SSM - Population Health 30 (2025) 101774

Contents lists available at ScienceDirect

SSM - Population Health

journal homepage: www.elsevier.com/locate/ssmph

Skin tone – a marker of bias known as colorism – in relation to sleep health among African American women

Bethany T. Ogbenna [a], Symielle A. Gaston [a], Taylor W. Hargrove [b], Quaker E. Harmon [a], Donna D. Baird [a], Chandra L. Jackson [a,c,*]

[a] Epidemiology Branch, National Institute of Environmental Health Sciences, National Institutes of Health, Research Triangle Park, NC, USA
[b] Department of Sociology and Carolina Population Center, University of North Carolina at Chapel Hill, Chapel Hill, NC, USA
[c] Division of Intramural Research, National Institute on Minority Health and Health Disparities, National Institutes of Health, Bethesda, MD, USA

ARTICLE INFO

Keywords:
Sleep duration
Sleep quality
Colorism
Black women
Skin tone
Differential treatment

ABSTRACT

People with darker-skin tone are more likely than their lighter-skin counterparts to have less access to health-promoting resources (e.g., economic security; quality housing; favorable neighborhood environment). These adverse conditions can affect sleep and result in poor health outcomes such as cardiovascular disease and depression. However, few studies have examined associations between skin tone and sleep disparities. To address this gap, we used cross-sectional (2010–2012) and longitudinal (until 2014–2018) data from the Study of Environment, Lifestyle and Fibroids cohort of 1674 Black women aged 23-35 years and residing in the Detroit, Michigan area. Skin tone was measured using a skin reflectance instrument and categorized as light [29.3–57.6] (25%), medium [57.7–72.4] (50%), and dark [72.5–106.1] (25%) brown. Self-reported sleep dimensions were dichotomized (yes vs. no): short sleep duration, non-restorative sleep, insomnia symptoms, and sleep apnea. Adjusting for age and educational attainment, we used Poisson regression with robust variance to estimate prevalence ratios (PRs) and 95% confidence intervals (CIs) and applied generalized estimating equations to log binomial models to determine risk ratios (RRs) and 95% CIs between skin tone and each sleep dimension, separately. Dark vs. light skin tone was associated with marginally higher prevalence and risk of short sleep (PR = 1.04 [95% CI:1.00–1.08]; RR = 1.07 [95% CI: 0.99–1.16]) and a lower prevalence of insomnia symptoms (PR = 0.95 [95% CI: 0.91–0.99]). Insomnia symptoms were more prevalent among women with light skin tone (21.1% vs. 17.7% [medium] and 15.6% [dark]). Our findings elucidate the critical importance and need to address the differential impact of historical ideologies, systems, policies, and practices on Black women, which can manifest health-damaging social phenomena like colorism.

1. Introduction

Historical systems in the United States (US) differentially affect racially minoritized groups leading to limited socioeconomic and educational attainment opportunities, healthcare access and quality, housing, and access to health-promoting resources (Bailey et al., 2017; Gee et al., 2011; Jones, 2000). Relatedly, prejudicial laws, policies, practices, and ideologies that emerge from these systems lead to disparate health outcomes and variation in overall wellbeing among racially minoritized groups (Braveman et al., 2022; Clark et al., 2022; Jones, 2001). This unequal distribution of power, privilege, and prestige and its sustaining force is the fundamental driver from which colorism emanates (Russell et al., 1992, p. 200). Moreover, at the individual-level, differential assumptions about others based on race may lead to unfavorable treatment such as microaggressions, bullying, or verbal harassment (Jones, 2001; Willis et al., 2021).

While such systems of differential treatment affect all racialized populations in the US, the magnitude of their consequences may vary based on other social status characteristics, including skin tone. As a key physical attribute that has been used to differentiate socially constructed racial groups, skin tone serves as a marker of colorism - a global system of differential treatment based on skin color (Borrell et al., 2006; Hargrove, 2019; Jablonski, 2021). Consequently, colorism reinforces the racial hierarchy within and across racial groups by assigning socioeconomic and psychosocial advantages to individuals with lighter-skin tones (who tend to benefit from the proximity to whiteness (Monk,

* Corresponding author. 111 TW Alexander Drive, Research Triangle Park, NC, 27709, USA.
E-mail address: Chandra.Jackson@nih.gov (C.L. Jackson).

https://doi.org/10.1016/j.ssmph.2025.101774
Received 30 December 2024; Received in revised form 28 February 2025; Accepted 5 March 2025
Available online 5 March 2025

2015; Monk, 2021a; Monk, 2021b). This differential treatment, both intragroup (i.e., within racial group) and intergroup (i.e., across racial group), limits access to health-promoting resources for darker skinned individuals (Keith et al., 1991). For example, African-American/Black (hereafter "Black") men in the US with dark skin tone have previously reported more intergroup differential treatment than Black men with light skin tone, whereas intragroup differential treatment is more commonly reported among Black men with light skin tone vs. Black men with medium skin tone (Uzogara et al., 2014). These differences in treatment can lead to adverse health (Johnson et al., 2022).

With regard to the impact of colorism on health, prior epidemiologic studies have shown Black adults with darker-skin tones tend to have a higher allostatic load (Hargrove, 2019) and a greater risk of cardiovascular-related conditions (e.g., hypertension) (Sweet et al., 2007). Additionally, colorism can have psychosocial consequences as asserted by the social pain theory, which theorizes that the effect of chronic rejection or exclusionary behaviors in the workplace and/or social environments can result in socioemotional pain (DeAngelis et al., 2022). The biosocial response to socioemotional pain is primarily exhibited as a chronic inflammatory stress response as observed among US Black adults (Clark et al., 1999). Prior studies suggest differential or perceived unfavorable treatment are associated with shorter sleep duration and sleep disturbances in US Black adults (Bethea et al., 2020; Johnson et al., 2021); however, exposure to unfavorable treatment likely varies by skin tone. US Black adults have limited exposure to positive Black media representation and over-exposure to predominately Eurocentric beauty standards, which could influence adverse interpersonal perceptions and self-perceptions (Keith et al., 2017; Klonoff et al., 2000; Mead et al., 2023). In the US, colorism affects Black women and men across skin tones differently. US Black women with lighter skin tone are typically more likely to experience better socioeconomic resources and benefits (Uzogara et al., 2016), and US Black men with lighter skin tone share similar socioeconomic benefits observed within corporate, mainstream work environments (Uzogara et al., 2014) compared to women and men with darker skin tone (Hall et al., 2015). These differential practices and interpersonal perceptions generally benefit women with lighter skin tones. This differential treatment can, for instance, lead to chronic stress and psychosocial distress that activates the main stress response system known as the hypothalamic-pituitary-adrenal axis (HPA) (Clark et al., 1999; DeAngelis et al., 2022; Monk, 2021b; Ocampo, 2000). These changes can affect sleep health. Like racism, colorism may be a fundamental determinant of sleep health disparities (Johnson et al., 2021; Lewis et al., 2019; Slopen et al., 2016).

Sleep – an essential pillar of health – can be adversely affected by physical and psychosocial stressors in ways that lead to a broad range of poor health outcomes, including obesity, hypertension, a compromised immune system, and cardiovascular disease (Lim et al., 2023). Prior studies have shown racially minoritized groups experience shorter sleep duration, poorer sleep continuity, more severe sleep-disordered breathing, and insomnia symptoms (Shah et al., 2020) compared to Non-Hispanic (NH)-White individuals. Moreover, Black women, in particular, have a higher prevalence of adverse sleep health outcomes compared to NH-White women (Hall et al., 2015) and a higher overall prevalence of sleep disturbances than men (Zeng et al., 2020). Few studies, however, have examined the association between skin tone and sleep health among US Black women. One study examined the disparate intragroup health outcomes, including sleep duration by skin tone, among Black women from the Study of Environmental, Lifestyle and Fibroids (SELF). Moore and coauthors observed Black women with darker-compared to lighter-brown skin had marginally significant shorter sleep duration in a cross-sectional analysis (Moore et al., 2021). While informative, further investigation is needed to examine skin tone in relation to sleep as a multidimensional outcome using sleep duration along with additional measures of sleep disturbances over time, as the association of skin tone and sleep is not well understood. To date, there are no studies, to our knowledge, that have investigated the association between skin tone – as a marker for bias – and sleep duration as well as sleep quality over time.

To address this important gap in the literature, we investigated cross-sectional and longitudinal risk associations between skin tone and multiple sleep dimensions among young Black women from SELF. Secondly, we investigated annual household income as a potential modifier of cross-sectional associations between skin tone and multiple sleep dimensions. Our rationale is that the consequences of colorism have impacted socioeconomic opportunities (e.g., educational attainment, income, and occupational prestige) among Black adults and have differentially affected Black adults across skin tones (Cobb et al., 2016; Keith et al., 1991; Monk, 2014). We used annual household income as a measure of socioeconomic status because it is associated with greater access to health-promoting resources and therefore may be linked to a greater likelihood of favorable sleep (Monk, 2021b; Phelan et al., 2015). Lastly, we investigated the interaction between annual household income and skin tone to assess its influence on sleep health. Based on prior literature (Monk, 2015; Moore et al., 2021), we hypothesized that: 1) dark-brown versus light-brown skin tone is associated with poorer sleep health, 2) women across all skin tones with lower annual household income vs. higher annual household income have poorer sleep, and 3) dark skin tone and low income vs. light skin tone and high income is associated with the worst sleep health outcomes.

2. Methods

2.1. Data source and study population

We used data from the ongoing community-based prospective cohort, SELF, which comprised 1693 Black women aged 23–35 years at enrollment residing in the Detroit, Michigan area in the US. Details on self-reported questionnaire data and recruitment have been described elsewhere (Baird et al., 2015). Women were ineligible for SELF if they were previously diagnosed with fibroids, had a hysterectomy, required medication for lupus, Grave's disease, Sjogren's scleroderma, or multiple sclerosis, or had previous radiation or chemotherapy treatment for cancer. Briefly stated, SELF included comprehensive questionnaire data at baseline (2010–2012) and each follow-up at approximately 20-month intervals. SELF was approved by the Institutional Review Board of the National Institute of the Environmental Health Sciences and by Henry Ford Health. All SELF participants provided informed consent.

The present study uses SELF data from the self-administered computer-assisted web interviewing (CAWI) questionnaire and the computer-assisted telephone interviewing questionnaire, which was administered at baseline and and at the first, second, and third follow-ups (2012–2015, 2014–2016, 2016–2018, respectively). Participants were excluded from the analysis if they reported long sleep duration >9 h (n = 19) at any visit. The proportion of participants reporting long sleep was ~1% at baseline. The final analytic population included 1674 Black women.

2.2. Exposure ascertainment – skin tone assessment and stratification

Skin tone was measured objectively at baseline using a digital skin reflectance instrument (DSM II ColorMeter, Cortex Technology, Denmark). Skin tone was measured on a scale with the lowest number indicating the lightest brown skin tone and the highest number indicating the darkest brown skin tone. Using the Commission International d'Eclariage (CIE), skin lightness was measured using three numerical values: L* for lightness, a* for green-red components and b* for blue-yellow components of the skin. Any skin tone variation can be expressed using the L*a*b coordinates (d'Eclairage, 2007). Triplicate skin tone measurements were obtained from the right inner arm and the mean skin tone value was calculated to determine skin tone for each participant. Consistent with previous studies using data from the

Table 1
Baseline participant sociodemographic characteristics, health behaviors, and clinical along with social factors, Study of Environment, Lifestyle and Fibroids, 2010–2012

Sociodemographic characteristics	Total N = 1674	Light Brown Skin Tone	Medium Brown Skin Tone	Dark Brown Skin Tone	*p*- value
		n = 422; 25%	n = 835; 50%	n = 417; 25%	
Age, years	29.0±6.0	29.0±6.0	29.0±5.0	29.0±6.0	0.57
Age, years					0.38
23-29	941 (56.2)	225 (53.3)	478 (57.2)	238 (57.1)	
30-35	733 (43.8)	197 (46.7)	357 (42.8)	179 (42.9)	
Educational attainment					<0.01
≤ High school or GED	364 (21.7)	61 (14.5)	179 (21.4)	124 (29.7)	
Some college/Associate or Technical Degree	835 (49.9)	213 (50.5)	417 (49.9)	205 (49.2)	
≥ Bachelor's Degree	475 (28.4)	148 (35.1)	239 (28.6)	88 (21.1)	
Annual household income, dollars					<0.01
< $20,000	760 (45.4)	155 (36.7)	370 (44.3)	235 (56.4)	
≥ $20,000	914 (54.6)	267 (63.3)	465 (55.7)	182 (43.6)	
Employment status					
Unemployed/homemaker	630 (37.6)	149 (35.3)	300 (35.9)	181 (43.4)	0.02
Current full-or part-time	1044 (62.4)	273 (64.7)	535 (64.1)	236 (56.6)	
Marital status					
Ever married	696 (41.6)	192 (45.5)	354 (42.4)	150 (36.0)	0.02
Never married	978 (58.4)	230 (54.5)	481 (57.6)	267 (64.0)	
Health behaviors					
Health status					0.76
Good/very good/excellent	1328 (79.3)	340 (80.6)	658 (78.8)	330 (79.1)	
Fair/poor	346 (20.7)	82 (19.4)	177 (21.2)	87 (20.9)	
Smoking status					0.01
Never	1233 (73.7)	325 (77.0)	623 (74.6)	285 (68.3)	
Former/current	441 (26.3)	97 (23.0)	212 (25.4)	132 (31.7)	
Alcohol consumption					
Low/moderate	1346 (80.4)	358 (84.8)	659 (78.9)	329 (78.9)	0.03
Heavy	328 (19.6)	64 (15.2)	176 (21.1)	88 (21.1)	
Clinical and social characteristics					
Skin color index	65.4 ± 11.0	51.8 ± 4.7	65.0 ± 4.1	79.7 ± 6.1	<0.01
Body mass index, (kg/m^2)	33.6± 9.5	32.5 ± 8.7	33.2 ± 9.4	35.7 ± 10.4	<0.01
Body mass index, (kg/m^2)					<0.01
<18.5 to < 25	333 (19.9)	97 (23.0)	165 (19.8)	71 (17.0)	
25 to < 30	346 (20.7)	95 (22.5)	190 (22.8)	61 (14.6)	
30 to < 35	325 (19.4)	74 (17.5)	173 (20.7)	78 (18.7)	
35 to < 40	275 (16.4)	71 (16.8)	135 (16.2)	69 (16.5)	
40+	395 (23.6)	85 (20.1)	172 (20.6)	138 (33.1)	
CES-D score [a]	5.7 ± 4.3	5.3 ± 4.3	5.7 ± 4.3	5.9 ± 4.5	0.13
CES-D scale categories [a]					0.57
CESD score <8	1191 (71.1)	311 (73.7)	589 (70.5)	291 (69.8)	
CESD score ≥9	403 (24.0)	89 (21.1)	208 (24.9)	106 (25.4)	
Missing	80 (4.8)	22 (5.2)	38 (4.6)	20 (4.8)	
Racism/discrimination in past 12 months					0.88
No	1413 (84.4)	356 (84.4)	708 (84.8)	349 (83.7)	
Yes	261 (15.6)	66 (15.6)	127 (15.2)	68 (16.3)	
Stress due to racism in past 12 months [b]					0.97
No stress	35 (13.4)	9 (13.6)	18 (14.2)	8 (11.8)	
Mild	122 (46.7)	33 (50.0)	59 (46.5)	30 (44.1)	
Moderate to severe	104 (39.8)	24 (36.4)	50 (39.4)	30 (44.1)	
Sleep measures (continuous)					
Sleep duration before a workday, hours	6.2 (1.5)	6.2 (1.6)	6.2 (1.5)	6.0 (1.6)	0.20
Wake up feeling well rested, days/week	3.0 (1.9)	2.9 (2.0)	3.0 (1.8)	3.1 (1.8)	0.97
Insomnia symptoms, days/week	2.9 (2.4)	2.9 (2.5)	2.9 (2.4)	2.7 (2.4)	0.11
Sleep measures (categories)					
Short sleep duration [c] (yes)	989 (59.1)	235 (55.7)	497 (59.5)	257 (61.6)	0.20
Nonrestorative sleep [d] (yes)	1043 (62.3)	265 (62.8)	519 (62.2)	259 (62.1)	0.97
Insomnia symptoms [e] (yes)	302 (18.0)	89 (21.1)	148 (17.7)	65 (15.6)	0.11
Sleep apnea [f] (yes)	88 (5.3)	19 (4.5)	44 (5.3)	25 (6.0)	0.72

Data presented as n (%), or mean ± standard deviation. Abbreviations: GED (general education development test); CESD (Center for Epidemiologic Studies Depression Scale); P-values were obtained from Chi-sq tests or One-way ANOVA (when comparing means); for age, the Kruskal Wallis nonparametric test was used.
Note: Unemployed/homemaker includes unemployed, homemaker, student, and retired. Ever married includes previously or currently married or lived/living with partner and never married includes never lived as married. Alcohol consumption was defined as: 1–5 drinks on day when having alcohol or 4+ drinks once/month or less (low to moderate) and 6+ drinks on days when having alcohol or 4+ minimum 2x/month (heavy). Baseline data collection occurred from 2010 to 2012.

[a] Measured at follow-up #1.
[b] Assessed among participants who responded "yes" to experiencing racism/discrimination in the past 12 months.
[c] Short sleep duration defined as <7 h vs. 7–9 h (recommended) (measured at baseline).
[d] Nonrestorative sleep defined as frequently waking feeling unrested (woke feeling well rested ≤3 days/week) (measured at baseline).
[e] Insomnia symptoms defined as frequent difficulty falling or staying asleep ≥10 days/month (measured at baseline).
[f] Sleep apnea defined as ever been told had sleep apnea by a doctor (measured at follow-up #3 only).

Coronary Artery Risk Development in Young Adults (CARDIA) study and the National Survey of American Life (NSAL) study (Borrell et al., 2006; Hargrove, 2019; Krieger et al., 1998; Oh et al., 2021; Sweet et al., 2007; Uzogara, 2019), skin tone was categorized based on the 25th and 75th percentiles of the distribution of data. Skin tone categories were defined as light: values ≤ 25th percentile [29.3–57.6], medium: values between 25th and 75th percentiles [57.7–72.4], and dark: values ≥ 75th percentile [72.5–106.1]. The light skin tone was selected as the referent group because lighter skin tone has closer proximity to the favorable societal perception and associated socioeconomic opportunities of White individuals, and prior literature suggests NH-White individuals have better sleep quality and duration compared to Black individuals (Johnson et al., 2019).

2.3. Outcome ascertainment: dimensions of sleep health

Participants reported sleep duration, nonrestorative sleep, and insomnia symptoms at baseline and at each follow-up, and sleep apnea during the third follow-up. Participants responded to "How many hours of sleep do you usually get before a workday?" Short sleep duration was dichotomized (<7 h vs 7–9 h) based on a joint consensus statement on sleep recommendations by the American Academy of Sleep Medicine and the Sleep Research Society (Watson et al., 2015). Nonrestorative sleep was defined as the number of days waking up feeling rested after sleeping, which was assessed with the following question: "How many days per week do you wake up feeling well rested?" and dichotomized as feeling well rested ≤3 days/week [yes, no]). Insomnia symptoms were captured as the number of days in a month having difficulty falling or staying asleep, using the following question: "About how many days per month do you have trouble falling asleep or going back to sleep when your sleep was interrupted?" with categorical response options ('0–4', '5–9', '10–14', or '15 or more' days). The insomnia symptoms measure was dichotomized as ≥10–14 days/month [yes] vs. 0–9 days/month [no]. Sleep apnea was assessed using the question, "Have you ever been told you have sleep apnea by a doctor?" [yes, no]. We operationalized each measure by categorizing responses consistent with prior literature (Gaston et al., 2024).

2.4. Potential confounders, moderators, and mediators

We identified potential confounders and potential mediators by construction of directed acyclic graphs (DAGs) (Supplemental Fig. 1) (Tennant et al., 2021). The following variables were potential confounders collected at baseline and at each follow-up: age in years (continuous); educational attainment (≤ high school or general education development (GED), some college/associate or technical degree, ≥ bachelor's degree). Annual household income (<$20,000, ≥ $20,000) was assessed as a potential moderator. The following were identified as potential mediators, and baseline data for these potential mediators are included in Table 1 for informational purposes: employment status (unemployed/homemaker, current full- or part-time); marital status (ever married, never married); health status (fair/poor, good/very good/excellent); body mass index category (<18.5 to < 25, 25 to < 30, 30 to < 35, 35 to < 40, 40+ kg/m^2) calculated using measured height and weight; smoking status (never, former/current); alcohol consumption; (low/moderate, heavy); racism/discrimination in past 12 months (no, yes); stress due to racism in past 12 months (no stress, mild, moderate to severe, missing); and depressive symptoms measured using a modified version of the 11-item Center for Epidemiologic Studies Depression Scale (CESD) as (yes [score ≥9] vs. no [score <9 score] (at follow-up #1) (Kohout et al., 1993)).

2.5. Statistical analyses

The distribution of sociodemographic, clinical and social characteristics, and health behaviors by skin tone was examined by estimating the mean as well as the standard deviation (SD) for continuous variables and frequencies as well as percentages for categorical variables. At baseline, differences in the distribution of characteristics by skin tone were assessed using the Chi-square test for categorical variables and a one-way ANOVA F test for continuous variables; for age, the Kruskal Wallis non-parametric test was used. The Cochran-Armitage tests assessed trends in sleep duration, nonrestorative sleep, and insomnia symptoms between baseline and the third follow-up.

We conducted cross-sectional analyses to estimate the prevalence ratios and 95% confidence intervals (CIs) for the association between skin tone and baseline data for sleep duration, nonrestorative sleep, insomnia symptoms, and sleep apnea (data collected at the third follow-up only). Models assessing skin tone and sleep duration, non-restorative sleep, and insomnia symptoms were age-adjusted and further adjusted for educational attainment at baseline. Models assessing skin tone and sleep apnea adjusted for age and educational attainment at the third follow-up. For the longitudinal analysis, we applied generalized estimating equations to log binomial regression models to estimate risk ratios and 95% CIs for the average association over time (i.e., from baseline to the third follow up) between skin tone (dark brown and medium brown vs. light brown) and short sleep, non-restorative sleep, and insomnia symptoms in separate models. For cross-sectional and longitudinal analyses, Model 1 was age-adjusted, and Model 2 was further adjusted for educational attainment. Potential mediators identified using DAG construction (Supplemental Fig. 1) influence the causal pathway between skin tone and sleep relationship (d'Eclairage, 2007) and therefore, were not included in the analytic models. Additionally, we stratified models by annual household income (<$20,000 vs. ≥$20,000) to assess annual household income as an effect modifier. Similar to prior literature investigating multiple disadvantages compared to multiple advantages (Massey et al., 2014), we investigated associations by combining categories of skin tone (dark- and medium-brown vs. light-brown) and annual household income (<$20,000 vs. ≥$20,000). We identified – based on prior literature – the least advantaged group as women with dark skin tone and income <$20,000 and the most advantaged group as women with light skin tone and income ≥$20,000, suggesting light skin advantage and higher income as more advantageous (DeAngelis et al., 2022). All analyses were conducted using SAS 9.4 (Cary, NC). We used a two-sided *p*-value of 0.05 to determine statistical significance.

3. Results

3.1. Participant characteristics overall and by skin tone

Among 1674 eligible Black women in the SELF cohort, at baseline, the mean ± standard deviation age of women was 29 ± 6.0 years (see Table 1). Similar proportions of women with dark skin tone attained some college, an associate or technical degree (49%), comparable to women with light (51%) and medium skin tone (50%); yet a smaller proportion of women with dark skin tone attained a bachelor's degree or more (21%) compared to women with light (35%) and medium skin tone (29%). A higher proportion of women with dark skin tone had annual household income < $20,000 (56%) compared to women with light (37%) or medium skin tone (44%), were unemployed or homemakers (43% vs 36% medium and 35% light skin tone) and had never been married (64% vs. 58% medium and 55% light skin tone). Women with dark skin tone were more likely to have been current or former smokers (32% vs. 25% medium and 23% light skin tone) and had comparable prevalence of heavy alcohol consumption (21%) to women with medium (21%) and light skin tone (15%). Additionally, women across skin tones had comparable health status as good/very good/excellent (79% vs. 79% medium and 81% light skin tone). In addition, women with dark skin tone were more likely to have a BMI 40+kg/m^2 (33% vs. 21% medium and 20% light skin tone), had comparable prevalence of having experienced racism and discrimination in the past 12 months (16% vs.

16% light and 15% medium skin) as well as moderate to severe stress due to racism in the past 12 months (44% vs 39% medium and 36% light skin tone), and comparable average CES-D scores (5.9 vs 5.7 medium and 5.3 light skin tone), with higher scores indicating depressive symptoms.

The mean ± SD hours for the continuous outcomes of sleep duration, days of nonrestorative sleep per week and number of days per week with insomnia symptoms were comparable across skin tone types at baseline (see Table 1). Women with dark skin had a higher prevalence of short sleep (62% vs. 56% light and 60% medium skin tone) but had a comparable prevalence of nonrestorative sleep (62% vs 63% light and 62% medium skin tone) and sleep apnea (6% vs 5% light and 5% medium skin tone). Insomnia symptoms were more prevalent among women with light skin tone (21% vs 18% medium and 16% dark skin tone).

Table 2 summarizes values of each outcome across time. The distribution of short sleep duration increased ($p < 0.01$) over time. Insomnia symptoms among participants were high at baseline, then decreased at follow-up 1, and then increased until follow-up 3 (p-trend <0.01). The distribution of nonrestorative sleep among participants was similar across the study time-period (p-trend = 0.9).

3.2. Associations between skin tone and sleep health at baseline and over time

Table 3 displays results from cross-sectional models assessing the association between skin color and sleep health at baseline. Women with dark skin tone had a 4% [adjusted prevalence ratio (aPR):1.04; 95% CI: 1.00–1.08] higher prevalence of short sleep duration compared to women with light skin tone at baseline when adjusting for age. With further adjustment for educational attainment, the association was similar [aPR:1.04; 95% CI: 0.99–1.08]. Women with dark skin tone had a 5% [aPR:0.95; 95% CI: 0.91–0.99] lower prevalence of insomnia symptoms compared to women with light skin in the age-adjusted model. With further adjustment for educational attainment, the association between skin tone and insomnia symptoms was marginally significant [aPR:0.96; 95% CI: 0.92–1.00], yet similar. No associations were observed for nonrestorative sleep at baseline or sleep apnea (assessed at third follow-up).

Table 4 summarizes the longitudinal findings related to associations between skin tone and sleep duration and sleep disturbances. From 2010 to 2018, women with dark skin tone had a 7% higher risk of short sleep duration, on average, compared to women with light skin [adjusted risk ratio (aRR):1.07; 95% CI: 0.99–1.16] in the age-adjusted and age-education-adjusted models.

Table 3
Prevalence ratios and 95% confidence intervals for the cross-sectional association between brown skin tone and sleep measures, Study of Environment Lifestyle and Fibroids, 2010–2012 and 2016 - 2018, (N = 1674).

	PR (95% Confidence Interval)	PR (95% Confidence Interval)
	Model 1	Model 2
Short Sleep Duration [a]		
Dark	1.04 (1.00–1.08)	1.04 (0.99–1.08)
Medium	1.03 (0.99–1.06)	1.02 (0.99–1.06)
Light	1.00 (reference)	1.00 (reference)
Nonrestorative Sleep [b]		
Dark	1.00 (0.96–1.04)	0.99 (0.95–1.03)
Medium	1.00 (0.96–1.03)	0.99 (0.96–1.03)
Light	1.00 (reference)	1.00 (reference)
Insomnia Symptoms [c]		
Dark	**0.95 (0.91–0.99)**	**0.96 (0.92–1.00)**
Medium	0.97 (0.94–1.01)	0.97 (0.94–1.01)
Light	1.00 (reference)	1.00 (reference)
Sleep Apnea [d]		
Dark	1.01 (0.98–1.05)	1.01 (0.98–1.04)
Medium	1.01 (0.98–1.03)	1.01 (0.98–1.03)
Light	1.00 (reference)	1.00 (reference)

All sleep characteristics were self-reported. PR: Prevalence Ratio.
Bolded values indicate statistical significance at a two-side *p*-value = 0.05.
Model 1 is age-adjusted.
Model 2 is additionally adjusted for educational attainment.
[a] Short sleep duration defined as <7 h vs. ≥ 7–9 h (recommended) (measured at baseline).
[b] Nonrestorative sleep defined as frequently waking feeling unrested (woke feeling well rested ≤3 days/week) (measured at baseline).
[c] Insomnia symptoms defined as frequent difficulty falling or staying asleep ≥10 days/month (measured at baseline).
[d] Sleep apnea defined as ever been told had sleep apnea by a doctor (measured only at Follow-up #3 (2016 to 2018)).

3.3. Annual household income as an effect modifier

We examined annual household income as a potential effect modifier of the association between skin tone and sleep health (see Supplemental Table 1). We observed a statistically significant interaction between annual household income and skin tone on sleep duration (p-interaction <0.01). At baseline, women with dark skin and household income <$20,000 had a 10% [aRR:1.10; 95% CI: 1.03–1.17] higher prevalence of short sleep compared to women with light-skin and household income <$20,000. There were no significant differences in short sleep duration between women with dark skin tone and household income ≥$20,000 and their light-skinned counterparts with household income ≥$20,000

Table 2
Sleep duration, non-restorative sleep, insomnia symptoms, and sleep apnea at baseline and at each follow-up, Study of Environment, Lifestyle and Fibroids, 2010–2018 (N = 1674).

Sleep measures	Baseline	Follow-Up 1	Follow-Up 2	Follow-Up 3	Two-sided *P* -trend
Sleep duration, h	6.2 ± 1.5	6.1 ± 1.6	6.1 ± 1.6	6.0 ± 1.5	
Wake up feeling well rested, d/wk	3.0 ± 1.9	3.2 ± 1.9	3.1 ± 1.9	3.0 ± 1.9	
Insomnia symptoms, d/wk	2.9 ± 2.4	2.7 ± 2.5	3.0 ± 2.5	3.0 ± 2.5	
Sleep duration [a]					
Short sleep (<7 h)	989 (59.1)	884 (60.8)	887 (62.4)	981 (65.4)	<0.01
Nonrestorative sleep [b] (yes)	1043 (62.3)	868 (51.9)	879 (52.5)	933 (55.7)	0.9
Insomnia symptoms [c] (yes)	302 (18.0)	221 (13.2)	288 (17.2)	311 (18.6)	<0.01
Sleep apnea [d] (yes)				88 (5.3)	

Data presented as mean ± SD or as n (%). Abbreviations: h (hours); d/wk (days per week)
Baseline data collection occurred from 2010 to 2012, Follow-Up 1 from 2012 to 2015, Follow-Up 2 from 2014 to 2016, and Follow-Up 3 from 2016 to 2018.
Missing data for sleep duration (missed visit): Follow-Up 1 (n = 221; 13.2%), Follow-Up 2 (n = 253; 15.1%), Follow-Up 3 (n = 173; 10.3%).
Remaining sleep parameters (missed visit): Follow-Up 1 (n = 205; 12.2%), Follow-Up 2 (n = 246; 14.7%), Follow-Up 3 (n = 156; 9.3%).
[a] Short sleep duration defined as <7 h vs. 7–9 h (recommended).
[b] Nonrestorative sleep defined as frequently waking feeling unrested (woke feeling well rested ≤3 days/week).
[c] Insomnia symptoms defined as frequent difficulty falling or staying asleep ≥10 days/month.
[d] Sleep apnea defined as ever been told had sleep apnea by a doctor (measured at follow-up #3 only).

Table 4
Risk Ratios and 95% confidence intervals for associations of brown skin tone and self-reported sleep duration, non-restorative sleep, and insomnia symptoms over time (using General Estimating Equations), Study of Environment Lifestyle and Fibroids, 2010 - 2018 (N = 1674).

	Risk Ratio (95% Confidence Interval)	Risk Ratio (95% Confidence Interval)
	Model 1	Model 2
Short Sleep Duration [a]		
Dark	1.07 (0.99–1.16)	1.07 (0.99–1.16)
Medium	1.05 (0.97–1.12)	1.05 (0.97–1.12)
Light	1.00 (reference)	1.00 (reference)
Nonrestorative Sleep [b]		
Dark	1.01 (0.93–1.09)	1.00 (0.92–1.08)
Medium	1.05 (0.98–1.12)	1.04 (0.97–1.12)
Light	1.00 (reference)	1.00 (reference)
Insomnia Symptoms [c]		
Dark	0.91 (0.74–1.13)	0.94 (0.76–1.15)
Medium	0.88 (0.74–1.06)	0.90 (0.75–1.07)
Light	1.00 (reference)	1.00 (reference)

Model 1 is age-adjusted.
Model 2 is additionally adjusted for educational attainment.
Note: Due to missingness, 6049 observations among 1674 participants were included in models for short sleep duration, and 6089 observations among 1674 participants were included in models for the remaining sleep parameters.
All sleep characteristics were self-reported.
[a] Short sleep duration defined as <7 h vs. ≥ 7–9 h (recommended).
[b] Nonrestorative sleep defined as frequently waking feeling unrested (woke feeling well rested ≤3 days/week).
[c] Insomnia symptoms defined as frequent difficulty falling or staying asleep ≥10 days/month.

[aRR:0.97; 95% CI: 0.92–1.03]. Interactions were not observed for the associations between skin tone and nonrestorative sleep, insomnia symptoms, and sleep apnea (p-interactions >0.05).

3.4. Intersections of skin tone and annual household income

Furthermore, we examined the combination of household income and skin tone on associations with sleep duration, non-restorative sleep, and insomnia symptoms (at baseline only) as well as sleep apnea (follow-up #3 data only). Women with dark brown skin and household income <$20,000 had a higher prevalence of short sleep duration compared to women with light brown skin with ≥$20,000 household income (PR: 1.07, [95% CI: 1.01, 1.13]), and women with dark brown skin with ≥$20,000 household income (PR: 1.10, [95% CI: 1.03, 1.17]) (see Supplemental Table 2).

4. Discussion

This study, with its cross-sectional and longitudinal design, was the first to our knowledge to investigate skin tone in relation to multidimensional assessment of sleep health, including sleep duration and sleep disturbances. Our findings extend the current literature by revealing that young Black women with dark-skin tone had a higher prevalence of short sleep compared to their counterparts with light skin tone. This finding persisted over the 8-year study period. We also observed women with a lighter skin tone had higher prevalence of insomnia symptoms compared to women with a darker skin tone. Additionally, annual household income modified the relationship between skin tone and short sleep duration. We observed women with dark skin vs. light skin tone and annual household income <$20,000 had higher prevalence of short sleep and no associations among women with dark skin tone vs. light skin tone and annual income ≥ $20,000. Moreover, women with dark skin and low income had higher prevalence of short sleep duration vs. women with dark skin or light skin and income ≥ $20,000.

While the relationship between skin tone and sleep is understudied, prior studies have examined skin tone as a marker for skin tone bias and differential treatment in relation to sleep health (Bethea et al., 2020; Chen et al., 2015; Johnson et al., 2021). A prior cross-sectional study also using the SELF data examining skin tone and socioeconomic, psychosocial, and health outcomes including sleep, demonstrated that dark skin tone was marginally associated with higher prevalence of short sleep duration compared to light skin tone (Moore et al., 2021). Consistent with the prior study, our cross-sectional study findings suggest dark skin tone was associated with higher prevalence of short sleep duration. Furthermore, our longitudinal findings suggest there is a higher risk of short sleep duration among women with dark skin compared to women with light skin tone whereas no associations between skin tone and risk of nonrestorative sleep or insomnia symptoms were observed. Prior studies that have examined the association of differential treatment based on race and the extent of varying degrees of bias and sleep health among Black adults suggest Black adults experience higher prevalence of differential treatment and higher prevalence of poorer sleep health and shorter sleep duration compared to White adults (Bethea et al., 2020; Chen et al., 2015; Johnson et al., 2021). However, these studies did not examine skin tone stratification and did not consider SES as an effect modifier – a feature of our study. Our findings further extend the literature by assessing multiple sleep dimensions over time rather than at one time point. Additionally, we examined SES as an effect modifier given the historical roots of colorism resulting in fewer socioeconomic opportunities among women with darker vs. lighter skin tone (Keith et al., 1991; Monk, 2021b; Russell et al., 1992, p. 200). The disparate sleep outcomes observed among Black adults may be influenced by SES. Extensive research has shown the relationship between higher SES and better health outcomes (Bell et al., 2020; Link et al., 1995; Williams, 2005) and growing evidence of the differential impact of SES on sleep health across racial minoritized groups (Moore et al., 2002; Petrov et al., 2020; Sheehan et al., 2020; Whinnery et al., 2014). Among Black adults, differences in socioeconomic position and related resources likely contribute to disparate sleep health outcomes, particularly among groups such as women with darker-skin tone and those who are low-income, as observed in the current study. Our finding related to annual household income modifying the colorism-sleep relationship suggests low-income women with dark skin tone have higher prevalence of short sleep duration compared to low-income women (<$20,000) with light skin tone; however, there was no association observed among higher income women (≥$20,000). Women living in low-income households encounter financial challenges that make it difficult to meet basic household needs such as food security, safe housing, and quality education across skin tones. A potential explanation for an increased prevalence of short sleep duration among low-income women with dark skin tone may be related to greater exposure to colorist or racist experiences that lead to greater levels of stress that women with medium to light skin tones may not experience beyond stress related to low income (DeAngelis et al., 2022; Moore et al., 2021).

Regarding potential explanations for our findings, colorism can be observed as inter-racial (i.e., across racial groups) or intra-racial (i.e., within group) and have differential impacts on sleep health and well-being across skin tone. Inter-racial colorism occurs when an individual from another racial group displays a form of differential treatment, prejudice, or bias against the individual with darker skin tone (Bell et al., 2020; Link et al., 1995; Williams, 2005). Women with dark skin tone experience higher levels of unfavorable treatment and differential exposure to historical systems and policies that disproportionately affect access to health-promoting resources (Monk, 2015; Uzogara et al., 2016) which may contribute, in part, to the observed higher prevalence of shorter sleep duration and risk of shorter sleep over time in our study. Primarily, Black women with darker-brown skin tone are adversely affected by inter-racial colorism due to historical policies and practices embedded within the societal structure and governing systems that influence the standards of beauty, economic and educational access, and

opportunities, and health care access needed for sustained health and economic stability (Dixon et al., 2017; Goldsmith et al., 2006; Thompson et al., 2016; Uzogara, 2019; Yearby, 2018). Historically, skin tone was used to establish the informal caste system, a social hierarchy of privilege, power, and prestige (Russell et al., 1992, p. 200). The skin tone stratification led to the self-perception among lighter skinned Black individuals as more favorable to dark-skinned individuals. As a result, colorism has reinforced ideologies that perpetuate social segregation within institutions in the Black community. Furthermore, intra-racial colorism occurs within a racial or ethnic group when an individual with a lighter-skin tone is typically perceived and treated more favorably or less favorably (by others within the same racial or ethnic group). For example, compared to Black women with darker skin tone, Black women with lighter skin tone may be perceived as more favorable or desirable potential marital or domestic partners by Black men of all skin tones. An extension of this perceived desirability of Black women with lighter skin tone may be subconsciously embraced among other Black women (with darker skin tone) as the standard of "beauty." Yet, lighter-skinned Black women may be prone to more harassment by other Black women (Monk, 2021b). Similarly, Black men with lighter skin may experience greater exposure to verbal harassment and perhaps perceived less favorably in terms of their masculinity by Black men or women with darker-skin tone (Phoenix et al., 2022; Sims et al., 2019). This psychological stress can affect sleep, as women with light skin tone compared to women with dark skin tone had higher prevalence of insomnia symptoms in the current study. Taken together, these forms of colorism may negatively influence overall health and sleep health while further stratifying risk by skin tone even within racial groups (Hoggard et al., 2018; Jackson et al., 2020; Johnson et al., 2022). While Black adults generally have poorer health outcomes compared to White adults, using skin tone stratification can help elucidate the effect of colorism as an extension of differential treatment associated with short sleep duration and sleep disturbances among Black adults. Intra-racial colorism may suggest the mechanism by which Black women with light skin tone may experience overall better health than women with darker skin tone, which contributes to higher overall socioeconomic position and access to health-promoting resources (Hargrove, 2019).

This study has limitations. For instance, self-reported sleep measures were used to define sleep health and future studies should use objective measures of sleep (e.g., actigraphy). Although the cross-sectional design precludes causal inference between skin tone and sleep health, we additionally conducted longitudinal analyses to assess risk of short sleep, nonrestorative sleep, and insomnia symptoms. The results examining skin tone and sleep were consistent across the cross-sectional and longitudinal study designs. The SELF data were collected from Black women residing in the Detroit, Michigan area and were observed to have, on average, lower household income than the general population of Black women in the United States; therefore, this sample is not a national representation of Black women. Secondly, Black women residing in the Detroit, MI area may be exposed to differential social and environmental stressors unique to the Detroit metropolitan area, in which the social, political, and economic history harbors unique social exposures and experiences compared to other Black women living elsewhere in United States. Additionally, the SELF study does not include Black men; the study findings are not generalizable to Black men residing in United States as colorism affects women and men differently based on their societal roles and status in the Black community (i.e., Black women and men with lighter skin tone may experience a lack of social belongingness and acceptance yet may benefit from closer racial proximity to whiteness than darker skinned women and men) (Monk, 2021b).

Despite the limitations, this study also has key strengths that are worth acknowledging. Our study is the first to examine associations between skin tone and sleep health using longitudinal analyses and multidimensions of sleep health. The large sample of young Black women allowed investigation of intra-racial differences by skin tone stratification, which was measured objectively. Furthermore, future studies should consider assessed and self-perceptions of skin tone, which may enhance the overall assessment of an individual's experience of colorism (e.g., whether there is a difference between an individual's skin tone perceived by others or how an individual perceives their skin tone). We also investigated various sleep health dimensions beyond short sleep duration, including non-restorative sleep and insomnia symptoms. We assessed sleep health over time using the longitudinal study design (vs. cross-sectionally). Sociodemographic, behavioral, clinical, social characteristics, and health outcomes were included in the SELF data, which allowed us to characterize the potential confounders and mediators in the study as well as investigate potential effect measure modification.

In summary, Black women with dark compared to light skin tone had a higher prevalence of short sleep, and risk of short sleep persisted across the study period. Black women with light skin tone were more likely to report insomnia symptoms. Colorism differentially impacts dark and light skinned individuals through structural barriers (e.g., the effects of differential access to health promoting resources and the subsequent limited socioeconomic opportunities) as well as psychosocial pathways (e.g., interpersonally-mediated stress emanating from how others interact and perceive an individual or not feeling belongingness), which can lead to short sleep and insomnia symptoms. As described in Jones' theoretical framework and Gardner's Tale for understanding differential treatment among racially minoritized groups (Jones, 2000), colorism highlights how societal stratification based on skin tone shapes exposure to such treatment. This stratification also influences social determinants that drive disparities in access to health-promoting resources and material goods, ultimately impacting overall health and sleep health. Therefore, the use of conceptual and causal frameworks in future investigation of colorism in relation to sleep health can support further understanding of the causal associations between colorism and sleep and inform potential interventions (Gee et al., 2011; Needham et al., 2023). Future research should also consider mediating pathways through, for instance, family/household-related factors (e.g., number of children living in the household) in the skin tone and sleep relationship. Although future research is needed to determine causality and identify pathways linking colorism to sleep health to inform interventions, our findings elucidate the critical importance and need to address the differential impact of historical systems and policies on Black women, which manifest health-damaging social phenomena like colorism.

CRediT authorship contribution statement

Bethany T. Ogbenna: Writing – original draft, Software, Methodology, Investigation, Formal analysis. **Symielle A. Gaston:** Writing – review & editing, Validation, Methodology, Investigation, Data curation. **Taylor W. Hargrove:** Writing – review & editing, Methodology. **Quaker E. Harmon:** Writing – review & editing, Validation, Project administration, Methodology, Investigation, Data curation. **Donna D. Baird:** Writing – review & editing, Validation, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation. **Chandra L. Jackson:** Writing – review & editing, Validation, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Data curation, Conceptualization.

Ethical approval and consent

The Study of Environmental Lifestyle and Fibroids (SELF) was approved by the Institutional Review Board of the National Institute of the Environmental Health Sciences and by Henry Ford Health. All SELF participants provided informed consent.

Funding

This work was funded by the Intramural Program at the National Institutes of Health (NIH), National Institute of Environmental Health

Sciences (Z1A ES103325).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2025.101774.

Data availability

Participant data that underlie the primary results reported in this article can be requested for purposes of replication or meta-analysis by emailing chandra.jackson@nih.gov. All data releases will require a data use proposal and a data use agreement and will comply with the IRB and consent of the SELF study, which may require omission of some data elements. The NIH IRB may be asked to review the request and study consent forms to approve a data transfer.

References

Bailey, Z. D., et al. (2017). Structural racism and health inequities in the USA: Evidence and interventions. *Lancet, 389*(10077), 1453–1463.

Baird, D. D., et al. (2015). A prospective, ultrasound-based study to evaluate risk factors for uterine fibroid incidence and growth: Methods and results of recruitment. *Journal of Women's Health (Larchmt), 24*(11), 907–915.

Bell, C. N., et al. (2020). Racial non-equivalence of socioeconomic status and self-rated health among African Americans and whites. *SSM - Population Health, 10*, Article 100561.

Bethea, T. N., et al. (2020). Perceived racial discrimination and risk of insomnia among middle-aged and elderly Black women. *Sleep, 43*(1).

Borrell, L. N., et al. (2006). Self-reported health, perceived racial discrimination, and skin color in African Americans in the CARDIA study. *Social Science & Medicine, 63*(6), 1415–1427.

Braveman, P. A., et al. (2022). Systemic and structural racism: Definitions, examples, health damages, and approaches to dismantling. *Health Affairs, 41*(2), 171–178.

Chen, X., et al. (2015). Racial/ethnic differences in sleep disturbances: The multi-ethnic study of atherosclerosis (MESA). *Sleep, 38*(6), 877–888.

Clark, R., et al. (1999). Racism as a stressor for African Americans. A biopsychosocial model. *American Psychologist, 54*(10), 805–816.

Clark, E. C., et al. (2022). Structural interventions that affect racial inequities and their impact on population health outcomes: A systematic review. *BMC Public Health, 22*(1), 2162.

Cobb, R. J., et al. (2016). Self-identified race, socially assigned skin tone, and adult physiological dysregulation: Assessing multiple dimensions of "race" in health disparities research. *SSM Popul Health, 2*, 595–602.

DeAngelis, R. T., Hargrove, T. W., & Hummer, R. A. (2022). Skin tone and the health returns to higher status. *Demography, 59*(5), 1791–1819.

d'Eclairage, C. I. (2007). *CIE colorimetetry. Part 4: 1976 L*a*b* colour space*. Report No.: CIE S 014-4/E:2007.

Dixon, A. R., & Telles, E. E. (2017). Skin color and colorism: Global research, concepts, and measurement. *Annual Review of Sociology, 43*, 405–424. Volume 43, 2017.

Gaston, S. A., et al. (2024). Perceived childhood neighborhood safety and sleep health during childhood and adulthood among a cohort of African American women. *Sleep Medicine, 117*, 115–122.

Gee, G. C., & Ford, C. L. (2011). Structural racism and health inequities: Old issues, new directions. *Du Bois Review, 8*(1), 115–132.

Goldsmith, A. H., Hamilton, D., & Darity, W. (2006). Shades of discrimination: Skin tone and wages. *The American Economic Review, 96*(2), 242–245.

Hall, W. J., et al. (2015). Implicit racial/ethnic bias among health care professionals and its influence on health care outcomes: A systematic review. *American Journal of Public Health, 105*(12), e60–e76.

Hargrove, T. W. (2019). Light privilege? Skin tone stratification in health among african Americans. *Sociology of Race and Ethnicity (Thousand Oaks), 5*(3), 370–387.

Hoggard, L. S., & Hill, L. K. (2018). Examining how racial discrimination impacts sleep quality in african Americans: Is perseveration the answer? *Behavioral Sleep Medicine, 16*(5), 471–481.

Jablonski, N. G. (2021). Skin color and race. *American Journal of Physical Anthropology, 175*(2), 437–447.

Jackson, C. L., et al. (2020). Racial/ethnic disparities in sleep health and potential interventions among women in the United States. *Journal of Women's Health (Larchmt), 29*(3), 435–442.

Johnson, D. A., et al. (2019). Are sleep patterns influenced by race/ethnicity - a marker of relative advantage or disadvantage? Evidence to date. *Nature and Science of Sleep, 11*, 79–95.

Johnson, D. A., et al. (2021). Associations between everyday discrimination and sleep quality and duration among African-Americans over time in the Jackson Heart Study. *Sleep, 44*(12).

Johnson, D. A., et al. (2022). Understanding the role of structural racism in sleep disparities: A call to action and methodological considerations. *Sleep, 45*(10).

Jones, C. P. (2000). Levels of racism: A theoretic framework and a gardener's tale. *American Journal of Public Health, 90*(8), 1212–1215.

Jones, C. P. (2001). Invited commentary: "Race," racism, and the practice of epidemiology. *American Journal of Epidemiology, 154*(4), 299–304.

Keith, V. M., et al. (2017). Microaggressions, discrimination, and phenotype among African Americans: A latent class analysis of the impact of skin tone and BMI. *Sociological Inquiry, 87*(2), 233–255.

Keith, V. M., & Herring, C. (1991). Skin tone and stratification in the black community. *American Journal of Sociology, 97*(3), 760–778.

Klonoff, E. A., & Landrine, H. (2000). Is skin color a marker for racial discrimination? Explaining the skin color-hypertension relationship. *Journal of Behavioral Medicine, 23*(4), 329–338.

Kohout, F. J., et al. (1993). Two shorter forms of the CES-D depression symptoms index. *Journal of Aging and Health, 5*(2), 179–193.

Krieger, N., Sidney, S., & Coakley, E. (1998). Racial discrimination and skin color in the CARDIA study: Implications for public health research. Coronary Artery risk development in young adults. *American Journal of Public Health, 88*(9), 1308–1313.

Lewis, P., Tené, T., & McKinnon, I. I. (2019). 257C11Exposure to discrimination and sleep. In D. T. Duncan, I. Kawachi, & S. Redline (Eds.), *The social epidemiology of sleep* (pp. 257–324). Oxford University Press.

Lim, D. C., et al. (2023). The need to promote sleep health in public health agendas across the globe. *The Lancet Public Health, 8*(10), e820–e826.

Link, B. G., & Phelan, J. (1995). Social conditions as fundamental causes of disease. *Journal of Health and Social Behavior*, 80–94.

Massey, D. S., & Brodmann, S. (2014). *Spheres of influence the social ecology of racial and class inequality*. Russell Sage Foundation.

Mead, M. P., Vargas, E. A., & Knutson, K. L. (2023). Racial disparities in sleep: Potential mediation by discrimination and psychological distress. *Journal of Racial and Ethnic Health Disparities, 10*(2), 573–580.

Monk, E. P., Jr. (2014). Skin tone stratification among black Americans, 2001–2003. *Social Forces, 92*(4), 1313–1337.

Monk, E. P., Jr. (2015). The cost of color: Skin color, discrimination, and health among African-Americans. *American Journal of Sociology, 121*(2), 396–444.

Monk, E. P., Jr. (2021a). Colorism and physical health: Evidence from a national Survey. *Journal of Health and Social Behavior, 62*(1), 37–52.

Monk, E. P., Jr. (2021b). The unceasing significance of colorism: Skin tone stratification in the United States. *Dædalus, 150*(2), 76–90.

Moore, P. J., et al. (2002). Socioeconomic status & health: The Role of sleep. *Psychosomatic Medicine, 64*, 337–344.

Moore, K. R., Williams, D. R., & Baird, D. D. (2021). Disparities by skin color among young African-American women. *Journal of Racial and Ethnic Health Disparities, 8*(4), 1002–1011.

Needham, B. L., et al. (2023). Institutional racism and health: A framework for conceptualization, measurement, and analysis. *Journal of Racial and Ethnic Health Disparities, 10*(4), 1997–2019.

Ocampo, C. (2000). Psychophysiology and racism. *American Psychologist, 55*(10), 1164–1165.

Oh, H., & Nicholson, H., Jr. (2021). Perceived skin tone discrimination and suicidal ideation black Americans: Findings from the national Survey of American Life. *Journal of Affective Disorders, 284*, 143–148.

Petrov, M. E., et al. (2020). Racial differences in sleep duration intersect with sex, socioeconomic status, and U.S. geographic region: The REGARDS study. *Sleep Health, 6*(4), 442–450.

Phelan, J. C., & Link, B. G. (2015). Is racism a fundamental cause of inequalities in health? *Annual Review of Sociology, 41*, 311–330. Volume 41, 2015.

Phoenix, A., & Craddock, N. (2022). Black men's experiences of colourism in the UK. *Sociology, 56*(5), 1015–1031.

Russell, K. Y., Wilson, M., & Hall, R. E. (1992). *The color complex: The politics of skin color among African Americans. The color complex: The politics of skin color among African Americans*. San Diego, CA, US: Harcourt Brace Jovanovich. vii, 200-vii.

Shah, N. S., et al. (2020). Adverse trends in premature cardiometabolic mortality in the United States, 1999 to 2018. *Journal of American Heart Association, 9*(23), Article e018213.

Sheehan, C. M., Walsemann, K. M., & Ailshire, J. A. (2020). Race/ethnic differences in educational gradients in sleep duration and quality among U.S. adults. *SSM Popul Health, 12*, Article 100685.

Sims, J. P., & Joseph-Salisbury, R. (2019). "We were all just the black kids": Black mixed-race men and the importance of adolescent peer groups for identity development. *Social Currents, 6*(1), 51–66.

Slopen, N., Lewis, T. T., & Williams, D. R. (2016). Discrimination and sleep: A systematic review. *Sleep Medicine, 18*, 88–95.

Sweet, E., et al. (2007). Relationships between skin color, income, and blood pressure among African Americans in the CARDIA Study. *American Journal of Public Health, 97*(12), 2253–2259.

Tennant, P. W. G., et al. (2021). Use of directed acyclic graphs (DAGs) to identify confounders in applied health research: Review and recommendations. *International Journal of Epidemiology, 50*(2), 620–632.

Thompson, M. S., & McDonald, S. (2016). Race, skin tone, and educational achievement. *Sociological Perspectives, 59*(1), 91–111.
Uzogara, E. E. (2019). Dark and sick, light and healthy: Black women's complexion-based health disparities. *Ethnicity and Health, 24*(2), 125–146.
Uzogara, E. E., et al. (2014). A comparison of skin tone discrimination among African American men: 1995 and 2003. *Psychology of Men and Masculinity, 15*(2), 201–212.
Uzogara, E. E., & Jackson, J. S. (2016). Perceived skin tone discrimination across contexts: African American women's reports. *Race and Social Problems, 8*(2), 147–159.
Watson, N. F., et al. (2015). Recommended amount of sleep for a healthy adult: A joint consensus statement of the American Academy of sleep medicine and sleep research society. *Sleep, 38*(6), 843–844.
Whinnery, J., et al. (2014). Short and long sleep duration associated with race/ethnicity, sociodemographics, and socioeconomic position. *Sleep, 37*(3), 601–611.
Williams, D. R.a. J. (2005). P B *social sources of racial disparities in health. Health Affairs, 24*(2), 325–334.
Willis, H. A., et al. (2021). The associations between internalized racism, racial identity, and psychological distress. *Emerging Adulthood, 9*(4), 384–400.
Yearby, R. (2018). Racial disparities in health status and access to healthcare: The continuation of inequality in the United States due to structural racism. *The American Journal of Economics and Sociology, 77*(3–4), 1113–1152.
Zeng, L. N., et al. (2020). Gender difference in the prevalence of insomnia: A meta-analysis of observational studies. *Frontiers in Psychiatry, 11*, Article 577429.