discrimination are separately linked to adverse sleep outcomes. The aim of this study is to examine the joint effects of workplace and everyday discrimination on sleep quality among middle-aged adults.

Methods Data from the Midlife in the United States (MIDUS) study were used, with a 9-year follow-up of 1,333 individuals free from sleep disturbances at baseline. Baseline measures of workplace and everyday discrimination were collected, and the incidence of sleep disturbances was assessed at follow-up. Poisson regression was used to estimate risk ratios (RRs) and 95% confidence intervals (CIs). The synergy index was applied to evaluate whether the combined effect of both types of discrimination was greater than their individual effects.

Results Workplace discrimination was associated with a higher risk of sleep disturbances (adjusted RR = 1.50 [1.09, 2.06]). Everyday discrimination also increased the risk of sleep disturbances (adjusted RR= 1.38 [1.00, 1.93]). The joint effect of workplace and everyday discrimination was associated with a higher risk of sleep disturbances (adjusted RR = 1.78 [1.16, 2.72]), with synergy index suggesting an additive interaction.

Conclusion Both workplace and everyday discrimination independently affect sleep quality, with an additive interaction between the two. The double burden of workplace and everyday discrimination can significantly impact sleep disturbances. Further research is needed to explore the biological mechanisms linking discrimination and sleep disturbances.

Keywords Sleep health · Workplace discrimination · Everyday discrimination · Sleep disturbances

Introduction

Sleep is one of the most important human physiological activities, as it is crucial to maintain proper functioning of the human body and plays a vital role in preserving overall health and well-being. While the duration of sleep is a pivotal determinant of health outcomes, sleep quality also has a significant impact on human health [1]. In the United States, approximately 70% of adults report sleep disturbances at least monthly, with 50–70 million people affected [2]. Impaired sleep quality has been consistently correlated with higher risk for diminished work-related productivity, injuries, and adverse health outcomes, including cardiometabolic complications and all-cause mortality [3–5]. Reduced sleep quality, one of the defining features of chronic insomnia, is characterized as low individual self-satisfaction with all aspects of sleep [6]. Midlife represents a critical period for examining sleep health, as individuals often face increased responsibilities related to career advancement, caregiving,

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and financial stability [7]. These cumulative demands may exacerbate vulnerability to psychosocial stressors, including discrimination, and amplify their impact on sleep quality. Moreover, physiological changes in midlife, such as early signs of aging or hormonal shifts, may make this group more susceptible to sleep disturbances in response to chronic stressors like discrimination [8, 9]. The four major attributes of sleep quality include sleep efficiency (the percentage of time in bed spent asleep), sleep latency (the amount of time it takes to fall asleep), sleep duration, and wake after sleep onset [6]. Poor sleep quality or sleep disturbances are operationalized by measures such as frequency of trouble falling asleep, middle-of-the-night awakenings, difficulty returning to sleep, and early morning awakenings [5].

Discrimination has gained attention for its profound impact on both physical and mental well-being [10, 11]. A wealth of literature reveals consistent associations between discrimination and adverse mental health outcomes, encompassing heightened levels of stress, anxiety, and depression [12–14]. Past research highlights that individuals subjected to discrimination are more susceptible to challenges in various aspects of poor sleep quality [11, 15–17].

One of the main settings where adults spend time – the workplace – unfortunately, has received less attention for its critical role in worker health [18]. Evidence indicates that the workplace itself can be an originating source for discrimination, with workplace discrimination related to poor health outcomes among workers [19]. Such negative experiences offer valuable insights regarding the interplay of both workplace and everyday discrimination with sleep-related outcomes. To the best of our knowledge, there is only a limited body of literature dedicated to examining the relationship between discrimination and sleep disturbances. Even fewer studies that studied discrimination and sleep disturbances focused on discrimination in the workplace. For instance, six cross-sectional studies [20–25] and seven longitudinal studies investigated the relationship between everyday discrimination and sleep disturbances in the United States [26–32]. Two of these studies recruited only women, one targeted primarily adolescents, two focused on the African American population, one drew upon the Filipino American population, and the rest included multiple ethnicities and both sexes. All reported positive associations between experiences of everyday discrimination and sleep disturbances [20–32]. Regarding the relationship between workplace discrimination and sleep disturbances, there were two cross-sectional studies [30, 33] and two prospective cohort studies [34, 35]. The majority were conducted in the United States, and one was conducted in South Korea. All were multiethnic studies, one study was focused on women, and the rest included both sexes. All four studies found a significant positive association between workplace discrimination and sleep disturbances.

Despite a growing body of evidence connecting both workplace and everyday discrimination to sleep disturbances, respectively [15, 20–35], there is a notable research gap concerning the joint effects of workplace discrimination and everyday discrimination with sleep quality. This study aims to investigate both the independent and combined effects of workplace discrimination and everyday discrimination on the incidence of sleep disturbances among U.S. workers using a prospective study design.
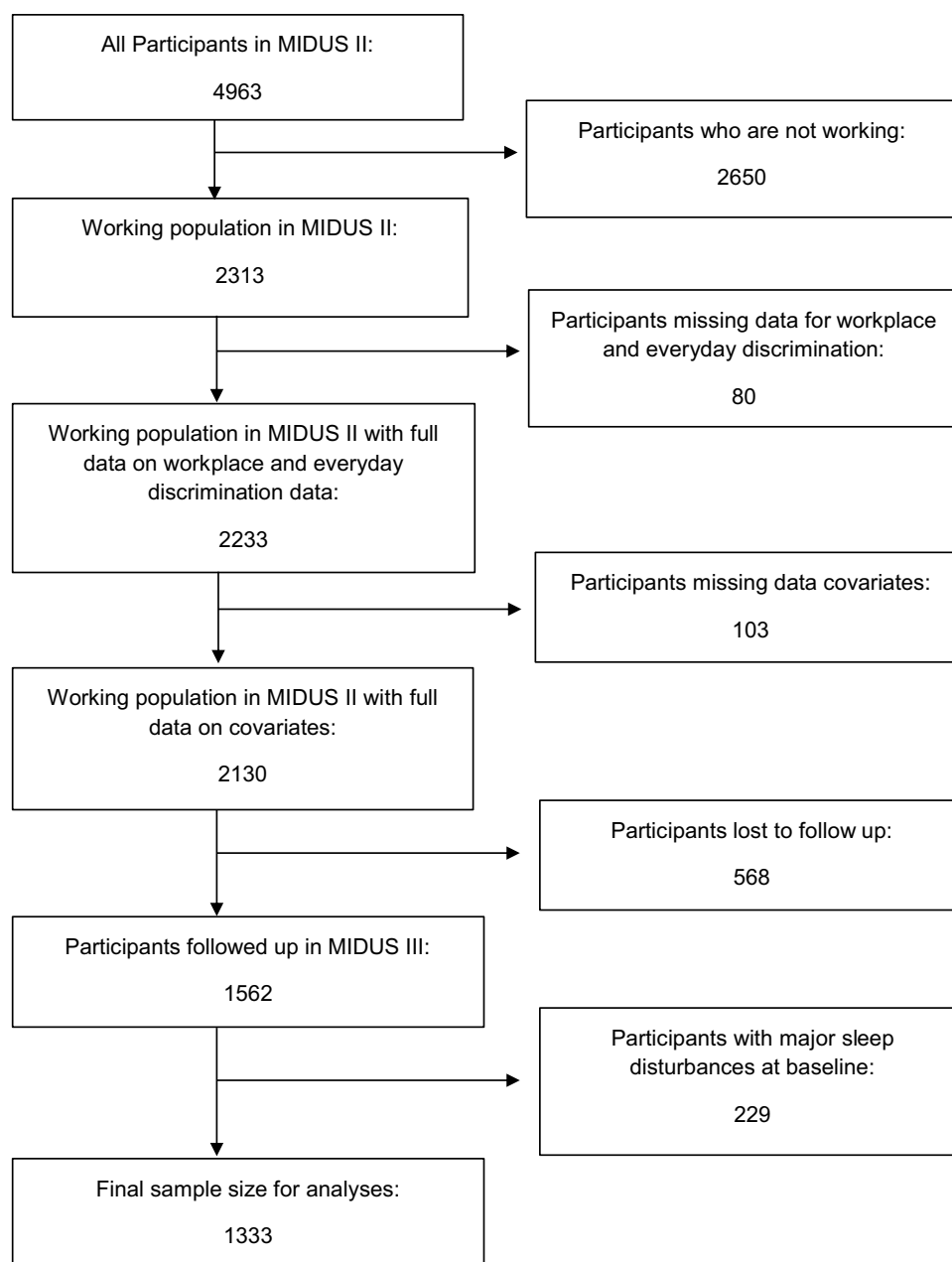
Methods

Study Population

This study utilized data from the MIDUS II and MIDUS III surveys [36]. Established in 1994, the MIDUS study is a national longitudinal investigation that assesses psychological, social, and behavioral factors, and health among adults in the United States. MIDUS II was conducted between 2004 and 2006 (baseline of current study), with MIDUS III taking place from 2013 to 2014 (follow-up of current study), resulting in a follow-up period of approximately 9 years.

At the baseline of our investigation, MIDUS II had 4963 participants, among whom 2313 reported being currently employed. Of those currently employed, 2130 (92%) had complete data for the variables used in the current analyses. In the 2013–2014 follow-up survey, 1562 participants with complete data were included, representing a follow-up rate of 73%. To minimize the impact of reverse causation and increase the accuracy of incidence estimates, participants who had experienced sleep disturbances at baseline were excluded. Consequently, the final sample size for the current analysis comprised 1333 individuals (refer to Fig. 1 for details on the sample size selection process). Written informed consent was obtained from all participants, and this study received approval from the University of California, Los Angeles Institutional Review Board (IRB#23-001176).

Measures

At baseline, workplace discrimination was assessed using an established six-item scale, which measures how frequently participants experienced unfair treatment in the workplace. Items reflect experiences such as being assigned undesirable tasks, being watched more closely than other workers, exposure to slurs or jokes from supervisors or coworkers, or being passed over for promotion. Responses were scored on a five-point scale ranging from $1 =$ Once a week or more to $5 =$ Never, and all items were reverse-coded so that higher scores reflected greater perceived discrimination. Total scores were calculated by summing item responses. The scale demonstrated good internal consistency (Cronbach's alpha $= 0.76$) [37]. Everyday discrimination was measured

Fig. 1 Flowchart of sample selection

All Participants in MIDUS II: 4963	
↓	→ Participants who are not working: 2650
Working population in MIDUS II: 2313	
↓	→ Participants missing data for workplace and everyday discrimination: 80
Working population in MIDUS II with full data on workplace and everyday discrimination data: 2233	
↓	→ Participants missing data covariates: 103
Working population in MIDUS II with full data on covariates: 2130	
↓	→ Participants lost to follow up: 568
Participants followed up in MIDUS III: 1562	
↓	→ Participants with major sleep disturbances at baseline: 229
Final sample size for analyses: 1333	

using a validated nine-item scale, which assesses interpersonal experiences of unfair treatment in daily life, such as being treated with less respect, receiving poorer service, or being insulted or harassed. Response options ranged from 1 = Often to 4 = Never, and items were reverse-coded so that higher values reflected more frequent discrimination. Total scores were calculated by summing item responses. The scale demonstrated strong internal consistency (Cronbach's alpha = 0.92) [36, 37]. The full item list for both scales is available in Supplementary Table 2.

Workplace and everyday discrimination scores were constructed by summing the item responses for each instrument, with possible score ranges of 0–30 for workplace discrimination and 0–45 for everyday discrimination. Both were dichotomized into high and low exposure groups using the median score of 9 as the cutoff. To examine the joint effects of both exposures, a composite variable was created with four categories: low workplace–low everyday, low workplace–high everyday, high workplace–low everyday, and high workplace–high everyday discrimination.

At both baseline and follow-up, participants answered four questions about how often they had trouble falling asleep, trouble with waking up during the night, trouble with waking up too early, and felt unrested in the morning. Each question had five response categories: 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, and 5 = Almost Always.

Response categories were recorded so that individuals were considered as experiencing sleep disturbances if they answered 'almost always', 'often' or 'sometimes' to all four of the questions. Sleep disturbances were defined as the experience of all four sleep difficulties (i.e. score = 4) [38].

At baseline, information on sociodemographic factors and health-related behaviors was collected. The following covariates were selected for adjustment to control for confounding due to being well-known risk factors for sleep disturbances [39, 40], and have commonly been adjusted for when examining associations between discrimination and sleep disturbances in previous studies [20–25]: age (≤ 45 years, 46–55 years, ≥ 56 years), sex (men, women), race (White, non-White without further sub-categories due to very small sample size), marital status (married, never married, other), educational attainment (high school or less, some college, university degree or more), annual household income (< $60 000, $60 000–99 999, ≥ $100 000), current cigarette smoking (no, yes), alcohol consumption (low to moderate drinking, up to 2 drinks per day for men and 1 drink per day for women; heavy drinking, more than moderate drinking), body mass index (underweight: BMI < 18.5, normal: BMI 18.5–24.9, overweight/obese: ≥ 25) [41, 42], and frequency of vigorous leisure-time physical exercise (low – never; moderate – once a week to once a month; high – several times a week) [20–25, 39, 40].

Statistical Analysis

First, descriptive statistics were generated. Relative frequencies were investigated for categorical variables. Cumulative incidence of sleep disturbances was also computed. Subsequently, the associations of job discrimination and everyday discrimination individually at baseline with the risk of sleep disturbances were estimated using a modified Poisson regression with log-link and robust error variance to estimate risk ratios (RRs) and 95% confidence intervals (CIs) relating discrimination and incident sleep disturbances [43]. We fit separate models for workplace discrimination alone, everyday discrimination alone, and the combination of workplace discrimination and everyday discrimination. To adjust for confounding, multivariable regression models were executed in three steps. Model I was adjusted for age and sex; Model II incorporated additional adjustments for race, marital status, education, and household income; and Model III further adjusted for smoking, alcohol consumption, and physical exercise.

The synergy index was calculated to assess whether the combined effect of both types of discrimination on sleep disturbances (RR_{11}) was greater than what would be expected based on their individual effects alone (RR_{01} and RR_{10}). Synergy index = $(RR_{11} - 1)/([RR_{01} - 1] + [RR_{10} - 1])$. Synergy index was calculated by first determining the risk ratios

for each exposure combination, representing the relative risk of experiencing sleep disturbances for individuals exposed to specific factors. The 95% CI for the synergy index was calculated using the delta method which estimates the variance by using the derivative of the transformation and the variance of the original parameter [44]. Results indicate departure from additivity and therefore would indicate evidence of either positive interaction (more than additivity) if synergy index is greater than 1, no interaction (exact additivity) if synergy index equals 1, or negative interaction (less than additivity) if synergy index is less than 1 [45]. Data were interpreted by assessing the magnitude, direction, and precision of effect estimates, rather than relying solely on binary significance testing. All analyses were performed using the SAS 9.4 software package.

Results

The characteristics of the study sample at baseline are shown in Table 1. The sample of 1333 participants were predominantly middle-aged, with most participants between the ages of 46–55 at baseline. There was a near-equal distribution of males and females, and the majority of participants identified as White. Most participants had at least some college education, were nonsmokers, consumed alcohol at low to moderate levels, overweight or obese, and engaged in at least moderate levels of physical exercise. Participants reporting high workplace discrimination were more likely to be male, younger, and current smokers compared to those who experienced low work discrimination. Those who experienced high everyday discrimination were more likely to be female, non-White, have lower household income, and overweight or obese than those who experienced low everyday discrimination.

Among the 1333 participants, the overall cumulative incidence of sleep disturbances was 11.63%. Respectively, the cumulative incidence of sleep disturbances was 14.01% for high workplace discrimination, 13.36% for high everyday discrimination, and 15.50% for both high workplace and everyday discrimination.

Table 2 presents estimated risk ratios (RR) relating discrimination and sleep disturbances. After adjusting for covariates, the nine-year risk of sleep disturbances among those who experienced high workplace discrimination was 1.5 times the nine-year risk of sleep disturbances among those who experienced low everyday discrimination (adjusted RR and 95% CI = 1.50 [1.09, 2.06]). After adjusting for covariates, the nine-year risk of sleep disturbances among those who experienced high everyday discrimination had a 39% higher nine-year risk of sleep disturbances among those who experienced low everyday discrimination (fully adjusted RR and 95% CI = 1.39 [1.00, 1.93]).

Table 1 Baseline Characteristics of Study Sample

Characteristics	Overall (n = 1333)	Workplace Discrimination		Everyday discrimination	
		Low (n = 669)	High (n = 664)	Low (n = 615)	High (n = 718)
Age (mean, SD)	51.3 (9.3)	53.09 (9.57)	49.55 (8.58)	51.90 (9.5)	50.95 (9.08)
Sex					
Male	684 (51.31)	306 (45.74)	378 (56.93)	345 (56.10)	339 (47.21)
Female	649 (48.69)	363 (54.26)	286 (43.07)	270 (43.90)	379 (52.79)
Race/Ethnicity					
White	1252 (93.92)	629 (94.02)	623 (93.83)	590 (95.93)	662 (92.20)
Non-White	81 (6.08)	40 (5.98)	41 (6.17)	25 (4.07)	56 (7.80)
Marital Status					
Married	999 (74.94)	507 (75.78)	492 (74.10)	483 (78.54)	516 (71.87)
Other	334 (25.06)	162 (24.22)	172 (25.90)	132 (21.46)	202 (28.13)
Education					
University or More	297 (22.28)	134 (20.03)	163 (24.55)	114 (18.54)	183 (25.49)
Some College	360 (27.01)	180 (26.91)	180 (27.11)	159 (25.85)	201 (27.99)
High School or Less	676 (50.71)	355 (53.06)	321 (48.34)	342 (55.61)	334 (46.52)
Annual Household (US$)					
< 60,000	543 (40.74)	280 (41.85)	263 (39.61)	227 (36.91)	316 (44.01)
60,000—99,999	405 (30.38)	193 (28.85)	212 (31.93)	191 (31.06)	214 (29.81)
≥ 100,000	385 (28.88)	196 (29.30)	189 (28.46)	197 (32.03)	188 (26.18)
Currently Smoking					
No	1164 (87.32)	607 (90.73)	557 (83.89)	549 (89.27)	615 (85.65)
Yes	169 (12.68)	62 (9.27)	107 (16.11)	66 (10.73)	103 (14.35)
Alcohol Consumption					
Low or Moderate	1294 (97.07)	648 (96.86)	646 (97.29)	601 (97.72)	693 (96.52)
Heavy	39 (2.93)	21 (3.14)	18 (2.71)	14 (2.28)	25 (3.48)
Physical Exercise					
Low	307 (23.03)	169 (25.26)	138 (20.78)	158 (25.69)	149 (20.75)
Moderate	451 (33.83)	201 (30.04)	250 (37.65)	183 (29.76)	268 (37.33)
High	575 (43.14)	299 (44.69)	276 (41.57)	274 (44.55)	301 (41.92)
BMI					
Underweight	9 (0.68)	7 (1.05)	2 (0.30)	5 (0.81)	4 (0.56)
Normal	445 (33.38)	249 (37.22)	196 (29.52)	227 (36.91)	218 (30.36)
Overweight/Obese	879 (65.94)	413 (61.73)	466 (70.18)	383 (62.28)	496 (69.08)

Table 2 Independent associations of baseline workplace and everyday discrimination with incident sleep disturbance (risk ratio and 95% CI) N = 1333

	Cumulative incidence (%)	Model 0	Model I	Model II	Model III
Workplace Discrimination:					
Low	9.27 [7.65, 10.88]	1.00	1.00	1.00	1.00
High	14.01 [12.39, 15.63]	1.51 [1.12, 2.05]	1.54 [1.14, 2.09]	1.53 [1.12, 2.09]	1.50 [1.09, 2.06]
Everyday Discrimination:					
Low	9.02 [7.45, 10.59]	1.00	1.00	1.00	1.00
High	13.36 [11.81, 14.92]	1.48 [1.07, 2.04]	1.42 [1.03, 1.97]	1.40 [1.01, 1.95]	1.39 [1.00, 1.93]

Model 0: crude model

Model I: adjustment for age and sex at baseline

Model II: Model I + additional adjustment for race, marital status, education, and household income at baseline

Model III: Model II + additional adjustment for smoking, alcohol consumption, body mass index, and physical exercise at baseline

In Table 3, findings of joint associations of workplace discrimination and everyday discrimination on sleep disturbances and synergy index are presented. The analyses indicated that the combination of high workplace discrimination and high everyday discrimination vs. the combination of low workplace discrimination and low everyday discrimination was associated with sleep disturbances (fully adjusted RR and 95% CI = 1.78 [1.16, 2.72]). The synergy index for the combined effect of high workplace discrimination and high everyday discrimination was 1.81 (95% CI: 0.33, 13.97) indicating evidence of additive interaction.

Discussion

Using a national sample of the working population in the United States, this study investigated the prospective associations of workplace and everyday discrimination with incident sleep disturbances. After adjusting for related covariates, both workplace and everyday discrimination were significantly associated with incident sleep disturbances at the 9-year follow-up. The combination of high workplace discrimination and high everyday discrimination exerted stronger effects on sleep disturbances. The synergy index (S) measures the combined effect of two factors—in this case, two types of discrimination—on an outcome, sleep disturbances. If the synergy index is greater than 1 (S > 1), it suggests that the joint impact of both forms of discrimination is greater than the sum of their individual effects. Although the point estimate indicates a value greater than 1, a wide confidence interval (CI) means that the precision of this estimate is uncertain.

Our findings that everyday discrimination is associated with increased risk of sleep disturbances are consistent with a growing body of research showing that experiences of discrimination, whether based on race, ethnicity, gender, or other factors, are linked to poorer sleep outcomes. Cross-sectional studies across large and diverse samples have consistently found associations between perceived discrimination and reduced sleep quality, lower sleep efficiency, and more frequent sleep disruptions [21–24]. For example, studies conducted during the COVID-19 pandemic found that racial discrimination disproportionately affected sleep quality among Black and Asian individuals [21], and similar associations have been observed among adolescents [22], and racial and ethnic minority women [23]. Longitudinal studies further support these findings. Data from the Jackson Heart Study showed that higher levels of everyday discrimination were associated with pronounced declines in sleep quality among African Americans [26]. Among pregnant African American women, greater exposure to racial and gendered discrimination was linked to poorer sleep during early and mid-pregnancy [28], while a study of Filipino migrants found that higher and stable levels of everyday discrimination over two years predicted faster declines in sleep quality [27]. Additionally, a subset of the MIDUS II Study in Wisconsin implicates sleep quality as a potential mediator between lifetime discrimination and inflammation burden [24]. This provides insight into the potential biological pathways that connect discrimination to sleep disturbances and ultimately poor health outcomes.

Our findings also show that workplace discrimination is associated with an increased risk of sleep disturbances, aligning with the smaller but consistent body of existing research on this topic. Previous cross-sectional studies have linked workplace mistreatment, including discrimination and harassment, to poorer sleep outcomes, as demonstrated by a large study conducted in South Korea [33], and another study examining experiences of workplace harassment [25]. Longitudinal research supports these associations as well, with data from the Sister Study showing that race-specific job discrimination increased the odds of developing sleep

Table 3 Joint associations of baseline workplace and everyday discrimination with incident sleep disturbance (risk ratio and 95% CI) N = 1333

Discrimination	Cumulative incidence (%)	Model 0	Model I	Model II	Model III
Workplace: Low + Everyday: Low (n = 339)	8.26 [6.70, 9.82]	1.00	1.00	1.00	1.00
Workplace: Low + Everyday: High (n = 330)	10.30 [8.72, 11.88]	1.44 [0.90, 2.33]	1.39 [0.86, 2.24]	1.36 [0.84, 2.20]	1.35 [0.83, 2.19]
Workplace: High + Everyday: Low (n = 193)	10.36 [8.77, 11.95]	1.62 [1.00, 2.32]	1.68 [1.03, 2.73]	1.66 [1.02, 2.71]	1.62 [0.99, 2.67]
Workplace: High + Everyday: High (n = 471)	15.50 [13.96, 17.04]	1.89 [1.25, 2.86]	1.85 [1.22, 2.80]	1.82 [1.19, 2.77]	1.78 [1.16, 2.72]
Synergy Index	-	1.75 [0.36, 9.36]	1.60 [0.33, 7.85]	1.75 [0.29, 10.66]	1.81 [0.33, 13.97]

Model 0: crude model

Model I: adjustment for age and sex at baseline

Model II: Model I + additional adjustment for race, marital status, education, and household income at baseline

Model III: Model II + additional adjustment for smoking, alcohol consumption, body mass index, and physical exercise at baseline

problems among working women [34], and findings from the MIDUS Study indicating that perceived unfairness in the workplace was associated with symptoms of insomnia over time [35].

While past literature has shown that workplace discrimination and everyday discrimination each independently contribute to disturbances, no comprehensive study has examined their combined effects. Our findings indicate an additive effect of workplace and everyday discrimination on sleep disturbances. The double burden of workplace and everyday discrimination can significantly impact sleep disturbances. Individuals who experience discrimination in multiple environments endure constant stress, which disrupts their sleep patterns and increases their overall stress burden [46]. The double burden also magnifies the psychological toll of discrimination, as the stress from multiple sources can overwhelm coping mechanisms and lead to emotional exhaustion [47]. This compounded stress not only affects mental health but also has significant physiological effects, such as increased cortisol levels and heightened autonomic arousal, which further disrupt sleep quality [48]. The concept of cumulative adversity may explain this relationship by highlighting how independent stressors from different sources combine to impact overall well-being. Cumulative adversity emphasizes that the total impact of these stressors is often greater than the sum of their parts, as each additional stressor can amplify negative effects on health, leading to increased vulnerability to adverse health consequences [47]. Over time, cumulative adversity can deplete an individual's resources and resilience, affecting their ability to cope with new stressors [46]. However, the idea that each stressor contributes independently to the overall burden because they originate from distinct contexts, involve separate coping mechanisms, and do not interact to amplify their effects may explain why the combination of workplace and everyday discrimination has an additive effect. Workplace discrimination typically involves structural and institutional biases, such as unequal opportunities for promotion or pay, while everyday discrimination includes interpersonal interactions like microaggressions or social exclusion. There may also be a threshold beyond which additional stress does not significantly increase negative outcomes, and resilience developed over time can help mitigate the impact [49]. Understanding these dynamics is crucial for developing effective interventions and support systems to address and mitigate the adverse effects of discrimination on health.

While evidence linking discrimination and sleep has been documented, the exact pathways remain unclear. The potential biological mechanisms connecting discrimination to sleep disruptions involve disturbances in the psychoneurological and endocrinological systems, namely the hypothalamic-pituitary-adrenocortical axis and cortisol pathway [48]. Sleep deprivation elevates cortisol levels, negatively impacting dynamic and static emotional balance, and dysregulates both sympathetic and parasympathetic branches of the central nervous system, contributing to difficulties in sleep initiation and maintenance [50, 51]. Given that previous literature has found that there is likely a positive relationship between racial discrimination and cortisol output despite its complex relationship, this may help explain the pathway through which discrimination leads to sleep disturbances [52]. Discrimination likely affects sleep through both immediate and long-term processes: acute experiences of stress and emotional arousal can trigger short-term sleep disturbances, while chronic exposure may lead to cumulative biological wear and tear, including hormonal dysregulation and inflammation. Baseline reports of discrimination may therefore reflect both ongoing exposure and a broader psychosocial environment that continues to shape sleep health over time. Future research incorporating repeated measures of discrimination will be critical to better understand how evolving exposure patterns influence sleep across the life course.

This study's findings that both workplace discrimination and everyday discrimination are associated with sleep disturbances hold significant implications for workplace policies and broader public health strategies. Our study extends prior research by simultaneously examining the independent and joint effects of workplace and everyday discrimination using prospective cohort data. We found that both forms of discrimination independently increased the risk of sleep disturbances and that their combined impact was additive. These results suggest that exposure to discrimination across multiple life domains may create a cumulative stress burden that overwhelms coping resources and disrupts physiological processes involved in sleep regulation. Addressing discrimination not only in interpersonal settings but also within organizational structures may be critical for improving sleep health and promoting overall well-being.

Notably, both discrimination and sleep issues have independently been linked to various health-related consequences [2–4]. The identified association emphasizes the critical need for further research, policies, and vigilant adherence to them. Since our study did not include analyses related to race and ethnicity, further investigation involving a more diverse cohort demographic incorporating thorough analyses of race and ethnicity is needed. Additional research should also be done on potential sources of workplace and everyday discrimination, examining contributions from both upper management and coworkers. In an ethnically and culturally heterogeneous country like the United States, prioritizing diversity and inclusion becomes even more crucial. This emphasizes the necessity for the implementation of protective policies and ongoing evaluations within workplaces. These measures may involve enhancing cultural competency training, conducting audits during both the hiring process and throughout employment,

and establishing more effective systems for reporting discriminatory behavior. Inclusivity in the workplace may promote better workplace satisfaction and could influence not only the health but the productivity of workers.

Strengths and Limitations

To the best of our knowledge, our study is the first to investigate the joint effects of workplace and everyday discrimination using prospective cohort data from a national United States working population. The utilization of a prospective cohort design, coupled with an extensive follow-up period, enhances the reliability of the findings. Even after adjusting for various covariates, the study's associations remain robust, adding credibility to our conclusions. The study utilized validated instruments to measure workplace discrimination, everyday discrimination, and sleep disturbances, and thus we are confident in the fidelity of exposure and outcome assessment.

While the long follow-up period is a strength in allowing the prospective assessment of discrimination and sleep disturbances, it also introduces certain limitations. One key assumption is that discrimination experiences reported at baseline either persist over time or serve as a reliable proxy for chronic exposure to discrimination. Although it is plausible that individuals who reported high levels of discrimination at baseline continued to experience discrimination over the subsequent nine years, the possibility of changes in exposure that were not captured must be acknowledged. This limitation could introduce exposure misclassification if discrimination levels changed substantially over time. Furthermore, as presented in Supplementary Table 1, we found that individuals lost to follow-up were more likely to be those who did not attend university, were smokers, non-white, overweight or obese, and had moderate to low levels of physical exercise. This suggests potential selection bias that may lead to skewed results, particularly if the relationships between workplace discrimination and sleep disturbances differ in underrepresented groups. While measurement of sleep disturbances is commonly self-reported, such reliance on self-reported sleep disturbances may introduce potential non-differential outcome misclassification due to equally likely recall bias in both exposure groups. These considerations suggest that the true effect size of associations may differ from what statistical analyses reveal.

Conclusion

Our study found that workplace discrimination and everyday discrimination individually were positively associated with an increased risk of sleep disturbances among United States workers. Moreover, the joint effect of high workplace discrimination and high everyday discrimination was also found to be prospectively associated with an elevated risk of sleep disturbance within the study population. The synergy index results evidence of additive interaction of workplace discrimination and everyday discrimination on sleep disturbances. These results imply that both workplace discrimination and everyday discrimination could serve as critical determinants of mental and physical health, functioning as independent risk factors for sleep disturbances. Acknowledging the joint effect of workplace and everyday discrimination is paramount in shaping psychosocial work environments, emphasizing the need for workplace interventions targeting inclusivity and mental health advocacy in the workplace.

Declarations

Ethics Approval This study received approval from the University of California, Los Angeles Institutional Review Board (IRB#23-001176). All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Consent to Participate Informed consent was obtained from all individual participants included in the study.

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