



Sleep Health Disparity and Race/Ethnicity, Socioeconomic Status, and Gender: A Systematic Review

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Despite improvement in US healthcare, racial and ethnic minorities have experienced health disparities including sleep health disparities. This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA). We searched three electronic databases (PubMed, Embase, Web of Science) from the earliest available date to September 2023 using the keywords sleep inequity, gender, race, and socioeconomic status. Studies published in languages other than English were excluded. Meta analysis, case reports, and editorials were also excluded. Medical Subject Headings (MeSH) of the National Library of Medicine and Keywords were used to search PubMed, Embase, and Web of Science. We also searched the reference lists of the selected articles. Using the search strategy, we identified 52 articles. After excluding 11 duplicate studies, we screened 41 articles. The studies not relevant to our search were further excluded and we finally assessed 16 full-text articles. Twelve of the 16 studies were cross sectional and 4 were prospective studies. Compared to Whites, increased prevalence of shorter sleep duration was found among people of diverse racial background. Similarly, individuals with lower socioeconomic status have been shown to have a disproportionate increase in insufficient sleep (1.62 times). Additionally, compared to White women, Black women were more likely to report short sleep (37% vs. 27%) and were less likely to obtain the recommended amount of sleep (52% vs. 64%). This review demonstrates disparities in sleep based on race/ethnicity as well as the effect of gender and socioeconomic status on the quality of sleep.

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Keywords Sleep health disparity; Race and ethnicity; Socioeconomic status.

INTRODUCTION

Sleep is one of the vital health promoting behaviors [1] and serves many functions such as a role in development, conserving energy, clearing brain waste, modulating immune responses, cognition, performance, vigilance, disease, and psychological state [2]. Appropriate sleep requirements vary across the lifespan, and decline from childhood to adulthood among healthy individuals [3]. Although the American Academy of Sleep Medicine and Sleep Research Society recommend 7 or more [4,5] hours of sleep for adults, about a third of US adults sleep less than the recommended amount [6].

Sleep disturbances and sleep deprivation are not only detrimental to population health, but the economic health of society is also negatively impacted. A sleep duration of less than 6 hours has been shown to increase the risk of developing diabetes and impaired glucose tolerance [7]. Poor sleep quality and short sleep duration have also been found to be independently associated with the risk of developing coronary heart disease [8]. Moreover, both short and long sleep durations have been linked with increased mortality. A meta-analysis of prospective studies demonstrated that "short sleepers (<5-7 h per night) have a 12%

greater risk, and long sleepers (>8 or 9 h per night) a 30% greater risk of dying than those sleeping 7 to 8 hours per night" [9]. Sleep disturbances have also been found among people with psychiatric disorders as well as those with cognitive impairment [10]. In addition to these negative health outcomes, chronic sleep loss has serious consequences for performance and safety [6]. Insufficient sleep can impair cognitive performance, and increase the risk of motor vehicle crashes, work-related accidents, industrial and medical errors, and loss of work productivity [11].

The World Health Organization (WHO) defines "Health" as a "state of complete physical, mental, and social well-being and not merely the absence of disease" [12]. Consistent with this definition of "Health," "Sleep Health" is defined as not mere absence of sleep disorders but includes multiple domains of sleep characteristics including duration, regularity, alertness, and satisfaction [13].

Despite improvement in the United States (US) healthcare, racial and ethnic minorities have experienced health disparities [14]. The National Institutes on Minority Health and Health Disparities (NIMHD) defines a health disparity as "health difference on the basis of one or more health outcomes that adversely affects a disadvantaged population." Healthy People 2030 is a collaborative initiative identifying public health priorities and challenges for the US to improve health and well-being. According to the US Department of Health and Human Services, the overarching goal of Healthy People 2030 is "to achieve health equity by eliminating disparities and creating environments that promote health and well-being of all [15]." Unfortunately, health disparities including sleep disparities exist in the US among minorities [16,17].

Sleep health disparities are defined as differences in one or more dimensions of sleep characteristics, e.g., duration, efficiency, timing, regularity, and quality. Although the exact prevalence of sleep health disparities is not known, racial and ethnic differences in sleep duration have been suggested. Chen et al. [18] reported short sleep duration among African American, Hispanics, and Chinese as compared to White individuals. Similarly, increased risk of obstructive sleep apnea and excessive daytime sleepiness has been reported among racial and ethnic minorities [19,20]. Cross-sectional data from US born and foreign-born adults demonstrated that compared to White individuals, Black individuals and Asians had a higher likelihood of short sleep regardless of their place of birth [21]. In contrast, US born Hispanics, but not foreign-born Hispanics had higher likelihood of short sleep [21]. In another study, the rate of very short sleep (≤ 4 h) among, African Americans, and Asians was at least 2.5 times those of non-Hispanic White individuals [22].

Sleep duration and regularity are socially driven and influenced by environmental and societal factors. Socioeconomic status is a measure of living conditions and habits affecting health and is thought to play a vital role since immigrants and racially diverse people may be employed in low skilled jobs requiring

them to work variable shifts [23]. Racial discrimination has also been shown to negatively impact sleep, and sleep disturbances have been seen independent of the effect of race, sociodemographic factors, and mood [24].

Gender differences in sleep have also been described, with women reporting shorter sleep and increased rates of insomnia [22-25]. In contrast, some sleep disorders are more common among men. Obstructive sleep apnea is more prevalent among men and results in increased mortality related to its complications [26,27], and REM behavior disorder also affects more men than women.

Prior systematic reviews have focused predominantly on singular aspects such as social/environmental factors, gender, or race and ethnicity when addressing sleep health disparities. However, our review aims to amalgamate findings from existing literature pertaining to the influence of race/ethnicity, gender, and socioeconomic status on the sleep health of marginalized racially diverse populations. Additionally, we seek to pinpoint potential avenues for future research in this domain.

METHODS

This review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Supplementary Table 1 in the online-only Data Supplement). We searched three electronic databases (PubMed, Embase, Web of Science) from the earliest available date to September 2023 using the keywords sleep inequity, gender, race, and socioeconomic status. Relevant boolean operators were used to make the search as sensitive as possible. The search strategy is provided in Supplementary Table 2 (in the online-only Data Supplement).

Medical Subject Headings (MeSH) of the National Library of Medicine and Keywords were used to search PubMed, and a similar strategy was used for Embase and Web of Science. We also searched the reference lists of the selected articles. Studies identified were assessed for relevance based on the title and abstract. Studies were included if they analyzed sleep health inequity. Sleep health inequity was defined as a difference in sleep characteristics based on race, gender, or socioeconomic status. For each selected article, we extracted data related to study design, sample size, race, gender, and results.

We limited the search to full texts articles written in English.

Inclusion Criteria

Studies published in a peer reviewed journal in English language were included in this review. Studies involving adults (19 years or older) and which evaluated sleep health among racial/ethnic minority men and women of different socioeconomic background were included in this review.

Exclusion Criteria

We excluded studies if: 1) they were not in English, 2) they were reviews, meta-analyses, or case reports, 3) editorials or practice guidelines were included, or 4) they were conducted outside the US.

Data Extraction

Based on the inclusion and exclusion criteria, one author (SBA) examined the titles and abstract to assess eligibility for full text review. Two reviewers (SBA, SFQ) together assessed the eligibility of the full text studies. The studies reporting the impact of race/ethnicity, gender, and socioeconomic status on sleep health were included in this review.

We only included randomized and cohort studies focused on adults. A systematic quality assessment of the studies was not performed because of the limited availability of studies.

Assessment of Study Quality

Using the National Heart, Lung, and Blood Institute (NHLBI)'s "Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies [28]," the methodological quality of the articles was assessed. The studies were evaluated on 14 criteria for a total score of 0–14. Based on the total score, each study was assigned a quality rating of "Good" (score ≥ 10), "Fair" (score 5–9), or "Poor" (score < 5). Race, gender, and socioeconomic status were considered as exposures, and sleep measures were considered the outcome variables.

RESULTS

Using the search strategy, we identified 52 articles. After ex-

cluding 11 duplicate studies we screened 41 articles. The studies not relevant to our search were excluded and we assessed 25 full-text articles. We further excluded 9 studies as the data were not pertinent to this review. A summary of our search results is shown in Fig. 1.

Table 1 demonstrates the summary of the studies included in this review. Twelve of the 16 studies were cross sectional and 4 were prospective studies. The majority of the studies used self-reported sleep parameters. Two studies used a validated insomnia scale, 5 studies used the validated Pittsburgh Sleep Quality Index (PSQI) and Epworth Sleepiness Scale (ESS), and one study used polysomnographic data. Ten studies were graded Fair and only 6 were graded Good (Table 2).

In this review, we have divided the included articles into three main categories based on inequality related to race/ethnicity, gender, and socioeconomic status.

Description of Included Studies

Race and ethnicity

Race and ethnicity have been found to be the fundamental cause of health inequities [29–31]. Although socioeconomic differences have been found to have an impact on health, studies have suggested that for many health outcomes racial differences persist even after accounting for socioeconomic differences [32–34].

Using the National Health Interview Survey Data from 2004–2017, the authors demonstrated that Black individuals have a shorter sleep duration (< 7 h) than White individuals (odds ratio [OR] 1.35, 95% confidence interval [CI] = 1.08–1.69) [35]. The prevalence of short sleep duration was 41% among Black individuals compared to 26% among Whites, 30% among Asian,

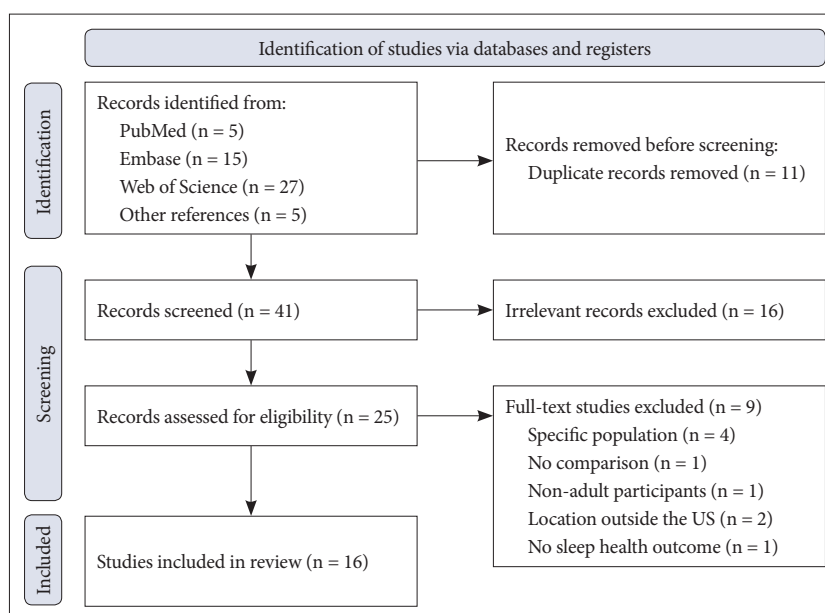


Fig. 1. PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers only.

Table 1. Summary of articles for review

Study	Sample	Design	Findings
Saini et al. [52]	Prospective 135 Participants, 90% married Whites/European American: 78% men, 76% women; Black/African American (AA): 18% men, 21% women; other ethnicities: 4% men, 3% women	Sleep evaluation: actigraphy, nightly sleep diary log; Pittsburgh Sleep Quality Index (PSQI), couples completed questionnaires after completing actigraphy Socioeconomic status (SES) indices used: income-to-needs ratio, perceived economic well-being, employment and occupation, education	- Women had higher levels of perceived economic well-being, jobs with greater occupational prestige, and longer and greater %sleep. - In contrast men had higher level of employment, and greater long wake episodes. - Occupation type or education did not affect sleep parameters.
Grandner et al. [46]	Cross sectional 5587 Participants from 2007–2008 National Health and Nutrition Examination Survey (NHANES)	Self- reported sleep symptoms Socioeconomic variables included poverty, education, access to health insurance, and food security; poverty was assessed by total household income above or below \$20000	- Sleep latency of >30 min was frequently reported in African Americans and Hispanic/Latino respondents compared to non-Hispanic Whites. - However, African American and Hispanic /Latino and Mexicans reported less difficulty falling and maintaining asleep and lesser degree of non-restorative sleep and daytime sleepiness. Asians/others also had similar results. - Low income and low food security category was associated with more symptoms. Education less than 9th grade reported fewer symptoms compared to college educated participants.
Ertel et al. [41]	Cross sectional 340 Subjects from extended care facilities took part in a survey in English, Spanish, and Haitian Creole: 26 were Hispanic/Latino; 126 non-Hispanic blacks (118 were foreign born); 144 non-Hispanic Whites (130 were foreign born); Other groups included 9 born in Cape Verde, 7 born in Haiti, 6 born in Philippines, and 12 in US. 82% Female	Sleep parameters measured via wrist actigraphy Self-reported occupational exposures	- Non-Hispanic African/Caribbean immigrants had less income and less education (p < 0.05). They were twice as likely to work night shifts. - 45% Non-Hispanic Whites reported low job strain whereas 41% of African/Caribbean immigrants reported high job strain and reported working >40 h/week. - After adjusting for gender and age, the difference in sleep duration between African/Caribbean immigrants and White was >1 h (estimate -64.4 min, 95% CI -81.0, -47.9).

Table 1. Summary of articles for review (continued)

Study	Sample	Design	Findings
Van Dyke et al. [49]	Cross sectional 425 Non-Hispanic African American (n = 215) and White (n = 210) adults from Morehouse and Emory Team up to Eliminate Cardiovascular Health Disparities (META-Health) study	For SES discrimination, Experiences of Discrimination Scale was used Sleep quality was measured using the PSQI	- Compared to Whites, AA were younger ($p = 0.02$), less likely to be college educated ($p < 0.01$), and more likely to report SES and racial discrimination overall and in a greater number of settings ($p < 0.01$). AA also reported worse subjective sleep quality ($p < 0.01$), had a higher body mass index (BMI) $p < 0.01$, and were more likely to report financial stress ($p < 0.01$). In correlation analyses, racial and gender discrimination were moderately corrected with SES discrimination in both races ($r_s = 0.29$ to 0.46; $p < 0.001$). - African Americans reporting SES discrimination were more likely to have poor sleep quality (PSQI score 5 or higher) than AA not reporting SES discrimination (OR = 2.32, 95% CI 1.14–4.72). - Whites 17%, Blacks 16%, Hispanic/Latino 7%, Asians 6%. - 65% were unemployed, 99% reported income <\$35000. - 29% reported short sleep (<7 hr); 22% reported symptoms of chronic insomnia. - Blacks reported short sleep duration (adjusted prevalence ratio: OR 1.36, 95% CI 1.04–1.78). - Prevalence of short sleep for Whites was 26%, Blacks 41%, Asians 30%, Hispanics 29%. - Asians reported greater nonrestorative sleep than Whites (1.40, 95% 1.12–1.75). - Women slept 34 min longer than men ($p = 0.002$). - Among men, Hispanics slept less than non-Hispanic Whites ($p = 0.002$).
Jones et al. [35]	National Health Interview Survey (2004–2017) from 2119 college students	Self-reported sleep duration, trouble falling/staying asleep, nonrestorative sleep Education attainment, employment status, and annual household income were collected	- Average sleep duration was 6.5 hours, and 53.7% reported insufficient sleep. - 52% reported moderate neighborhood reputation, and 20% reported bad reputation. - Overall neighborhood stigma was not associated with sleep quality or duration. - In contrast, media perception was associated with poor sleep quality (RR 2.64, 95% CI 1.32, 5.26) and less average sleep duration ($\beta = 0.96$, 95% CI -1.69, -0.22). - Compared to Blacks, Whites were older, with higher education, employed and had income \$50000 or more. - Compared with the highest quintile of SES, the lowest quintile was associated with a 10% (AOR Q1 vs. Q5 [95% CI], 1.10 [1.03, 1.17]) and 37% (1.27 [1.24, 1.52]) increase in the odds of short and long sleep, respectively. - Lower SES neighborhood had higher odds of short sleep among white women (1.21, 1.05–1.40), and long sleep among black women (1.31, 1.06–1.60).
Dietch et al. [34]	Cross sectional Community based study 300 Participants (150 men): 60% non-Hispanic Whites, 15% non-Hispanic Blacks, 19% Hispanic/Latino, 6% Asian/other	Psychological survey, actigraphy, ambulatory/ecological momentary assessment (EMA)	- Neighborhood stigma assessed using 4-item survey previously tested among diverse people - Sleep duration and quality measured through PSQI - Self-reported sleep
Ruff et al. [48]	Pilot study 120 Participants (45% men): 67.8% Blacks, 23.7% Hispanic; 69% had high school or less education; 71.6% with household income <\$25000 a year	Neighborhood stigma assessed using 4-item survey previously tested among diverse people Sleep duration and quality measured through PSQI	- Average sleep duration was 6.5 hours, and 53.7% reported insufficient sleep. - 52% reported moderate neighborhood reputation, and 20% reported bad reputation. - Overall neighborhood stigma was not associated with sleep quality or duration. - In contrast, media perception was associated with poor sleep quality (RR 2.64, 95% CI 1.32, 5.26) and less average sleep duration ($\beta = 0.96$, 95% CI -1.69, -0.22). - Compared to Blacks, Whites were older, with higher education, employed and had income \$50000 or more. - Compared with the highest quintile of SES, the lowest quintile was associated with a 10% (AOR Q1 vs. Q5 [95% CI], 1.10 [1.03, 1.17]) and 37% (1.27 [1.24, 1.52]) increase in the odds of short and long sleep, respectively. - Lower SES neighborhood had higher odds of short sleep among white women (1.21, 1.05–1.40), and long sleep among black women (1.31, 1.06–1.60).
Nyarko et al. [50]	Cross sectional from Southern Community Cohort Study 74392 Participants (29968 Black women, 21362 Black men, 14138 White women, 8924 White men)	Self-reported sleep	- Average sleep duration was 6.5 hours, and 53.7% reported insufficient sleep. - 52% reported moderate neighborhood reputation, and 20% reported bad reputation. - Overall neighborhood stigma was not associated with sleep quality or duration. - In contrast, media perception was associated with poor sleep quality (RR 2.64, 95% CI 1.32, 5.26) and less average sleep duration ($\beta = 0.96$, 95% CI -1.69, -0.22). - Compared to Blacks, Whites were older, with higher education, employed and had income \$50000 or more. - Compared with the highest quintile of SES, the lowest quintile was associated with a 10% (AOR Q1 vs. Q5 [95% CI], 1.10 [1.03, 1.17]) and 37% (1.27 [1.24, 1.52]) increase in the odds of short and long sleep, respectively. - Lower SES neighborhood had higher odds of short sleep among white women (1.21, 1.05–1.40), and long sleep among black women (1.31, 1.06–1.60).

Table 1. Summary of articles for review (continued)

Study	Sample	Design	Findings
Pranathiasagarwan et al. [42]	Prospective study between July 1996–February 1999 472 Participants: 340 African American, 172 Whites; 244 men, 228 women	Polysomnographic data	- Whites: 70% men, 30% women. - African American: 45% men, 55% women. - High prevalence of HTN among African American (46% vs. 12.5%, $p < 0.001$). - Among African American, apnea-hypopnea index (AHI) was higher for younger than 39 years and also for those between 50–59 years of age.
Ruggiero et al. [51]	172 Participants: 119 Whites, 22 African American, 20 Asians, 7 Hispanic/Latino, 1 native American, 4 mixed	Sleep attitudes measured through Charlotte Attitudes Towards Sleep Scale (CATS) Sleep hygiene practice scale (SHPS) Sleep duration/quality measured using the PSQI	- Females and older adults had more positive attitudes towards sleep. - Whites had more positive attitudes than minorities. - Minorities with higher SES had negative sleep attitude vs Whites with higher SES.
Ruthberg et al. [43]	Cross sectional analysis of National Inpatient Sample database between 2007–2014 449705 Participants: 59% males, 65% Caucasians	Patients with OSA were included Surgical and non-surgical cohorts were compared	- 27841 (5.8%) had surgical intervention. - Surgical patients were younger (43.8 vs. 55 years, $p < 0.001$). - Males (74.4% vs. 59%), Hispanics (10.2% vs. 6.2%), and Asians (3.6% vs. 1.0%). - 36.1% were from higher income bracket (vs. 25.1%).
Cheng et al. [36]	Cross sectional 1458 Participants: 74.2% Whites, 25.8% minorities (Blacks 271, Asian Americans 33, Native American 14, More than one race 58)	Insomnia Severity Index (ISI)	Black participants reported more severe insomnia symptoms ($\beta = 0.17 \pm 0.07$, $p < 0.05$). In contrast, there was no significant effect of race on insomnia for Asian American or multiracial individuals ($\beta = 0.11 \pm 0.11$, $p = 0.31$).
Holler et al. [38]	Indiana Network for Patient Care (INPC) 9557 Participants	Relationship between race and time to an order for an FDA approved insomnia medication	1187 (12.4%) received the medication (6.2% Blacks, 13.5% Whites, 8% other race, 16.7% unknown race).
Pigeon et al. [40]	92 Patients Blacks 52.2%	PSQI, CES-D-R (Center for Epidemiologic Studies–Depression Scale-Revised)	Black race was found to be associated with poor sleep (OR, 3.00; 95% CI, 1.17–7.69) even after adjusting for gender, employment, and income category.

Table 1. Summary of articles for review (continued)

Study	Sample	Design	Findings
Chen et al. [18]	Multi-Ethnic Study of Atherosclerosis (MESA) Prospective study 2230 Participants: 37.1% White, 27.4% Black, 23.7% Hispanics, and 11.7% Chinese. Overall, 9.0% of participants had doctor diagnosed sleep apnea	Actigraphy, Women Health Initiative Insomnia Rating Scale (WHIIRS), Epworth Sleepiness Scale (ESS)	The prevalence of short sleep varied from 43.4% among Blacks to 19.3% among Whites. Compared with Whites, Blacks had higher odds of sleep apnea syndrome (OR = 1.78; 95% CI: 1.20–2.63), short sleep (OR = 4.95; 95% CI: 3.56–6.90), poor sleep quality (OR = 1.57; 95% CI: 1.00–2.48), and daytime sleepiness (OR = 1.89; 95% CI: 1.38–2.60). Hispanics were 1.64 times as likely to report habitual snoring, 2.14 times as likely to have severe sleep disordered breathing, and 1.80 times as likely to have short sleep as compared with Whites. - Black men living in a house/apartment were likely to be short sleeper (36% vs. 27% for Whites) and long sleeper (11% vs. 8%). Similar results were seen for women. - In contrast, White men living in trailer/mobile home were short sleeper (34% vs. 29%) but less likely to be long sleeper (12% vs. 19%). - White women living in trailer/mobile home reported short sleep (37% vs. 31%) but less likely to be long sleeper (12% vs. 16%).
Johnson et al. [47]	Gross sectional data from 2004–2015 National Health Interview Survey		

and 29% among Hispanic/Latino [35].

Another study examining individuals from communities in the Detroit metropolitan area demonstrated that compared to White individuals, Black participants reported more severe insomnia symptoms ($\beta = 0.17 \pm 0.07$, $p < 0.05$) [36]. Insomnia severity in this study was measured using the Insomnia Severity Index (ISI). The ISI is a 7-item self-reported questionnaire evaluating difficulty falling or staying asleep, early morning awakenings, dissatisfaction with sleep, and effect of sleep on daytime functioning [37]. In contrast, there was no significant effect of race on insomnia for Asian American or multiracial individuals ($\beta = 0.11 \pm 0.11$, $p = 0.31$) [36]. Similarly, race has been shown to impact the prescription of FDA-approved insomnia medication. In this study, the authors demonstrated that “6.2% of Black individuals, 13.5% of White individuals, 8.0% of other race patients, and 16.7% of unknown race patients received an order for FDA approved pharmacotherapy after insomnia diagnosis” [38]. Biases, stereotypes, and/or communication difficulties were thought to play a role in clinicians’ decision to prescribe insomnia medication [38].

Using the PSQI [39], Pigeon et al. [40] targeted middle aged and older adults for sleep disturbances across the life span. The PSQI assesses sleep quality during the previous month. The PSQI consists of 19 self-reported symptoms related to sleep duration and sleep onset latency as well as frequency and severity of sleep related problems. The participants were primarily black (52.2%). Black race was found to be associated with poor sleep (OR = 3.00; 95% CI: 1.17–7.69) even after adjusting for gender, employment, and income category.

To understand the interplay of socioeconomic status, occupational exposure, race/ethnicity, and sleep, actigraphic data were collected from employees of extended care facilities. Total sleep duration per day including the naps and daytime sleep was measured. In this study, the authors demonstrated that African/Caribbean immigrants had shorter sleep duration than the white participants, and the difference in sleep duration was >1 h (estimate -64.4 min, 95% CI: -81.0 to -47.9) [41].

Using the Multi-Ethnic Study of Atherosclerosis (MESA) data the authors examined the distribution of objectively measured sleep disordered breathing (SDB), short sleep duration, poor sleep quality, and insomnia across racial/ethnic groups [18]. Sleep disordered breathing was measured using 15-channel polysomnographic data, and SDB was defined as an apnea-hypopnea index (AHI) ≥ 5 events/h. Sleep duration and sleep quality was measured using actigraphy with short sleep duration defined as sleep duration of <6 h and 6–7 h, whereas long sleep duration was defined as ≥ 8 h. Compared to White individuals, Black individuals had a higher prevalence of short sleep (43.4% vs. 19.3%). Similarly, compared with White individuals, Black individuals had higher odds of sleep apnea syndrome (OR = 1.78; 95% CI: 1.20–2.63), short sleep (OR = 4.95; 95% CI: 3.56–6.90), poor sleep quality (OR = 1.57; 95% CI: 1.00–2.48), and daytime

Table 2. Study quality assessment rating for 16 studies included in a systematic review on sleep health disparity and race/ethnicity, socioeconomic status, and gender

Study	Study design	NHLBI study quality rating*
Saini et al. 2021 [52]	Longitudinal	8 (“Fair”)
Grandner et al. 2013 [46]	Cross-sectional	7 (“Fair”)
Ertel et al. 2011 [41]	Cross-sectional	8 (“Fair”)
Van Dyke et al. 2016 [49]	Cross-sectional	9 (“Fair”)
Jones et al. 2020 [35]	Cross-sectional	9 (“Fair”)
Dietch et al. 2017 [34]	Cross-sectional	9 (“Fair”)
Ruff et al. 2018 [48]	Cross-sectional	8 (“Fair”)
Nyarko et al. 2023 [50]	Longitudinal	11 (“Good”)
Pranathiageswaran et al. 2013 [42]	Longitudinal	11 (“Good”)
Ruggiero et al. 2019 [51]	Cross-sectional	11 (“Good”)
Ruthberg et al. 2020 [43]	Cross-sectional	9 (“Fair”)
Cheng et al. 2020 [36]	Cross-sectional	10 (“Good”)
Holler et al. 2020 [38]	Longitudinal	10 (“Good”)
Pigeon et al. 2011 [40]	Cross-sectional	8 (“Fair”)
Chen et al. 2015 [18]	Cross-sectional	10 (“Good”)
Johnson et al. 2018 [47]	Cross-sectional	9 (“Fair”)

*Based on National Heart, Lung, and Blood Institute’s (NHLBI) Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies; “Good” (score of 10–14), “Fair” (score of 5–9), or “Poor” (score of 0–4).

sleepiness (OR = 1.89; 95% CI: 1.38–2.60). Hispanics were 1.64 times as likely to report habitual snoring, 2.14 times as likely to have severe SDB, and 1.80 times as likely to have short sleep as compared with White individuals [18].

Similarly, a polysomnographic study of 472 adults demonstrated differences in sleep architecture (%Stage 1, %slow wave, and SpO₂ during REM) and AHI amongst White individuals and African Americans. Higher AHI was found among African American males, but not among women [42]. Interestingly, they did not differ in time in bed, total sleep time, sleep efficiency, %Stage 2, and %REM.

Additionally, disparities in surgical treatment of OSA have also been demonstrated in a cross-sectional analysis of National Inpatient Sample (NIS) database [43]. The authors noted that the “patients undergoing surgical treatment for OSA were younger ($p < 0.001$), and there was a preponderance of males (74.4% vs. 59%), Hispanic (10.2% vs. 6.2%), and Asians (3.6% vs. 1.0%), and from higher income brackets (36.1% vs. 25.1%)” [43].

Social determinants

Socioeconomic status is a measure of living conditions and habits affecting health. The socioeconomic differences between racial and ethnic minorities have been well documented. Lower socioeconomic status and limited education are often associated

with less knowledge about healthy lifestyle and in particular the impact of sleep deprivation [44]. Although the overall prevalence of insufficient sleep (sleep duration <7 h per night) has risen in the US from 15% in 1965 to above 30% in 2000, individuals with lower household incomes and those with less than a high school education have been shown to have a disproportionate increase in insufficient sleep (1.62 times and 1.51, times respectively) [45].

The participants enrolled in the 2007–2008 National Health and Nutrition Examination Survey (NHANES) were examined for the effect of sociodemographic and socioeconomic factors on sleep [46]. In a fully adjusted model, increased likelihood of sleep latency of a >30 min was found to be associated with lower socioeconomic status [46].

Using the data from 2004–2015 National Health Interview Survey of adults, Johnson et al. [47] examined sleep disparities by housing type. They demonstrated that compared to White men living in a house/apartment, Black men were more likely to report short sleep duration of less than 7 h (36% vs. 27%) and long (11% vs. 8%) sleep duration of ≥ 9 h as well as were less likely to obtain the recommended amount of sleep (54% vs. 65%) [47]. In contrast compared to Black participants White men living in a mobile home/trailer, were more likely to report short sleep (34% vs. 29%) but less likely to report long sleep (12% vs. 19%). In addition, for those living in a mobile home/trailer, there was no significant difference in the percentage of individuals who obtained the recommended amount of sleep between Black and White men (52% vs. 54%) [47].

Neighborhood stigma or reputation has also been linked with poor sleep. Using the data on 120 participants from the New York City (NYC) Low-Income Housing, Neighborhoods, and Health Study, the authors demonstrated that sleep duration and quality is negatively affected by negative media image of the neighborhoods [48]. Consistent findings were reported in another study demonstrating poor sleep quality (PSQI scores ≥ 5) in response to socioeconomic status discrimination [49].

Similarly, another study examined the association between neighborhood socioeconomic status and sleep duration among a large cohort of Black and low incomes participants in the Southeast United States [50]. Compared to the highest quintile of socioeconomic status, the lowest quintile was associated with an increase in the odds of short sleep duration of <7 h and long sleep duration of ≥ 9 h (10% and 37%, respectively). Interestingly, compared to White participants, Black participants living in neighborhoods with higher socioeconomic status were more likely to report short sleep compared to their counterparts living in lower socioeconomic status neighborhoods. Similar results were found in another study where minorities reporting higher socioeconomic status had the most negative sleep attitudes [51].

Gender, race, and socioeconomic interactions

The effect of gender on sleep is affected by race and socioeco-

conomic status and results have been inconsistent. The data from the Southern Community Cohort Study (SCCS) demonstrated that the association between neighborhood socioeconomic status and sleep duration differs substantially across race-and-sex subgroups. “Lower socioeconomic status neighborhoods were associated with higher odds of short sleep duration (7 h) among White women (OR = 1.21, 95% CI: 1.05–1.40), and long sleep (≥ 9 h) among Black women (OR = 1.31, 95% CI: 1.06–1.60).” While not directly compared, the proportion of women sleeping < 7 h was greater than in men [50].

In contrast in another study of cohabiting couples, lower socioeconomic status was associated with worsening sleep for both men and women. Higher income to needs ratio was associated increase in sleep duration but decrease in sleep quality for men, whereas women reported improved sleep quality [52]. Sleep duration was measured using the actigraphy and sleep quality was assessed using the PSQI and actigraphy (%sleep and long wake episodes). Similarly, in an exploratory study of adults living in the US, women were found to have more positive attitudes towards sleep and reported longer sleep on weekends. In addition, compared to minority women with positive sleep attitude, women with lower sleep attitudes reported less weekend sleep [51].

Johnson et al. [47] demonstrated that compared to White women, Black women living in a house/apartment were more likely to report short sleep duration of < 7 h (37% vs. 27%) and long (11% vs. 9%) sleep duration of ≥ 9 h as well as were less likely to obtain the recommended amount of sleep (52% vs. 64%). Similarly, White women living in trailers/mobile homes were more likely to report short sleep (37% vs. 31%) but were less likely to report long sleep (12% vs. 16%). Although no direct comparisons were made between men and women, race stratified results did not appear to show a gender difference in the proportion of participants sleeping < 7 h.

Using the data from the Mechanisms Underlying the Impact of Stress and Emotions on African American Women’s Health Study (MUSE) [53], the authors examined the association between racism related events and sleep quality which was assessed using the PSQI; a 19-item questionnaire measuring sleep quality over the previous month. Worse overall global sleep quality was found to be associated with experiences of racism.

DISCUSSION

This systematic review examined the effect of race/ethnicity, socioeconomic status, and gender on sleep domains. To our knowledge, this is the first review examining existing research on the role of race, gender, and socioeconomic status on sleep health disparity. This systematic review documents consistent evidence of sleep health disparity.

It is well known that racial minorities have limited access to healthcare. In this review, we have demonstrated the effect of

race on sleep health. The data from NHANES (2007–2008) demonstrated that Hispanic/Latino respondents were more likely to report snorting/gasping, and snoring compared to non-Hispanic White individuals [46]. Similarly, compared to White individuals, Black and Hispanic individuals are 1.97 and 1.43 times more likely to report increased insufficient sleep, respectively [45]. Extended working hours, irregular sleep schedule due to rotating shift work, a need to provide extra care to the dependents, and a lack of social and emotional support are some of the factors affecting their sleep [54].

In addition, racial minorities are overrepresented in low socioeconomic strata with adverse working conditions/unemployment, substandard housing, and social stresses. These conditions may also affect mental health and account for sleep disturbances. The impact of physical environment on sleep has been described in research studies. Exposure to a green environment has been demonstrated to improve quality of sleep and protect against the effects of insufficient sleep among racial minorities [55]. In a survey study in Wisconsin, tree canopy was found to be associated with longer weekday sleep duration [56]. The access to green spaces promotes healthy behaviors such as walking and improves mental health by lowering stress level and could have a positive effect on sleep. Unfortunately, Black and Hispanic individual have poor access to green spaces [57,58] contributing to health disparities. Neighborhoods lacking access to parks and recreational facilities can foster obesity which is an established strong risk factor for sleep apnea [26].

Moreover, living in an unsafe neighborhood may have an adverse effect on one’s ability to relax and sleep. Higher crime in neighborhoods has been shown to be associated with lower sleep efficiency and longer wakefulness after sleep onset (WASO) independent of other covariates [59]. Several other studies have also demonstrated an association between neighborhood safety and sleep quality, sleep duration, and daytime sleepiness [60–67]. Minorities and individuals with low socioeconomic status are likely to live in densely populated areas with more air, noise, and light pollution [68]. Light is the most important zeitgeber for circadian rhythms and exposure to light at night suppresses melatonin secretion and can delay sleep onset. Light pollution resulting from inappropriate exposure bright light is associated with prolonged sleep latency, delayed circadian rhythm, and insufficient sleep [69]. Similarly, neighborhoods with loud noise from traffic, disorderly bar patrons, night club music, construction work and other sources can contribute to insomnia, short/fragmented sleep, poor sleep quality, early awakenings, and daytime sleepiness [65,66].

In addition to noise, air pollution has also been linked with poor sleep. Higher annual exposure to fine particulate matter < 2.5 micrometers (PM_{2.5}) and nitrogen oxide has been found to be associated with increased odds of moderate to severe sleep apnea [67,68]. In a study from the US, a 39% increase in odds of sleep apnea was found to be associated with an exposure to

a 10 ppb increase in nitrous oxide [68].

Racial discrimination is a chronic stressor which is a significant contributor to sleep disturbance and is experienced by almost all minority groups [69-71]. The perceived or actual discrimination can produce a chain of causation of stressors adversely affecting health [72]. Increased risk of hypertension has also been demonstrated in response to perceived discrimination [73]. There is evidence that the effect of environmental stressors on personal health is mediated by disturbed sleep [74,75]. The effects of racism and discrimination on sleep have also been investigated. Using polysomnographic monitoring, the authors demonstrated that Black individuals had significantly less slow wave sleep and more self-reported daytime fatigue ($p < 0.05$). Perceived discrimination was thought to mediate differences in stage 4 sleep and physical fatigue [76].

Although we found gender differences in sleep were inconsistent and related to race and socioeconomic differences, in previous studies [22-25] women in general report shorter sleep and increased rates of insomnia. These differences can be explained by biological, psychosocial, and environmental factors.

Poor sleep is linked with increased mortality and morbidity. Therefore, sleep health must be addressed to bring equity and equality among populations divided by race, socioeconomic status, and other determinants. More research is needed to examine neighborhood segregation and sleep health to identify areas of improvement across racially diverse populations. Furthermore, future studies should use objective measures of sleep duration and quality in order to examine relationships between race, socioeconomic status, gender, and sleep health.

Overall, this review demonstrates an association between sleep and race/ethnicity, gender, and socioeconomic status. There are several limitations of this review. The primary limitation is the quality of evidence. There is substantial heterogeneity in study design for the included studies. Most studies were cross sectional in nature which limits the causal inference. Additionally, except for a few studies using actigraphy, sleep duration was self-reported which can lead to overestimates. However, most comparisons among exposures were within and not between studies thereby mitigating this bias. Furthermore, other potential confounders such as psychosocial stress were not measured in most studies. Self-reported assessments and subjective measures for sleep were used which have been developed and validated in predominantly White samples further questioning the validity of studies. Finally, the studies included in this review were conducted in the US, therefore the results may not be generalizable to other countries.

CONCLUSION

This review demonstrates disparities in sleep based on race/ethnicity as well as the effect of gender and socioeconomic status

on the quality of sleep. There is a need for future research that addresses interventions impacting the root cause of sleep health disparity.

Supplementary Materials

The online-only Data Supplement is available with this article at <https://doi.org/10.17241/smr.2024.02152>.

Availability of Data and Material

Data sharing not applicable to this article as no datasets were generated or analyzed during the study.

Author Contributions

Conceptualization: Salma Batool-Anwar. Data curation: Salma Batool-Anwar. Writing—original draft: Salma Batool-Anwar. Writing—review & editing: Salma Batool-Anwar, Stuart F. Quan.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

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