Objective Sleep Quality in Diverse Older Adults: the Importance of Race and Ethnicity and Sex

Clémence Cavaillès, PhD[a], Katie L. Stone, PhD[b], Yue Leng, PhD[a], Carrie Peltz, PhD[a], Kristine Yaffe, MD[a,c,d]

a. Department of Psychiatry and Behavioral Sciences, University of California San Francisco, San Francisco, California, USA.

b. Department of Research Institute, California Pacific Medical Center, San Francisco, California, USA.

c. Department of Neurology, University of California San Francisco, San Francisco, California, USA.

d. Department of Epidemiology, University of California San Francisco, San Francisco, California, USA.

Corresponding author: Clémence Cavaillès ; clemence.cavailles@ucsf.edu ; 675 18th Street, San Francisco, CA 94107; +1(628)209-9749.

Abstract

Background: Research on sleep disparities across different sociodemographic groups is limited and often yields inconsistent findings. We aimed to examine differences in objective sleep measures by race and ethnicity, sex, and age within a diverse cohort of community-dwelling older adults.

Methods: We analyzed cross-sectional data from 838 participants aged ≥50 years in the Dormir Study (2020-2024). Sleep metrics, including sleep duration, sleep efficiency, wake after sleep onset (WASO), and sleep fragmentation index (SFI), were derived from 7-day wrist actigraphy. Race and ethnicity (Black; Mexican American [MA]; Non-Hispanic White [NHW]), sex, and age (<65; ≥65 years) were self-reported. We compared sleep metrics across sociodemographic groups and assessed their multivariable associations using linear, logistic, and multinomial regression models.

Results: We studied 190 (22.7%) Black, 282 (33.6%) MA, and 366 (43.7%) NHW Dormir participants, with a mean age of 66.7 ±8.4 years, and 64.8% women. Compared to NHW participants, Black and MA participants had shorter mean sleep duration (Black: 7.1 ±1.2 hours; MA: 7.1 ±1.1 hours; NHW: 7.5 ±1.1 hours; p<0.0001), lower median sleep efficiency (Black: 87.2%; MA: 87.8%; NHW: 90.6%; p<0.0001), longer median WASO (Black: 61.2 minutes; MA: 56.7 minutes; NHW: 44.4 minutes; p<0.0001), and higher mean SFI (Black: 32.0 ±11.0%; MA: 27.3 ±9.7%; NHW: 24.0 ±9.0%; p<0.0001). Compared to men, women had longer mean sleep duration (women: 7.4 ±1.1 hours; men: 7.1 ±1.2 hours; p=0.0004) and lower mean SFI (women: 25.9 ±8.8%; men: 28.9 ±12.1%; p=0.0001). Older participants had longer mean sleep duration (old: 7.4 ±1.1 hours; young: 7.1 ±1.1 hours; p<0.0001), higher median sleep efficiency (old: 89.8%; young: 87.7%; p<0.0001), shorter median WASO (old: 48.5 minutes; young: 56.8 minutes; p<0.0001), and lower mean SFI (old: 26.1 ±10.2%; young: 28.1 ±10.2%; p=0.007).

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After adjusting for socioeconomic and behavioral factors, comorbidities, and sleep medications, findings were consistent except for age group comparisons in which differences were no longer significant.

Conclusions: Our findings demonstrate significant variations in objective sleep measures across sociodemographic groups, with non-White participants and men experiencing poorer sleep quality. These disparities may contribute to health inequalities, emphasizing the need for targeted interventions to support at-risk populations.

Keywords: sleep; actigraphy; race and ethnicity; sex; older adults

Background

Poor sleep quality is common in the general population and has been associated with a wide range of physical and mental health issues, including metabolic and cardiovascular disease, cognitive impairment, depression, and an increased mortality risk [1–5]. Understanding how sleep measures vary across sociodemographic groups and identifying populations that experience worse sleep are critical for informing targeted public health interventions. These efforts may help mitigate the burden of poor sleep and address broader health disparities. This is particularly important for older adults, who are already at greater risk for adverse health outcomes and for whom poor sleep may exacerbate or accelerate the onset of age-related diseases.

Race and ethnicity are a key sociodemographic factor that may highlight sleep disparities [6,7]. A few studies have investigated racial and ethnic minorities, such as Black adults, and reported worse sleep outcomes compared to White adults [8–10]. However, research examining sleep across diverse racial and ethnic populations remains limited. Most studies have primarily focused on sleep differences between White and Black individuals, leaving other minority groups, such as Hispanics, relatively understudied [11]. Moreover, most prior studies relied on self-reported sleep data, which is prone to bias and often overlooks sleep features that require objective measurement for good accuracy like sleep fragmentation [11]. Actigraphy, an objective, non-invasive, and cost-effective method for sleep assessment, offers a valuable alternative.

Furthermore, sex differences may also play an important role in sleep health [12]; but the relationship between sleep measures and sex is inconsistent and appears to vary according to the method of sleep assessment. Studies based on self-reported sleep data have generally indicated that women reported more sleep complaints, insomnia symptoms, and experienced

25   poorer sleep quality and shorter sleep duration than men [13–17]. In contrast, studies using

26   objective sleep measures have suggested that women may have better objective sleep quality,

27   less fragmented sleep, and longer sleep duration compared to men [13,15,16,18,19]. Previous

28   research has also shown that sleep quality declines with age, as evidenced by longer periods of

29   wakefulness after sleep onset, more frequent nighttime awakenings, reduced sleep efficiency,

30   decreased nighttime sleep duration, and higher frequency of sleep disorders [13,18,20–22].

31   However, the combined effects of sex, age, and race and ethnicity in relation to sleep

32   differences remain unexplored.

33   To address these gaps, we examined differences in objective sleep measures by race and

34   ethnicity, sex, and age groups, as well as their combinations, using actigraphy-derived data from

35   a recently assembled large, diverse cohort of community-dwelling older adults, including Non-

36   Hispanic White (NHW) participants and nearly 60% of non-White (Black and Mexican American

37   [MA]) individuals. We also assessed whether sleep disparities among diverse populations are

38   independent of socioeconomic status and health factors.

39   ## Methods

40   *Study Design*

41   We conducted a sleep study ancillary to the Health & Aging Brain Study – Health Disparities

42   (HABS-HD), the Dormir Study. Briefly, HABS-HD is a longitudinal, community-based study of

43   cognitive aging among Black, MA, and NHW participants, conducted by the University of North

44   Texas Health Science Center [23]. Subjects were enrolled in the study baseline visit using a

45   community-based participatory research approach for reaching underserved and racial and

46   ethnic minority populations, leading to a representative sample of the larger community [23].

47   Inclusion criteria included age 50 and older, self-reported race and ethnicity of Black, MA, or

48   NHW, fluency in English or Spanish; detailed HABS-HD protocol has been described previously

49   [23].

50   The Dormir Study was conducted between 2020 and 2024 and invited eligible HABS-HD

51   participants to undergo a comprehensive sleep examination, including actigraphy and a sleep

52   diary. Participants who had agreed to be re-contacted from the HABS-HD cohort were invited to

53   complete a brief pre-screening questionnaire if they were interested. Those with permanent

54   pacemakers and those currently using a continuous positive airway pressure machine were

55   excluded. Our study included 838 participants with complete sociodemographic data as of May

56   2024 and valid actigraphy data (defined as wearing the watch for at least four nights and

57   maintaining a sleep diary). All study participants provided written informed consent, and the

58   Dormir Study was approved by the University of North Texas Health Science Center Institutional

59   and University of California San Francisco Review Boards.

60   *Actigraphy*

61   Actigraphy data was collected using the GT3XActiGraph Link device (ActiGraph, Inc.).

62   Participants were instructed to wear this watch-like device on their nondominant wrist

63   continuously (except for bathing) for a minimum of 4 and up to 7 consecutive days and nights.

64   Data were scored in 60-second epochs, and the Cole-Kripke sleep scoring algorithm was

65   applied using ActiLife 6 software to determine "sleep" and "wake" periods [24]. Trained scorers

66   edited the data using participants' sleep diaries to identify (i) in-bed and out-of-bed intervals; and

67   (ii) non-wear times, which were removed, by using either the declared off-wrist sensor or the

68   Troiano non-wear algorithm [25,26]. The ActiLife software option was used to set all non-wear

69   periods within the in-bed interval as sleep for calculations in the nightly in-bed interval

70   summaries. Sleep measures were averaged across all days and nights of recording.

71   We examined four measures of nighttime sleep: sleep duration (hours), sleep efficiency (ratio of

72   sleep duration to time spend in bed, multiplied by 100), wake after sleep onset (WASO; minutes

73   of wake during the sleep interval), and sleep fragmentation index (SFI; sum of the percentage of

74   the sleep period spent moving and the percentage of immobile periods ≤1 minute). We

75   examined these measures continuously and categorically considering commonly used cut-offs

76   for sleep duration (<6, 6-8, >8 hours) and sleep efficiency (<85, ≥85%), and WASO and SFI

77   tertile.

78   *Covariates*

79   Sociodemographic and health characteristics, including age, sex, race and ethnicity, education,

80   retirement status, household income, current smoking status, and medical history of

81   hypertension, diabetes, stroke, heart attack, and depression, were self-reported through clinical

82   interviews. Body mass index (BMI) was calculated and physical activity measured using the

83   Rapid Assessment of Physical Activity (RAPA) questionnaire [27]. Cognitive status (normal

84   control; cognitive impairment [mild cognitive impairment and dementia]) was determined through

85   an algorithmic decision tree and consensus review [23]. Sleep medication use was self-reported

86   from the Pittsburgh Sleep Quality Index [28]. In a subsample (n=784), sleep apnea was

87   assessed using the WatchPAT 200 (Itamar Medical Ltd.) [29], with a respiratory event index

88   (REI) ≥15 indicating moderate to severe sleep apnea (see eMethods).

89   *Statistical Analysis*

90   Participants' characteristics were compared by race and ethnicity using chi-squared tests for

91   categorical variables, ANOVA for normally distributed continuous variables, and Kruskal-Wallis

92   tests for skewed continuous variables. Sleep measures were compared by sex and age groups

93   using chi-squared, t-tests, and Mann-Whitney U tests. Sleep comparisons by sex were further

94   stratified by race and ethnicity (six groups) and analyzed similarly. We presented frequencies for

95   categorical variables, mean (± standard deviation) for normally distributed continuous variables,

96   and median (interquartile) otherwise.

97   We examined the multivariable associations between sleep measures and sociodemographic

98   groups using linear, logistic, and multinomial logistic regressions. Models were adjusted for race

99   and ethnicity, sex, age, education, income, cognitive status, retirement status, smoking, physical

100   activity, BMI, sleep medications, and history of hypertension, diabetes, stroke, heart attack, and

101   depression. Non-normally distributed variables were transformed (cube and log transformations)

102   with results back-transformed to their original scale. Adjusted means (95% confidence intervals

103   [CI]) were reported for continuous variables and odds ratios (95% CI) for categorical variables.

104   Sensitivity analyses included False Discovery Rate (FDR) corrections for multiple testing and

105   further adjustment for income (n=787; due to missing data) and sleep apnea (n=784).

106   Furthermore, we used a stepwise approach to assess the impact of covariates on the

107   association between sleep measures and age groups. Notable changes in effect size, loss of

108   significance, or substantial improvement in adjusted R^2 indicated that the covariate explained

109   meaningful variation in the outcome. All statistical tests were two-sided, and analyses were

110   performed using R version 4.4.0.

Results

112   The 838 participants had a mean age of 66.7±8.4 years and 64.8% were women, 190 (22.7%)

113   were Black, 282 (33.6%) were MA, and 366 (43.7%) were NHW. Compared to NHW

114   participants, Black and MA participants were more likely to be women, younger, employed,

115   smokers, and to have lower incomes. They also had higher BMI, as well as higher rates of

116   cognitive impairment, history of hypertension and diabetes, and sleep medication use.

117   Additionally, MA participants had fewer years of education and were less physically active than

118   NHW participants (Table 1).

119   *[Table 1]*

120   *Race and ethnic differences in sleep*

121   The average sleep duration among all participants was 7.3±1.1 hours, with a median sleep

122   efficiency of 89.0%, a median WASO of 51.1 minutes, and a mean SFI of 26.9±10.2%.

123   Compared to NHW participants, Black and MA participants had shorter mean sleep duration

124   (Black: 7.1±1.2 hours; MA: 7.1±1.1 hours; NHW: 7.5±1.1 hours; p<0.0001), lower median sleep

125   efficiency (Black: 87.2%; MA: 87.8%; NHW: 90.6%; p<0.0001), longer median WASO (Black:

126   61.2 minutes; MA: 56.7 minutes; NHW: 44.4 minutes; p<0.0001), and higher mean SFI (Black:

127   32.0±11.0%; MA: 27.3±9.7%; NHW: 24.0±9.0%; p<0.0001) (Table 2). The prevalence of short

128   sleep duration, poor sleep efficiency, long WASO, and high SFI were highest among Black

129   participants, followed by MA participants, and then NHW participants (Table 2). These racial and

130   ethnic differences remained statistically significant for all sleep measures, except for the

131   prevalence of short sleep duration and high SFI in MA participants after adjusting for potential

132   confounders (Table 3, eTable 1). Moreover, the differences remained significant after FDR

133   correction and further adjustment for income and sleep apnea (eTables 2-5).

134   [Table 2]

135   *Sex differences in sleep*

136   Sleep measures differed by sex (Table 2). Compared to men, women had longer mean sleep

137   duration (7.1±1.2 *vs.* 7.4±1.1 hours; p=0.0004) and lower mean SFI (28.9±12.1 *vs.* 25.9±8.8%;

138   p=0.0001). Women also showed lower prevalence of short sleep duration, high SFI, and higher

139   prevalence of long sleep duration; with a tendency for higher rates of good sleep efficiency

140   (p=0.09) and short WASO (p=0.12). In the multivariable model, women displayed lower odds of

141   short sleep duration and high SFI (highest tertile) than men (Table 3). The adjusted mean sleep

142   duration and SFI were 7.0 hours and 32.4% for men and 7.3 hours and 29.1% for women,

143   respectively (eTable 6). Sensitivity analyses displayed comparable findings (eTables 2, 4, 7, 8).

144   [Table 3]

145   Figure 1 illustrates the sleep measures by sex and race and ethnicity. Among the six groups,

146   NHW women exhibited the longest mean sleep duration, highest median sleep efficiency, and

147   lowest median SFI, alongside the highest prevalence of long sleep duration, good sleep

148   efficiency and lowest prevalence of long WASO and high SFI (eTable 9). NHW men had the

149   shortest median WASO. In contrast, Black men exhibited the shortest mean sleep duration,

150   lowest median sleep efficiency, longest median WASO, and highest mean SFI. They also had

151   the highest prevalence of short sleep duration, poor sleep efficiency, long WASO, and high SFI

152   (eTable 9).

153   *Age differences in sleep*

154   Compared to younger participants (<65 years), older participants (≥65 years) had longer mean

155   sleep duration (7.1±1.1 *vs.* 7.4±1.1 hours; p<0.0001), higher median sleep efficiency (87.7 *vs.*

156   89.8%; p<0.0001), shorter median WASO (56.8 *vs.* 48.5 minutes; p<0.0001), and lower mean

157   SFI (28.1±10.2 *vs.* 26.1±10.2%; p=0.007). They also exhibited higher prevalence of long sleep

158   duration and lower prevalence of short sleep duration, poor sleep efficiency, long WASO, and

159   high SFI (Table 2). However, after controlling for potential confounders, sleep measures no

160   longer differed between the two groups (Table 3, eTable 6). The main covariates driving the

161   association were race and ethnicity and retirement status (eFigures 1-4). Results remained

162   consistent in the sensitivity analyses (eTables 2, 4, 7, 8).

163   Discussion

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164   In a diverse sample of community-dwelling older adults, we identified disparities in actigraphy-

165   derived sleep measures across race and ethnicity and sex. Compared to NHW adults, Black

166   and MA participants had shorter sleep duration and worse sleep quality, with lower sleep

167   efficiency and more fragmented sleep. Additionally, women experienced better sleep than men,

168   with longer sleep duration and lower SFI. With further stratification, White women generally

169   demonstrated the most favorable sleep outcomes, while Black men exhibited the poorest. After

170   adjusting for potential confounders, we did not find sleep differences between age groups.

171   Overall, these findings indicate that objective poor sleep is more frequent among non-White

172   participants and among men, potentially contributing to broader health disparities.

173   Our findings align with a few prior studies, suggesting that non-White individuals have worse

174   sleep outcomes than White adults [6,7,11]. Our results are notable for including several race

175   and ethnic groups and investigating sex and age groups as well. These are particularly

176   important as Hispanics remain underrepresented in sleep research, despite being the largest

177   racial and ethnic minority group in the US [30]. Given that the Hispanic population aged 65 and

178   older is projected to triple by 2050 [31], addressing sleep disparities in this group is a growing

179   public health priority. Only a few studies have used actigraphy to investigate sleep in several

180   racial and ethnic minority groups [8,9,32]. Moreover, these studies typically involve small sample

181   sizes with disproportionately fewer non-White participants and fail to adjust for major

182   confounders like socioeconomic status, depression, or sleep medications. For example, Chen et

183   al., in the Multi-Ethnic Study of Atherosclerosis, reported higher odds of short sleep duration

184   among Black, Chinese, and Hispanic participants compared to NHW adults and that Black

185   participants had poorer sleep efficiency than NHWs, though no significant differences were

186   observed for Chinese and Hispanic participants [8]. However, this study did not account for

187   education, income, or important health conditions. In contrast, our study controlled for a broad

188   range of socioeconomic, behavioral, and comorbidity variables, and yet significant disparities

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189   persisted. The causes of these disparities are likely multifactorial and may include stress,

190   environmental factors (e.g., housing, neighborhood environment, pollution), psychological or

191   medical factors [33–35]. Structural racism and discrimination may also contribute to these

192   disparities, in part by limiting access to quality healthcare and increasing psychological distress

193   [33–35]. Future studies should explore more deeply the role of these potential drivers in diverse

194   populations.

195   We also found that women had objectively longer sleep duration and lower SFI than men,

196   consistent with some previous studies [13,15,16,18,19]. Although the mechanisms underlying

197   these sex differences are not well understood, several hypotheses have been suggested. One

198   suggests that men tend to have unhealthier lifestyles than women [36,37], possibly leading to

199   poorer sleep quality. However, our findings indicate that sex differences in sleep persist even

200   after accounting for numerous behavioral and comorbidity factors, suggesting that lifestyle may

201   not be the primary driver of these differences. Hormonal factors may also play a role. In women,

202   progesterone has been shown to improve sleep onset latency and sleep continuity [38–40],

203   while estrogen would enhance rapid-eye movement sleep [38]. In contrast, testosterone levels,

204   which decline with age in men, have been linked to poorer sleep quality [39,41]. Additionally,

205   sleep architecture differences may contribute to these disparities, as women generally have

206   more slow-wave sleep, the deepest and most restorative sleep stage [19,20,42]. Interestingly,

207   although women had lower fragmented sleep based on the SFI, no differences were observed

208   for WASO, another marker of sleep fragmentation. SFI captures the frequency of sleep

209   interruptions and movements, including brief arousals, whereas WASO represents the total time

210   spent awake after falling asleep. Thus, our results suggest that men may experience more

211   frequent but shorter sleep disruptions than women.

212   When examining the interaction between race and ethnicity and sex, striking patterns emerged.

213   NHW women demonstrated the most favorable sleep patterns, while Black men exhibited the

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214   least favorable sleep measures. Both MA men and women and Black women generally showed

215   intermediate sleep measures. These findings are consistent with a prior study of middle-aged

216   adults, showing longer sleep duration and higher sleep efficiency among White women, followed

217   by White men, Black women, and finally Black men [43]. Our study greatly adds to these

218   observations to older adults and includes MA participants, providing a broader understanding of

219   sleep disparities across diverse populations.

220   Contrary to previous studies [13,20,44,45], our unadjusted age-stratified analysis revealed that

221   older participants had better sleep compared to younger participants. This discrepancy could

222   stem from our sample's relatively narrow age range, potentially limiting the ability to capture

223   broader age-related trends. It is also possible that our older participants represent a healthier

224   subset with subsequent better sleep (eTable 10). Another explanation is that, as most prior

225   studies have been conducted in White populations, they may have missed important disparities

226   driven by race and ethnicity. Indeed, our multivariate analysis showed that the sleep differences

227   were no longer significant after adjusting for the potential confounders, and particularly race and

228   ethnicity and retirement status. This suggests that sleep disparities are more strongly influenced

229   by a combination of racial and ethnic background and socioeconomic factors than by aging

230   alone. Therefore, sleep improvement strategies should target specific challenges like work

231   stress or systemic barriers.

232   Taken together, our findings highlight that race and ethnicity and sex are key contributors to

233   sleep disparities, independent of socioeconomic and health factors, with age being of lesser

234   importance in this context. Objective screening for sleep disturbances in primary care should be

235   prioritized for non-White individuals and men. This is particularly important given that men tend

236   to report fewer sleep problems [12,46] and that both men and racial and ethnic minorities have

237   higher rates of undiagnosed sleep disorders [8,47,48]. Implementing racial and ethnic- and sex-

238   specific programs to monitor and mitigate sleep disparities could also support broader health

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239   equity efforts, as poor sleep is a well-established risk factor for various physical and

240   psychological conditions, reduced quality of life, and increased mortality [1–5,49].

Strengths and Limitations

242   This study benefits from a diverse, community-based cohort of older adults, including not only

243   NHW and Black participants but also MA individuals with nearly 60% of non-White participants.

244   Additional strengths include objective sleep measures, relatively large sample size, and

245   consideration of numerous important confounders. However, information that could influence

246   sleep disparities, such as occupational history (e.g., night shift work) and residential

247   environment (e.g., urban vs. rural setting, noise, neighborhood safety) was not available in this

248   study. Nonetheless, the potential impact of occupation might be limited given that we controlled

249   for retirement status and 60% of the sample was retired. As this is a cross-sectional study with a

250   single sleep measurement, it does not capture changes in sleep patterns over time. Future

251   longitudinal studies with repeated objective sleep measures across diverse populations are

252   needed to better understand the dynamics and drivers of sleep disparities.

Conclusions

254   Our findings reveal significant differences in objective sleep measures across sociodemographic

255   groups, independently of socioeconomic and health factors, with non-White participants and

256   men experiencing poorer sleep. Race and ethnicity and sex were identified as key

257   sociodemographic factors contributing to sleep disparities. These results suggest that poor

258   sleep quality may contribute to health disparities, particularly among vulnerable populations,

259   emphasizing the need for targeted interventions to support those at higher risk.

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List of abbreviations

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263 **_BMI_**: Body Mass Index

264 **_CI_**: Confidence Interval

265 **_FDR_**: False Discovery Rate

266 **_HABS-HD_**: Health & Aging Brain Study – Health Disparities

267 **_MA_**: Mexican American

268 **_NHW_**: Non-Hispanic White

269 **_OR_**: Odds Ratios

270 **_RAPA_**: Rapid Assessment of Physical Activity

271 **_REI_**: Respiratory Event Index

272 **_SD_**: Standard Deviation

273 **_SFI_**: Sleep Fragmentation Index

274 **_WASO_**: Wake After Sleep Onset

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Declarations

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277 *Ethics approval and consent to participate*

278 All study participants provided written informed consent, and the Dormir Study was approved by

279 the University of North Texas Health Science Center Institutional and University of California

280 San Francisco Review Boards.

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281   *Consent for publication*

282   Not applicable*.*

283   *Availability of data and materials*

284   Anonymized data within this article will be made available by request from any qualified

285   investigator.

286   *Competing interests*

287   CC, YL, CP, and KY have no conflicts of interest to declare. KLS reports grant funding from Eli

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289   *Funding*

292   *Authors' contributions*

293   CC conceived and designed the study, analyzed the data, interpreted the study findings, and

294   drafted the manuscript. KLS, YL, and CP interpreted the study findings and critically revised the

295   manuscript. KY conceived and designed the study, interpreted the study findings, and reviewed

296   the manuscript.

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Figure Legends

Figure 1. Objective sleep measures by race and ethnicity and sex.

Anova test was used for continuous variables with a normal distribution and Kruskal-Wallis test for continuous

variables without a normal distribution.

Table 1. Description of covariates by race and ethnicity (n=838).

	Missing data, No.	Total sample (n=838) No. (%) or mean (±SD)	Black (n=190) No. (%) or mean (±SD)	MA (n=282) No. (%) or mean (±SD)	NHW (n=366) No. (%) or mean (±SD)	P value[b]
Sex, *women*	0	543 (64.8)	131 (68.9)	198 (70.2)	214 (58.5)	0.003
Age, years	0	66.7 (±8.4)	63.5 (±7.5)	64.5 (±7.9)	70.1 (±8.1)	<.0001
Age, ≥*65 years*	0	492 (58.7)	83 (43.7)	136 (48.2)	273 (74.6)	<.0001
Education, years	0	13.8 (±4.0)	15.0 (±2.6)	10.5 (±4.2)	15.7 (±2.7)	<.0001
Retirement status	2	507 (60.6)	100 (52.6)	136 (48.4)	271 (74.2)	<.0001
Income group	38					<.0001
<25,000		215 (26.9)	58 (34.1)	117 (44.2)	40 (11.4)	
[25,000-50,000[		193 (24.1)	37 (20.0)	81 (30.6)	75 (21.4)	
[50,000-75,000[		124 (15.5)	27 (14.6)	36 (13.6)	61 (17.4)	
≥75,000		268 (33.5)	63 (34.1)	31 (11.7)	174 (49.7)	
Cognitive impairment	0	188 (22.4)	59 (31.1)	72 (25.5)	57 (15.6)	<.0001
Smoke currently	0					
RAPA score [a]	0	4 (3-6)	4 (3-6)	4 (3-4.8)	4 (3-6)	0.0004
BMI, kg/m^2 [a]	10	29.8 (26.1,34.7)	32.1 (27.3,37.5)	29.8 (26.9,35.3)	29.2 (24.7,32.9)	<.0001
Sleep medications	0	307 (36.6)	67 (35.3)	85 (30.1)	155 (42.3)	0.005
History of hypertension	0	537 (64.1)	149 (78.4)	173 (61.3)	215 (58.7)	<.0001
History of diabetes	0	210 (25.1)	57 (30.0)	98 (34.8)	55 (15.0)	<.0001
History of stroke	0	42 (5.0)	12 (6.3)	7 (2.5)	23 (6.3)	0.06
History of heart attack	2	33 (3.9)	10 (5.3)	11 (3.9)	12 (3.3)	0.53
History of depression	0	290 (34.6)	58 (30.5)	108 (38.3)	124 (33.9)	0.20
REI, ≥*15*	54	399 (50.9)	90 (53.6)	141 (52.6)	168 (48.3)	0.42

Abbreviations: BMI, body mass index; MA, Mexican American; NHW, Non-Hispanic White; RAPA, rapid assessment of physical activity; REI, respiratory event index; SD, standard deviation
[a] median (interquartile range)
[b] Anova test was used for continuous variables with a normal distribution, Kruskal-Wallis test for continuous variables without a normal distribution and, Chi-square test for categorical variables

Table 2. Objective sleep measures by sociodemographic groups (n=838).

	Black (n=190)	MA (n=282)	NHW (n=366)	P value[b]	Men (n=295)	Women (n=543)	P value[c]	<65 years (n=346)	≥65 years (n=492)	P value[c]
	No. (%) or mean (±SD)	No. (%) or mean (±SD)	No. (%) or mean (±SD)		No. (%) or mean (±SD)	No. (%) or mean (±SD)		No. (%) or mean (±SD)	No. (%) or mean (±SD)	
Sleep duration, hour				<.0001*			0.002*			0.002*
<6	38 (20.0)	42 (14.9)	23 (6.3)		51 (17.3)	52 (9.6)		54 (15.6)	49 (10.0)	
[6-8]	115 (60.5)	186 (66.0)	238 (65.0)		187 (63.4)	352 (64.8)		229 (66.2)	310 (63.0)	
>8	37 (19.5)	54 (19.1)	105 (28.7)		57 (19.3)	139 (25.6)		63 (18.2)	133 (27.0)	
Continuous	7.1 (±1.2)	7.1 (±1.1)	7.5 (±1.1)	<.0001*	7.1 (±1.2)	7.4 (±1.1)	0.0004*	7.1 (±1.1)	7.4 (±1.1)	<.0001*
Sleep efficiency, %				<.0001*			0.09			0.001*
≥85	124 (65.3)	192 (68.1)	318 (86.9)		213 (72.2)	421 (77.5)		242 (69.9)	392 (79.7)	
<85	66 (34.7)	90 (31.9)	48 (13.1)		82 (27.8)	122 (22.5)		104 (30.1)	100 (20.3)	
Continuous [a]	87.2 (83.3,90.0)	87.8 (83.6,90.8)	90.6 (87.2,93.0)	<.0001*	89.0 (84.1,92.3)	89.0 (85.3,91.8)	0.61	87.7 (84.2,90.9)	89.8 (86.3,92.4)	<.0001*
WASO, min				<.0001*			0.12			0.001*
<41.7	41 (21.6)	68 (24.1)	170 (46.4)		110 (37.3)	169 (31.1)		93 (26.9)	186 (37.8)	
[41.7-63.5]	64 (33.7)	99 (35.1)	117 (32.0)		87 (29.5)	193 (35.5)		117 (33.8)	163 (33.1)	
>63.5	85 (44.7)	115 (40.8)	79 (21.6)		98 (33.2)	181 (33.3)		136 (39.3)	143 (29.1)	
Continuous [a]	61.2 (44.4,79.8)	56.7 (42.2,78.0)	44.4 (30.6,60.5)	<.0001*	48.6 (34.3,73.4)	52.7 (37.3,68.5)	0.51	56.8 (40.4,75.6)	48.5 (33.3,66.9)	<.0001*
SFI,%				<.0001*			0.006*			0.004*
<22.1	28 (14.7)	88 (31.2)	164 (44.8)		92 (31.2)	188 (34.6)		94 (27.2)	186 (37.8)	
[22.1-29.9]	62 (32.6)	97 (34.4)	119 (32.5)		84 (28.5)	194 (35.7)		120 (34.7)	158 (32.1)	
>29.9	100 (52.6)	97 (34.4)	83 (22.7)		119 (40.3)	161 (29.7)		132 (38.2)	148 (30.1)	
Continuous	32.0 (±11.0)	27.3 (±9.7)	24.0 (±9.0)	<.0001*	28.9 (±12.1)	25.9 (±8.8)	0.0001*	28.1 (±10.2)	26.1 (±10.2)	0.007*

Abbreviations: CI, confidence interval; MA, Mexican American; NHW, Non-Hispanic White; SD, standard deviation; SFI, sleep fragmentation index; WASO, wake after sleep onset

[a] median (interquartile range)

[b] Anova test was used for continuous variables with a normal distribution, Kruskal-Wallis test for continuous variables without a normal distribution and, Chi-square test for categorical variables

[c] T-test was used for continuous variables with a normal distribution, Mann-Whitney U test for continuous variables without a normal distribution and, Chi-square test for categorical variables

* results are significant after false discovery rate correction

Table 3. Multivariable-adjusted associations between objective sleep measures and sociodemographic groups (n=824).

	Black versus NHW	MA versus NHW		Women versus Men		≥65 years versus <65 years	
	OR (95%CI)	OR (95%CI)	P value	OR (95%CI)	P value	OR (95%CI)	P value
Sleep duration, hour			0.005*		0.001*		0.93
<6	2.86 (1.53,5.33)	1.64 (0.82,3.26)		0.47 (0.29,0.75)		1.02 (0.57,1.83)	
[6-8]	1	1		1		1	
>8	0.82 (0.50,1.35)	0.71 (0.42,1.18)		1.28 (0.86,1.90)		1.09 (0.70,1.71)	
Sleep efficiency, %			<.001*		0.07		0.47
≥85	1	1		1		1	
<85	2.52 (1.58,4.04)	1.82 (1.10,3.01)		0.71 (0.49,1.03)		0.85 (0.55,1.32)	
WASO, min			0.0006*		0.33		0.42
<41.7	1	1		1		1	
[41.7-63.5]	1.89 (1.14,3.13)	1.59 (0.97,2.60)		1.34 (0.91,1.96)		1.02 (0.65,1.60)	
>63.5	3.00 (1.80,4.99)	1.84 (1.09,3.10)		1.15 (0.77,1.70)		0.78 (0.49,1.24)	
SFI, %			<.0001*		0.005*		0.95
<22.1	1	1		1		1	
[22.1-29.9]	2.76 (1.60,4.77)	1.04 (0.64,1.70)		0.89 (0.60,1.32)		0.99 (0.63,1.54)	
>29.9	5.44 (3.16,9.38)	1.37 (0.82,2.30)		0.54 (0.36,0.81)		1.06 (0.66,1.69)	

Abbreviations: CI, confidence interval; MA, Mexican American; NHW, Non-Hispanic White; SFI, sleep fragmentation index; WASO, wake after sleep onset
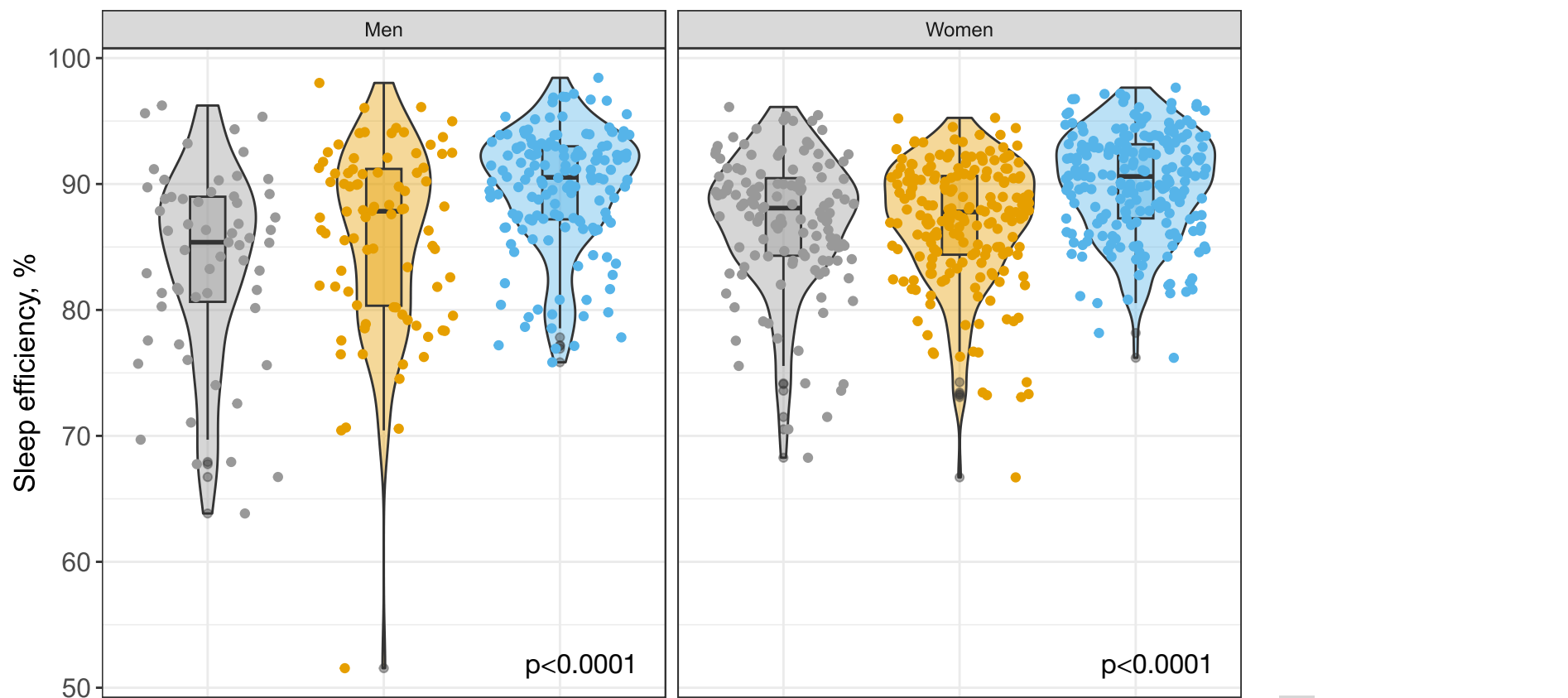
Models adjusted for race and ethnicity, sex, age, education, retirement status, cognitive impairment, body mass index, physical activity, smoking, sleep medications, and history of hypertension, diabetes, stroke, heart attack, and depression.

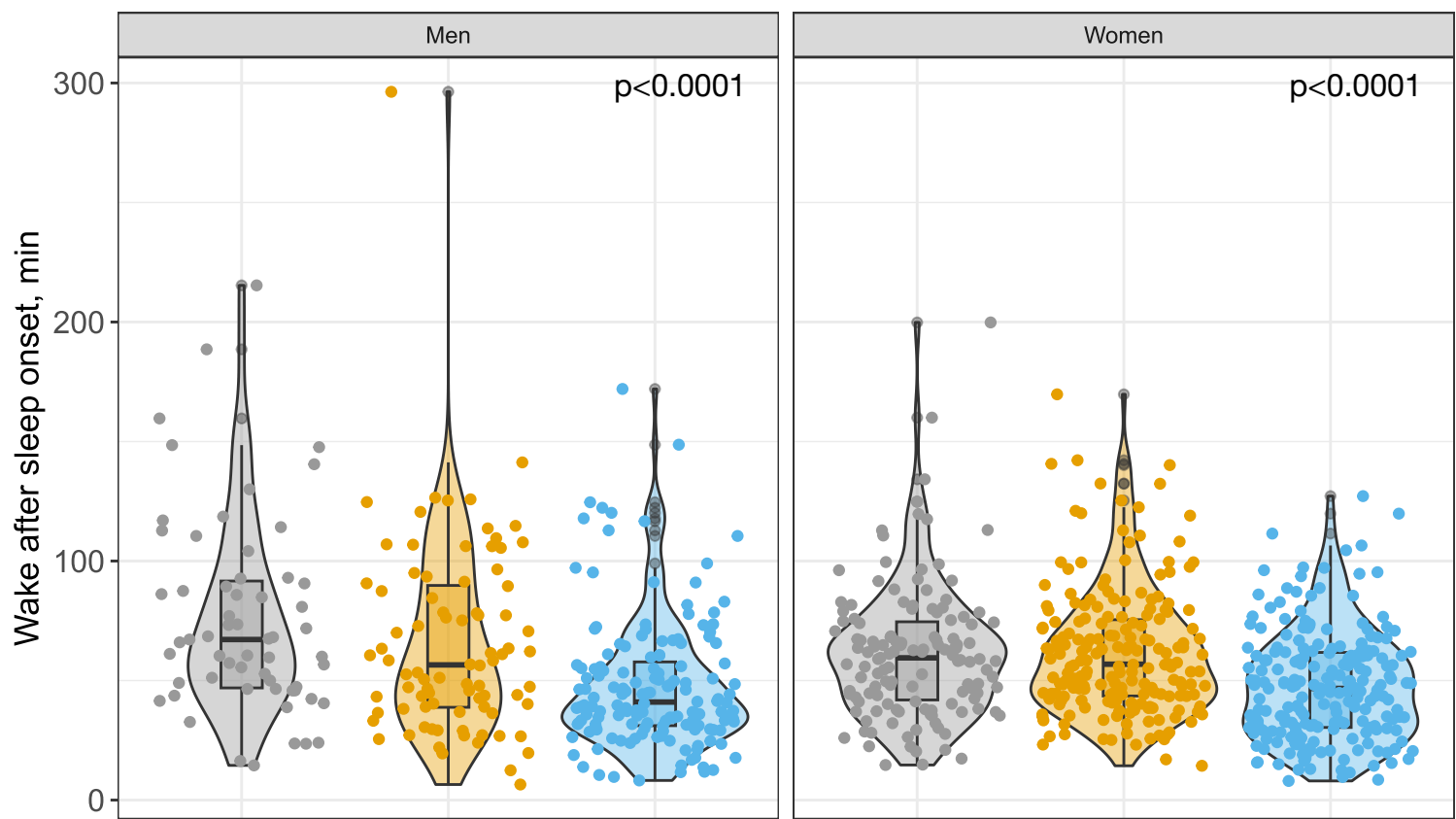* results are significant after false discovery rate correction

A. Sleep duration
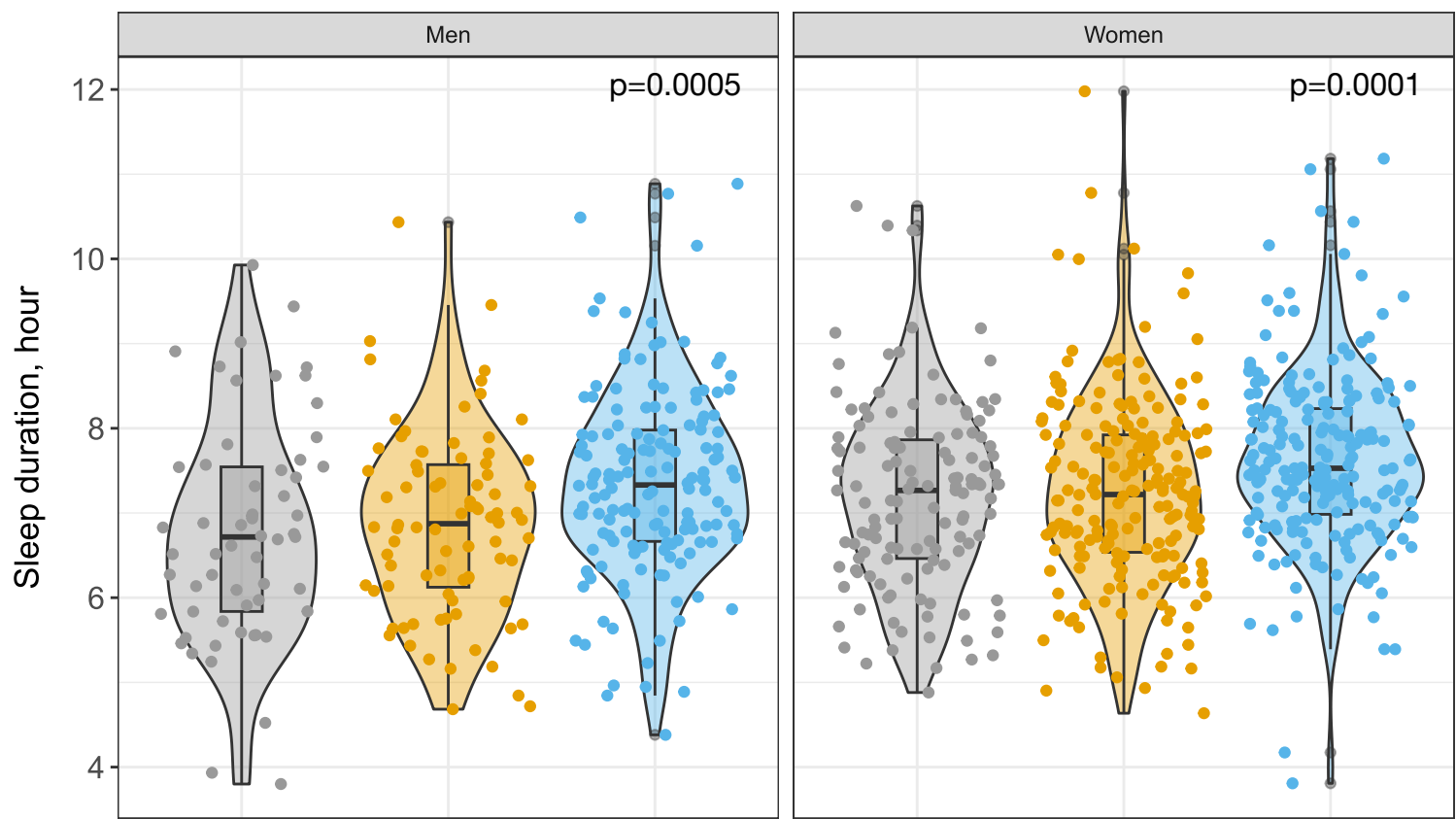
B. Sleep efficiency

C. Wake after sleep onset

D. Sleep fragmentation index