

Short and Long Sleep Duration Associated with Race/Ethnicity, Sociodemographics, and Socioeconomic Position

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Study Objectives: Short and/or long sleep duration are associated with cardiometabolic disease risk and may be differentially experienced among minorities and the socioeconomically disadvantaged. The present study examined nationally representative data along multiple dimensions of race/ethnicity and socioeconomic status.

Design: Cross-sectional.

Setting: Survey.

Patients or Participants: 2007-2008 NHANES (N = 4,850).

Interventions: None.

Measurements and Results: Self-reported sleep duration was classified as very short (< 5 h), short (5-6 h), normative (7-8 h) and long (\geq 9 h). Population-weighted multinomial logistic regression analyses examined race/ethnicity, country of origin, language, income, education, health insurance, and food security, controlling for all others as well as age, sex, marital-status, and overall self-rated health. Outcome was self-reported sleep duration, relative to normative sleep duration. Blacks/African Americans were more likely than whites to report very short (OR = 2.34, $P < 0.001$) and short (OR = 1.85, $P < 0.001$) sleep. Mexican Americans reported less long sleep (OR = 0.36, $P = 0.032$). Other Hispanics/Latinos reported more very short sleep (OR = 2.69, $P = 0.025$). Asians/Others reported more very short (OR = 3.99, $P = 0.002$) and short (OR = 2.08, $P = 0.002$) sleep. Mexico-born adults reported less short sleep (OR = 0.63, $P = 0.042$). Spanish-only speakers reported less very short sleep (OR = 0.32, $P = 0.030$). Lower income groups reported more very short sleep versus $>$ \$75,000. Compared to college graduates, increased very short sleep was seen among all lower education levels. Those with public insurance reported more very short (OR = 1.67, $P = 0.31$) and long (OR = 1.83, $P = 0.011$) sleep versus uninsured. Very low food security was associated with very short (OR = 1.86, $P = 0.036$) and short (OR = 1.44, $P = 0.047$) sleep.

Conclusions: Minority status and lower socioeconomic position were associated with shorter self-reported sleep durations.

Keywords: Sleep duration, race/ethnicity, socioeconomic status, acculturation, epidemiology

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INTRODUCTION

Sleep duration is an important indicator of health. Indeed, many studies have suggested that consistently acquiring sufficient sleep is necessary for the maintenance of good health.¹ However, up to 30% of Americans report only obtaining 6 or fewer hours of sleep per night,² and based on self-report, the average nightly sleep duration in the United States may be declining.³ Both subjectively reported and objectively measured non-normative sleep duration—particularly short sleep and, to a lesser extent, long sleep, is not only associated with several adverse health outcomes⁴⁻⁸ but also mortality risk.^{5,8-14} Short sleep duration has been independently linked to obesity,¹⁵⁻¹⁷ diabetes mellitus,¹⁸⁻²³ hypertension,^{4,24,25} and deleterious cardiovascular events including myocardial infarction, stroke, and coronary artery disease.²⁶ Given the increasing prevalence of obesity and diabetes worldwide²⁷ and the fact that heart disease is the leading cause of death in the United States,²⁸ it becomes

clear that short sleep is an important topic of public health relevance, and worth studying.

Self-reported sleep duration is influenced by a number of factors, particularly race/ethnicity and socioeconomics. Indeed, studies have shown that African Americans and other racial minorities are more likely to report both short²⁹ and long sleep durations.^{30,31} In addition, lower socioeconomic status has been implicated as potentially influencing the relationship between long sleep and mortality.³² Few studies, however, have examined these associations in the context of overall health. In 2007, Stamatakis and colleagues³³ found that, when adjusted for confounding health characteristics, socioeconomic status was highly linked to the incidence of self-reported short sleep duration. Furthermore, short sleep appeared to be more common among minority race/ethnic groups, although the association was not significant. While this longitudinal study revealed that the relationship between socioeconomic status and sleep duration persisted after controlling for certain health characteristics, the study sample was not nationally representative, and the analysis was limited by examining only short, but not long, sleep duration.

Krueger and Friedman² found that, in a nationally representative, cross-sectional study, non-Hispanic Blacks, along with those having lower education, lower income, and fewer income sources, had an increased odds of both short and long sleep duration when adjusted for health status and health behaviors.

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Furthermore, despite the fact that immigration status has been shown to correlate with sleep health,^{34,35} past research has failed to sufficiently examine the role that acculturation may play in the relationship among socioeconomic status, acculturation, race/ethnicity, and sleep duration. To account for some of the limitations of past research, the present study captures many aspects of race/ethnicity and socioeconomic status that have not been previously studied, such as food security, access to insurance, language spoken at home, and birth country. Furthermore, the present study uses both short and very short (< 5 h/night) sleep duration, a somewhat novel approach that has not been previously used within this context. It is through these novel additions that the present study aims to extend the current literature.

Accordingly, the present study analyzed data from the 2007-2008 NHANES cohort to explore, in a nationally representative sample, whether racial/cultural and socioeconomic factors are associated with sleep duration. Further, we aimed to assess multiple dimensions simultaneously to discern unique effects, adjusting for other social factors, as well as overall health.

METHODS

NHANES Sample

The subjects used in this study were participants in the 2007-2008 National Health and Nutrition Examination Survey (NHANES), a national survey conducted by the Centers of Disease Control and Prevention, reporting the health and nutritional characteristics of children and adults. Participants were administered questionnaires concerning their demographic, socioeconomic, and nutritional statuses during in-person interviews conducted in the home. The NHANES survey oversamples Hispanics, African Americans, and adults aged 60 or older.^{36,37}

Sampling in this survey was performed to ensure generalizability to the entire population across all ages. Because of the complexity of the survey design coupled with variable probabilities of selection, the data used in the following analyses were also weighted to control for representatives according to the procedures outlined in the current NHANES Analytic and Reporting Guidelines.³⁶ For the present study, analyses included adults aged ≥ 18 years with complete data on all independent and dependent variables ($n = 4,850$). All participants provided written informed consent and were treated in keeping with the principles of the Declaration of Helsinki.

Sleep Duration

Sleep duration was assessed with the survey item, "How much sleep do you usually get at night on weekdays or workdays?" Responses were coded in whole numbers and categorized as "very short" (< 5 h per night), "Short" (5-6 h per night), "Normal" (7-8 h per night), and "Long" (≥ 9 h per night) sleep duration. These categories were chosen based on the existing laboratory and epidemiologic literature regarding sleep duration.^{6,38}

In supplementary analyses, we included probable insomnia and probable sleep apnea as covariates. Probable insomnia was assessed as presence of either difficulty falling asleep or difficulty maintaining sleep (hallmark symptoms of insomnia).

Difficulty falling asleep was assessed with the item, "In the past month, how often did you have trouble falling asleep?" Difficulty maintaining sleep was assessed with the question, "In the past month, how often did you wake up during the night and had trouble getting back to sleep?" Respondents who indicated problems ≥ 15 nights per month on either item were categorized as having probable insomnia. Probable sleep apnea was assessed as presence of diagnosed sleep apnea, snorting/gasping during sleep, or frequent snoring. Snorting and/or gasping was assessed with, "In the past 12 months, how often did you snort, gasp, or stop breathing while you were asleep?" Responses were categorized as either representing a likely clinical problem ("occasionally" or "frequently") or not. Snoring was assessed with, "How often do you snore?" Respondents were categorized having probable sleep apnea if they responded "Frequently." Previous diagnosis of sleep apnea was assessed with the question, "Have you ever been told by a doctor or other health professional that you have a sleep disorder?" If they indicated "sleep apnea" then this was used to establish probable sleep apnea.

Race/Ethnicity, Country of Origin, and Acculturation

Ethnoracial group was assessed using a series of questions and categorized as "non-Hispanic white," "black/African American," "Mexican-American," "other Hispanic/Latino," or "Asian/other." Country of origin was assessed as "US-Born," "Mexico-Born," "Born in another Spanish-speaking country" or "Born in other country." Acculturation was assessed as primary language spoken at home (English, English and Spanish, Spanish, or other).

Although there are multiple ways of assessing acculturation, language use is one of the most widely recognized,³⁹ especially in the context of epidemiologic studies. Previous sleep research studies that have explored acculturation used either language only^{40,41} or country of origin only,³⁵ with one study using both of these variables in addition to cultural exposure during childhood.⁴² The present study extends prior work by incorporating both language use and country of origin in a nationally representative sample (early childhood exposure was not available in NHANES).

Socioeconomic Position

Socioeconomic variables included (1) income, (2) education, (3) access to insurance, (4) home ownership, and (5) food security. Income was classified as < \$20,000, \$20,000-\$25,000, \$25,000-\$35,000, \$35,000-\$45,000, \$45,000-\$55,000, \$55,000-\$65,000, \$65,000-\$75,000, or > \$75,000 based on self-reported annual income. Education level was categorized as < high school, some high school, high school graduate (including GED), some college (including Associates degree), and college graduate. Home ownership was dichotomized as "yes" or "no." Household food security was categorized as high, marginal, low, or very low food security. This determination was based on standardized NHANES procedures based on responses to a combination of 18 items that assessed running out of food, inability to afford food, skipping meals, inability to provide adequate food for children, and other similar items.

Additional Covariates

Other covariates included (1) age, (2) sex, and (3) marital status. Age was categorized as 18-24, 25-44, 45-64, 65-79, or ≥ 80 . Sex was assessed as male/ female. Marital status was classified as married, widowed, divorced, separated, never married, or living with partner. In addition, overall health was classified as excellent, very good, good, fair, or poor in response to a single item asking, "Would you say your health in general is..." with the choices of "Excellent," "Very Good," "Good," "Fair" or "Poor."

Statistical Analyses

Differences between sleep duration groups were assessed using ANOVA for continuous variables and Pearson χ^2 for categorical variables. The effects of social and behavioral factors on sleep duration were assessed using multinomial logistic regression, with sleep duration categories referenced to 7-8 h of sleep. Three models were evaluated in primary analyses: First, unadjusted associations were examined. Then, these associations were adjusted for all of the other factors. This allowed for assessment of unique effects of each variable over and above all of the other variables. Finally, overall health was included in the model. This allows for an evaluation of unique effects that also take into account general health. In supplementary analyses, probable insomnia and probable sleep apnea were added as covariates. All statistical analyses were performed using STATA version 12 (STATA Corp., College Station, TX).

RESULTS

Sample Characteristics

Characteristics of the sample are displayed in Table 1. Sample weights were applied per NHANES guidelines to increase the generalizability of the sample to the population. Individuals who participated in the survey but did not provide complete data on all independent and dependent variables were excluded from analyses. All variables except language spoken at home demonstrated associations with sleep duration category using χ^2 analyses.

Sleep Duration Associated with Race/Ethnicity, Country of Origin, and Acculturation

In all 3 models, blacks/ African Americans, non-Mexican Hispanics/Latinos, and those identifying as Asian/other were significantly more likely than non-Hispanic whites to report very short sleep (< 5 h). In the unadjusted analysis (Model 1, Table 2), blacks/ African Americans were over 3 times as likely as non-Hispanic whites to report very short sleep. This relationship was also found for Asians/others and other Hispanics/Latinos, though the magnitude of the effect was smaller. When adjusted for sociodemographic and socioeconomic variables (Model 2, Table 3), as well as when adjusted in the final model that included overall health status (Model 3, Table 4), Asians/others and non-Mexican Hispanics/ Latinos were about 2 to 3 times as likely as non-Hispanic whites to report very short sleep. Blacks/ African Americans and Asians/ others were more likely than non-Hispanic whites to report short sleep in all 3 analyses, though this relationship was not found among non-Mexican Hispanics/ Latinos.

Concerning country of origin, respondents born in Mexico were less likely than U.S.-born individuals to report very short sleep, but only in the unadjusted model. Further, respondents born in Mexico were significantly less likely than those born in the U.S. to report short sleep, and this relationship was maintained throughout all three models. In terms of acculturation, respondents in exclusively Spanish-speaking households were 2-3 times less likely to report very short sleep compared to those living in primarily English-speaking households, although this was only significant in Models 1 and 3. No significant relationships were found between self-reported long sleep and race/ethnicity, country of origin or acculturation, with the exception of Mexican-Americans, who were less likely than non-Hispanic Whites to report long sleep in Model 3.

Sleep Duration Associated with Socioeconomic Position

In the unadjusted analysis, respondents with an education level lower than "completed college" were significantly more likely that those who completed college to report very short sleep (Model 1, Table 2). When adjusted for sociodemographic and socioeconomic variables (Model 2, table 3), as well as when adjusted for overall health (Model 3, Table 4), respondents with a lower education level remained about twice as likely as college graduates to report very short sleep. In all 3 models, respondents with an education level of at least some high school were significantly more likely than college graduates to report short sleep. While a significant relationship was found between self-reported long sleep duration and an education level of high school graduate or lower in the unadjusted model, this relationship was not maintained in Model 3 (adjusted for all covariates and overall health). Only those who completed some high school showed an elevated likelihood of reporting long sleep in Model 2 ($P = 0.0483$).

When compared to respondents who reported an annual income of > \$75,000, those with an income less than \$75,000 were significantly more likely to report very short sleep in the unadjusted model. When adjusted for socioeconomic and sociodemographic characteristics (Model 2, Table 3), this relationship was only maintained for the < \$20,000, \$25,000-\$30,000, \$45,000-\$55,000, and \$65,000-\$75,000 income categories. In the fully adjusted model (Model 3, Table 4), respondents within these income categories remained almost twice as likely to report very short sleep, with the exception of those within the \$45,000-\$55,000 category, who did not have an increased likelihood in Model 3. Income was not significantly related to self-reported short sleep (5-6 h/night), with the exception of those with an income less than \$20,000, who were more likely to report short sleep in the unadjusted model only (Model 1, Table 2). In terms of self-reported long sleep (> 8 h/night), respondents with an income less than \$45,000 were more likely to report long sleep in the unadjusted model only, with the exception of those in the \$20,000-\$25,000 income category, who had a slightly elevated likelihood of reporting long sleep in Model 3 only ($P = 0.0458$).

In terms of insurance and home ownership, in both the adjusted and unadjusted models, respondents with public insurance were significantly more likely than those without insurance to report very short sleep. Homeowners and those with private insurance were less likely than non-homeowners and those

Table 1—Characteristics of the sample, overall and stratified by sleep duration category

Variable	Category	Overall Sample	Stratified by Sleep Duration Category				P
			Very Short (< 5 Hours)	Short (5-6 Hours)	Normal (7-8 Hours)	Long (≥ 9 Hours)	
Ethnoracial Group	Non-Hispanic White	69.242%	71.978%	58.248%	65.618%	72.818%	< 0.0001
	Black/African American	11.354%	8.523%	21.286%	14.864%	9.851%	
	Mexican-American	8.456%	9.541%	4.474%	7.363%	7.985%	
	Other Hispanic/Latino	4.968%	4.758%	6.886%	4.932%	5.353%	
	Asian/Other	5.981%	5.200%	9.106%	7.223%	3.992%	
Immigrant Status	Born in the US	83.761%	82.657%	87.661%	84.741%	84.970%	0.0022
	Born in Mexico	4.931%	6.043%	1.797%	3.573%	4.846%	
	Born in Other Spanish-Speaking Country	3.841%	3.752%	4.560%	3.974%	3.388%	
	Born in Other Country	7.467%	7.548%	5.982%	7.712%	6.795%	
Language Spoken at Home	English	83.795%	82.797%	85.962%	85.196%	83.506%	0.2284
	English and Spanish	6.220%	6.600%	5.919%	5.589%	6.391%	
	Spanish	5.134%	5.745%	3.012%	4.365%	5.496%	
	Other	4.851%	4.859%	5.106%	4.850%	4.608%	
Income	< \$20,000	16.405%	14.559%	29.099%	17.053%	18.494%	< 0.0001
	\$20,000-\$25,000	7.192%	6.642%	7.184%	7.108%	11.871%	
	\$25,000-\$35,000	11.409%	10.361%	15.254%	11.720%	15.325%	
	\$35,000-\$45,000	9.296%	9.342%	9.458%	8.931%	10.493%	
	\$45,000-\$55,000	8.486%	8.374%	9.515%	8.208%	9.878%	
	\$55,000-\$65,000	6.718%	6.714%	6.053%	6.973%	6.070%	
	\$65,000-\$75,000	7.118%	7.545%	9.650%	6.317%	5.605%	
	> \$75,000	33.377%	36.463%	13.788%	33.690%	22.263%	
Education	Less Than High School	7.634%	7.837%	10.242%	6.009%	11.656%	< 0.0001
	Some High School	13.360%	11.571%	19.694%	14.574%	17.032%	
	High School Graduate	26.881%	25.525%	30.654%	28.277%	28.219%	
	Some College	27.688%	26.705%	30.232%	29.949%	22.981%	
	College Graduate	24.437%	28.362%	9.178%	21.192%	20.112%	
Insurance	Uninsured	19.463%	18.877%	21.432%	20.133%	19.471%	< 0.0001
	Public Insurance Only	16.064%	14.133%	30.605%	15.118%	24.789%	
	Private Insurance	64.474%	66.990%	47.963%	64.749%	55.740%	
Home Ownership	Yes	70.118%	72.091%	62.207%	68.976%	65.900%	0.0019
	No	29.882%	27.909%	37.793%	31.024%	34.100%	
Food Security	High	80.841%	83.420%	64.870%	79.366%	79.466%	< 0.0001
	Marginal	7.467%	7.007%	13.559%	7.234%	7.585%	
	Low	7.863%	6.754%	12.371%	8.671%	9.420%	
	Very Low	3.828%	2.819%	9.200%	4.728%	3.529%	
Age	18-24	12.811%	12.256%	7.559%	12.150%	24.212%	< 0.0001
	25-44	36.131%	36.823%	38.697%	36.905%	25.150%	
	45-64	34.854%	34.673%	40.408%	37.095%	21.670%	
	65-79	11.861%	12.151%	10.085%	10.397%	17.742%	
	≥ 80	4.342%	4.097%	3.251%	3.454%	11.225%	
Sex	Male	48.328%	48.328%	46.540%	50.767%	38.289%	0.0017
	Female	51.672%	51.672%	53.460%	49.233%	61.711%	
Marital Status	Married	56.526%	60.161%	45.475%	54.616%	44.725%	< 0.0001
	Widowed	6.110%	5.577%	7.792%	5.611%	11.647%	
	Divorced	10.134%	8.930%	15.515%	11.542%	8.833%	
	Separated	2.365%	2.092%	6.508%	2.255%	1.858%	
	Never Married	17.952%	16.279%	14.524%	19.887%	24.969%	
	Living with Partner	6.913%	6.961%	10.187%	6.089%	7.969%	
Overall Health	Excellent	11.817%	14.378%	8.572%	8.136%	10.758%	< 0.0001
	Very Good	32.903%	35.200%	18.467%	31.810%	30.223%	
	Good	38.849%	37.730%	30.114%	42.340%	38.084%	
	Fair	13.435%	10.335%	31.119%	15.191%	17.085%	
	Poor	2.996%	2.357%	11.728%	2.523%	3.850%	

without insurance to report very short sleep, though these results were not maintained when adjusted in Models 2 and 3. No relationship was found between insurance and self-reported short sleep, although those with public insurance were found to be significantly more likely than the uninsured to report long sleep in all three models. Respondents who reported not owning a home were more likely than homeowners to report short (5-6 h/night) and long (> 8 h/night) sleep, though only in the unadjusted analyses.

Compared to those with high food security, respondents with marginal, low, and very low food security were significantly more likely to be very short sleepers in the unadjusted analysis ($P < 0.0001$). When results were adjusted for potential confounders in Models 2 and 3, however, only those with marginal or very low, but not low, food security were significantly more likely to be very short sleepers. Further, while respondents with both low and very low food security had a significantly elevated likelihood of being short sleepers (5-6 h) in the unadjusted model, only those reporting very low food security were significantly more likely to be short sleepers in adjusted Models 2 and 3. Lastly, no significant relationship was found between food security and long sleep duration, with the exception of those with low food security, who were found to have a slightly elevated likelihood of being long sleepers in the unadjusted model. However, this association was not maintained in either of the adjusted models.

Sleep Duration Associated Sociodemographics: Age, Sex, and Marital Status

In unadjusted analyses (Model 1, Table 2), age category, relative to the ≥ 80 year old group, was not associated

Table 2—Associations between age, sex, ethn racial group, sociodemographics, and socioeconomic position and sleep duration category (unadjusted)

Variable	Category	Very Short Sleep (< 5 Hours)			Short Sleep (5-6 Hours)			Long Sleep (≥ 9 Hours)		
		RRR	95% CI	P	RRR	95% CI	P	RRR	95% CI	P
Ethnoracial Group	Black/African American	3.54	(2.56, 4.90)	< 0.001	2.05	(1.71, 2.40)	< 0.001	1.27	(0.90, 1.70)	0.171
	Mexican American	0.65	(0.40, 1.00)	0.076	0.87	(0.71, 1.00)	0.162	0.71	(0.50, 1.00)	0.066
	Other Hispanic/Latino	1.87	(1.21, 2.80)	0.005	1.35	(1.06, 1.70)	0.014	1.00	(0.63, 1.50)	0.993
	Asian/Other	2.51	(1.31, 4.80)	0.006	1.67	(1.15, 2.40)	0.007	0.56	(0.23, 1.30)	0.200
	Non-Hispanic White		Reference			Reference			Reference	
Immigrant Status	Born in Mexico	0.33	(0.18, 0.61)	< 0.001	0.59	(0.46, 0.75)	< 0.001	0.72	(0.47, 1.09)	0.124
	Born in Other Spanish-Speaking Country	1.12	(0.65, 1.92)	0.685	1.15	(0.87, 1.53)	0.327	0.70	(0.41, 1.20)	0.195
	Born in Other Country	0.74	(0.35, 1.58)	0.436	0.99	(0.71, 1.37)	0.935	0.66	(0.34, 1.28)	0.220
	Born in the US		Reference			Reference			Reference	
Language Spoken at Home	English + Spanish	0.89	(0.58, 1.37)	0.587	0.88	(0.71, 1.10)	0.256	0.89	(0.59, 1.32)	0.548
	Spanish	0.50	(0.30, 0.82)	0.007	0.78	(0.62, 0.99)	0.039	0.81	(0.53, 1.23)	0.318
	Other	1.16	(0.49, 2.75)	0.730	1.08	(0.71, 1.65)	0.720	0.54	(0.21, 1.40)	0.203
	English		Reference			Reference			Reference	
Income	< \$20,000	5.51	(3.29, 9.20)	< 0.001	1.27	(1.03, 1.50)	0.028	1.99	(1.30, 3.00)	0.002
	\$20,000-\$25,000	2.91	(1.44, 5.80)	0.003	1.10	(0.82, 1.40)	0.539	2.95	(1.77, 4.90)	< 0.001
	\$25,000-\$35,000	4.05	(2.26, 7.20)	< 0.001	1.23	(0.95, 1.50)	0.122	2.58	(1.62, 4.10)	< 0.001
	\$35,000-\$45,000	2.37	(1.15, 4.80)	0.019	1.00	(0.75, 1.30)	0.988	1.45	(0.85, 2.40)	0.169
	\$45,000-\$55,000	2.79	(1.35, 5.80)	0.006	1.00	(0.73, 1.30)	0.982	1.79	(0.98, 3.20)	0.057
	\$55,000-\$65,000	2.41	(1.12, 5.20)	0.025	1.06	(0.75, 1.40)	0.750	1.39	(0.72, 2.70)	0.330
	\$65,000-\$75,000	3.78	(1.84, 7.80)	< 0.001	0.92	(0.65, 1.30)	0.636	1.25	(0.62, 2.50)	0.529
	> \$75,000		Reference			Reference			Reference	
Education	Less Than High School	4.11	(2.21, 7.60)	< 0.001	1.11	(0.83, 1.50)	0.478	1.92	(1.21, 3.00)	0.006
	Some High School	5.34	(2.92, 9.70)	< 0.001	1.72	(1.34, 2.20)	< 0.001	2.05	(1.30, 3.20)	0.002
	High School Graduate	4.29	(2.41, 7.60)	< 0.001	1.62	(1.28, 2.00)	< 0.001	1.48	(0.96, 2.20)	0.074
	Some College	3.63	(2.01, 6.50)	< 0.001	1.58	(1.26, 1.90)	< 0.001	1.31	(0.86, 2.00)	0.206
	College Graduate		Reference			Reference			Reference	
Insurance	Public Insurance Only	1.96	(1.31, 2.90)	0.001	1.09	(0.86, 1.30)	0.468	2.16	(1.46, 3.20)	< 0.001
	Private Insurance	0.64	(0.43, 0.90)	0.029	0.91	(0.75, 1.10)	0.350	0.99	(0.69, 1.40)	0.957
	Uninsured		Reference			Reference			Reference	
Home Ownership	No	1.64	(1.21, 2.20)	0.002	1.13	(0.96, 1.30)	0.137	1.23	(0.92, 1.60)	0.164
	Yes		Reference			Reference			Reference	
Food Security	Marginal	2.77	(1.74, 4.40)	< 0.001	1.11	(0.85, 1.40)	0.432	0.96	(0.56, 1.60)	0.883
	Low	2.25	(1.48, 3.40)	< 0.001	1.33	(1.03, 1.70)	0.027	1.25	(0.79, 2.00)	0.342
	Very Low	4.70	(2.87, 7.70)	< 0.001	1.79	(1.29, 2.40)	0.001	1.52	(0.77, 2.90)	0.226
	High		Reference			Reference			Reference	
Age	18-24	0.90	(0.37, 2.16)	0.813	1.29	(0.88, 1.90)	0.198	0.83	(0.49, 1.38)	0.463
	25-44	1.13	(0.61, 2.10)	0.698	1.07	(0.79, 1.47)	0.654	0.28	(0.18, 0.44)	< 0.001
	45-64	1.33	(0.72, 2.47)	0.368	1.19	(0.87, 1.63)	0.285	0.24	(0.15, 0.38)	< 0.001
	65-79	0.83	(0.42, 1.66)	0.602	0.93	(0.66, 1.30)	0.662	0.59	(0.39, 0.91)	0.017
	≥ 80		Reference			Reference			Reference	
Sex	Female	0.87	(0.64, 1.19)	0.385	1.13	(0.96, 1.32)	0.142	0.65	(0.49, 0.86)	0.003
	Male		Reference			Reference			Reference	
Marital Status	Widowed	1.82	(1.04, 3.10)	0.035	1.07	(0.81, 1.40)	0.631	2.20	(1.43, 3.30)	< 0.001
	Divorced	2.31	(1.48, 3.60)	< 0.001	1.43	(1.11, 1.80)	0.007	1.21	(0.75, 1.90)	0.440
	Separated	4.22	(2.27, 7.80)	< 0.001	1.25	(0.79, 1.90)	0.333	1.15	(0.46, 2.90)	0.764
	Never Married	1.32	(0.83, 2.00)	0.245	1.41	(1.14, 1.70)	0.002	2.19	(1.51, 3.10)	< 0.001
	Living with Partner	1.51	(0.86, 2.60)	0.152	1.01	(0.73, 1.30)	0.965	1.58	(0.94, 2.60)	0.084
	Married		Reference			Reference			Reference	

Table 3—Associations between age, sex, ethn racial group, sociodemographics, and socioeconomic position and sleep duration category (adjusted)

Variable	Category	Very Short Sleep (< 5 Hours)			Short Sleep (5-6 Hours)			Long Sleep (≥ 9 Hours)		
		RRR	95% CI	P	RRR	95% CI	P	RRR	95% CI	P
Ethnoracial Group	Black/African American	2.52	(1.74, 3.60)	< 0.001	1.91	(1.57, 2.30)	< 0.001	1.05	(0.72, 1.50)	0.800
	Mexican American	0.93	(0.42, 2.00)	0.866	1.29	(0.90, 1.80)	0.167	0.37	(0.15, 0.90)	0.036
	Other Hispanic/Latino	2.69	(1.10, 6.50)	0.029	1.58	(0.99, 2.50)	0.054	0.69	(0.25, 1.80)	0.470
	Asian/Other	4.04	(1.75, 9.30)	0.001	2.12	(1.33, 3.30)	0.002	0.73	(0.24, 2.20)	0.579
	Non-Hispanic White		Reference			Reference			Reference	
Immigrant Status	Born in Mexico	0.64	(0.24, 1.60)	0.363	0.63	(0.41, 0.90)	0.040	0.99	(0.48, 2.00)	0.976
	Born in Other Spanish-Speaking Country	0.73	(0.26, 2.00)	0.554	1.00	(0.60, 1.60)	0.988	0.52	(0.21, 1.20)	0.155
	Born in Other Country	0.35	(0.11, 1.10)	0.078	0.74	(0.46, 1.10)	0.215	1.02	(0.49, 2.10)	0.950
	Born in the US		Reference			Reference			Reference	
Language Spoken at Home	English + Spanish	0.56	(0.24, 1.20)	0.164	0.75	(0.50, 1.10)	0.160	1.90	(0.76, 4.70)	0.172
	Spanish	0.38	(0.14, 1.00)	0.058	0.84	(0.51, 1.30)	0.490	1.90	(0.70, 5.10)	0.208
	Other	1.49	(0.39, 5.70)	0.563	1.00	(0.55, 1.70)	0.993	0.70	(0.20, 2.40)	0.574
	English		Reference			Reference			Reference	
Income	< \$20,000	2.60	(1.32, 5.10)	0.006	1.00	(0.75, 1.30)	0.985	1.05	(0.61, 1.80)	0.851
	\$20,000-\$25,000	1.92	(0.88, 4.20)	0.103	0.95	(0.69, 1.30)	0.784	1.88	(1.04, 3.40)	0.038
	\$25,000-\$35,000	2.53	(1.30, 4.90)	0.006	1.04	(0.77, 1.30)	0.805	1.74	(1.03, 2.90)	0.039
	\$35,000-\$45,000	1.87	(0.86, 4.00)	0.113	0.93	(0.68, 1.20)	0.632	1.07	(0.59, 1.90)	0.825
	\$45,000-\$55,000	2.21	(1.02, 4.80)	0.045	0.89	(0.64, 1.20)	0.484	1.29	(0.67, 2.50)	0.442
	\$55,000-\$65,000	1.91	(0.87, 4.10)	0.108	0.95	(0.66, 1.30)	0.765	1.21	(0.61, 2.40)	0.584
	\$65,000-\$75,000	3.10	(1.48, 6.40)	0.003	0.83	(0.58, 1.10)	0.310	1.11	(0.54, 2.20)	0.782
	> \$75,000		Reference			Reference			Reference	
Education	Less Than High School	2.91	(1.43, 5.90)	0.003	1.20	(0.83, 1.70)	0.326	1.62	(0.93, 2.80)	0.090
	Some High School	3.08	(1.58, 5.90)	0.001	1.64	(1.24, 2.10)	0.001	1.51	(0.91, 2.50)	0.112
	High School Graduate	3.18	(1.74, 5.80)	< 0.001	1.65	(1.28, 2.10)	< 0.001	1.17	(0.74, 1.80)	0.504
	Some College	2.70	(1.46, 4.90)	0.002	1.56	(1.23, 1.90)	< 0.001	1.09	(0.70, 1.60)	0.707
	College Graduate		Reference			Reference			Reference	
Insurance	Public Insurance Only	1.94	(1.21, 3.10)	0.006	1.12	(0.86, 1.40)	0.412	1.89	(1.19, 3.00)	0.007
	Private Insurance	1.08	(0.68, 1.70)	0.742	1.08	(0.85, 1.30)	0.530	1.19	(0.75, 1.80)	0.450
	Uninsured		Reference			Reference			Reference	
Home Ownership	No	0.82	(0.58, 1.10)	0.277	0.92	(0.75, 1.10)	0.401	0.89	(0.62, 1.20)	0.538
	Yes		Reference			Reference			Reference	
Food Security	Marginal	1.89	(1.13, 3.10)	0.016	1.00	(0.75, 1.30)	0.986	0.90	(0.51, 1.50)	0.707
	Low	1.34	(0.84, 2.10)	0.216	1.19	(0.90, 1.50)	0.226	0.98	(0.57, 1.60)	0.947
	Very Low	2.28	(1.32, 3.90)	0.003	1.54	(1.08, 2.20)	0.018	1.34	(0.66, 2.70)	0.420
	High		Reference			Reference			Reference	
Age	18-24	1.23	(0.42, 3.60)	0.703	1.08	(0.67, 1.70)	0.753	0.69	(0.36, 1.30)	0.270
	25-44	1.85	(0.85, 4.00)	0.120	1.11	(0.76, 1.60)	0.593	0.33	(0.20, 0.50)	< 0.001
	45-64	2.08	(1.02, 4.20)	0.045	1.20	(0.83, 1.70)	0.325	0.30	(0.18, 0.50)	< 0.001
	65-79	0.88	(0.42, 1.80)	0.729	0.94	(0.66, 1.30)	0.733	0.57	(0.36, 0.80)	0.013
	≥ 80		Reference			Reference			Reference	
Sex	Female	1.02	(0.73, 1.40)	0.918	1.17	(1.00, 1.30)	0.055	0.65	(0.48, 0.80)	0.004
	Male		Reference			Reference			Reference	
Marital Status	Widowed	1.58	(0.81, 3.10)	0.184	1.15	(0.83, 1.60)	0.397	0.90	(0.57, 1.40)	0.669
	Divorced	1.53	(0.94, 2.50)	0.089	1.36	(1.03, 1.70)	0.032	1.06	(0.62, 1.80)	0.842
	Separated	2.38	(1.28, 4.40)	0.006	1.08	(0.66, 1.70)	0.753	1.15	(0.45, 2.90)	0.770
	Never Married	0.98	(0.58, 1.60)	0.935	1.30	(1.00, 1.70)	0.052	1.86	(1.21, 2.80)	0.005
	Living with Partner	1.10	(0.59, 2.00)	0.771	0.94	(0.66, 1.30)	0.723	1.60	(0.87, 2.90)	0.128
	Married		Reference			Reference			Reference	

Table 4—Associations between age, sex, ethnoracial group, sociodemographics, and socioeconomic position and sleep duration category (adjusted with overall health)

Variable	Category	Very Short Sleep (< 5 Hours)			Short Sleep (5-6 Hours)			Long Sleep (≥ 9 Hours)		
		RRR	95% CI	P	RRR	95% CI	P	RRR	95% CI	P
Ethnoracial Group	Black/African American	2.34	(1.60, 3.40)	< 0.001	1.85	(1.53, 2.20)	< 0.001	1.02	(0.70, 1.40)	0.934
	Mexican American	0.91	(0.40, 2.00)	0.815	1.27	(0.88, 1.80)	0.197	0.36	(0.14, 0.90)	0.032
	Other Hispanic/Latino	2.69	(1.13, 6.30)	0.025	1.56	(0.98, 2.40)	0.060	0.69	(0.25, 1.80)	0.463
	Asian/Other	3.99	(1.67, 9.50)	0.002	2.08	(1.31, 3.30)	0.002	0.72	(0.23, 2.10)	0.557
	Non-Hispanic White		Reference			Reference			Reference	
Immigrant Status	Born in Mexico	0.64	(0.24, 1.60)	0.363	0.63	(0.41, 0.90)	0.042	0.99	(0.48, 2.00)	0.987
	Born in Other Spanish-Speaking Country	0.76	(0.25, 2.20)	0.618	1.04	(0.62, 1.70)	0.888	0.53	(0.21, 1.30)	0.172
	Born in Other Country	0.31	(0.08, 1.10)	0.075	0.73	(0.45, 1.10)	0.183	1.02	(0.49, 2.10)	0.963
	Born in the US		Reference			Reference			Reference	
Language Spoken at Home	English + Spanish	0.53	(0.23, 1.20)	0.128	0.72	(0.48, 1.00)	0.116	1.84	(0.73, 4.60)	0.194
	Spanish	0.32	(0.11, 0.90)	0.030	0.77	(0.47, 1.20)	0.302	1.75	(0.64, 4.70)	0.273
	Other	1.71	(0.40, 7.40)	0.472	1.00	(0.55, 1.70)	0.989	0.70	(0.20, 2.40)	0.571
	English		Reference			Reference			Reference	
Income	< \$20,000	2.06	(1.05, 4.00)	0.035	0.94	(0.70, 1.20)	0.661	0.99	(0.58, 1.70)	0.974
	\$20,000-\$25,000	1.69	(0.75, 3.80)	0.205	0.93	(0.67, 1.30)	0.675	1.84	(1.01, 3.30)	0.046
	\$25,000-\$35,000	2.12	(1.08, 4.10)	0.028	0.99	(0.74, 1.30)	0.954	1.68	(0.99, 2.80)	0.053
	\$35,000-\$45,000	1.64	(0.76, 3.50)	0.209	0.90	(0.66, 1.20)	0.492	1.04	(0.57, 1.80)	0.903
	\$45,000-\$55,000	1.96	(0.89, 4.30)	0.095	0.86	(0.62, 1.10)	0.358	1.25	(0.65, 2.40)	0.497
	\$55,000-\$65,000	1.76	(0.79, 3.90)	0.168	0.93	(0.65, 1.30)	0.679	1.19	(0.60, 2.30)	0.618
	\$65,000-\$75,000	3.02	(1.44, 6.30)	0.003	0.82	(0.57, 1.10)	0.273	1.10	(0.54, 2.20)	0.792
	> \$75,000		Reference			Reference			Reference	
Education	Less Than High School	2.14	(1.04, 4.40)	0.040	1.07	(0.74, 1.50)	0.717	1.45	(0.83, 2.50)	0.197
	Some High School	2.50	(1.26, 4.90)	0.009	1.51	(1.14, 2.00)	0.004	1.39	(0.83, 2.30)	0.215
	High School Graduate	2.75	(1.50, 5.00)	0.001	1.55	(1.20, 2.00)	0.001	1.10	(0.70, 1.70)	0.675
	Some College	2.52	(1.36, 4.60)	0.004	1.51	(1.19, 1.90)	0.001	1.05	(0.68, 1.60)	0.816
	College Graduate		Reference			Reference			Reference	
Insurance	Public Insurance Only	1.67	(1.04, 2.60)	0.035	1.08	(0.82, 1.40)	0.598	1.83	(1.15, 2.90)	0.011
	Private Insurance	1.07	(0.67, 1.70)	0.774	1.08	(0.86, 1.30)	0.516	1.19	(0.75, 1.80)	0.450
	Uninsured		Reference			Reference			Reference	
Home Ownership	No	0.84	(0.59, 1.20)	0.343	0.92	(0.75, 1.10)	0.449	0.90	(0.62, 1.30)	0.575
	Yes		Reference			Reference			Reference	
Food Security	Marginal	1.79	(1.05, 3.00)	0.031	0.98	(0.73, 1.30)	0.869	0.87	(0.49, 1.50)	0.646
	Low	1.22	(0.77, 1.90)	0.390	1.15	(0.86, 1.50)	0.346	0.94	(0.55, 1.60)	0.827
	Very Low	1.86	(1.04, 3.30)	0.036	1.44	(1.01, 2.00)	0.047	1.25	(0.61, 2.50)	0.538
	High		Reference			Reference			Reference	
Age	18-24	1.45	(0.49, 4.30)	0.501	1.15	(0.71, 1.80)	0.568	0.73	(0.38, 1.40)	0.360
	25-44	2.12	(0.97, 4.60)	0.061	1.18	(0.80, 1.70)	0.412	0.35	(0.21, 0.60)	< 0.001
	45-64	2.04	(0.98, 4.20)	0.055	1.22	(0.84, 1.70)	0.288	0.30	(0.18, 0.50)	< 0.001
	65-79	0.91	(0.43, 1.90)	0.792	0.95	(0.67, 1.30)	0.798	0.58	(0.37, 0.90)	0.016
	≥ 80		Reference			Reference			Reference	
Sex	Female	1.04	(0.74, 1.40)	0.816	1.18	(1.00, 1.30)	0.046	0.65	(0.48, 0.80)	0.005
	Male		Reference			Reference			Reference	
Marital Status	Widowed	1.59	(0.79, 3.10)	0.195	1.15	(0.82, 1.60)	0.421	0.89	(0.56, 1.40)	0.636
	Divorced	1.47	(0.89, 2.40)	0.135	1.34	(1.01, 1.70)	0.042	1.04	(0.61, 1.70)	0.897
	Separated	2.38	(1.28, 4.40)	0.006	1.08	(0.66, 1.70)	0.766	1.14	(0.43, 3.00)	0.792
	Never Married	1.00	(0.59, 1.70)	0.997	1.31	(1.00, 1.70)	0.050	1.87	(1.22, 2.80)	0.004
	Living with Partner	1.09	(0.59, 2.00)	0.792	0.94	(0.66, 1.30)	0.719	1.59	(0.87, 2.90)	0.134
	Married		Reference			Reference			Reference	

*Adjusted for all other sociodemographic and socioeconomic variables as well as health: age, sex, race/ethnicity, marital status, immigration status, income, education, private insurance, household food security, and general health

with self-reported very short (< 5 h) or short sleep (5-6 h), relative to normal sleep duration (7-8 h). In analyses where adjustments for all other sociodemographic and socioeconomic variables were made (Model 2, Table 3), the 25-44 and 45-65 age groups were more likely to report very short sleep than the ≥ 80 group. However, this pattern was not seen in the final model that included overall health (Model 3, Table 4). Regarding long sleep (≥ 9 h), those in the 25-44, 45-64, and 65-79 age groups were less likely than those in the ≥ 80 year old group to report long sleep. This pattern was maintained throughout all 3 models. Regarding sex, women were more likely to report long sleep in all models (Tables 2-4). Men were more likely to report short sleep, but only in Model 2 (Table 3).

Compared to married individuals, respondents who reported being widowed, divorced, separated, or living with a partner were more likely to report very short sleep, but only in the unadjusted model. When adjusted for sociodemographic and socioeconomic variables (Model 2, Table 3), this relationship was maintained for widowed, divorced, and separated individuals; when fully adjusted for overall health (Model 3, Table 4), significance only remained for separated individuals, who were two times as likely as married respondents to report very short sleep. In terms of self-reported short sleep, divorced and never married individuals were more likely than married respondents to report short sleep, and this relationship only showed significance in Models 1 and 3. In the unadjusted model, widowed respondents were two times as likely to report long sleep; however, this relationship was non-significant in the adjusted analyses. Lastly, respondents who were never married were more likely to report long sleep than those who reported being married, and this relationship was maintained throughout all three models.

Effects of Probable Insomnia and Sleep Apnea

In supplementary analyses, we evaluated whether these relationships were modified by the presence of probable insomnia or sleep apnea. These results are reported in Supplementary Table 1. When probable sleep disorders are included in the model, the overall pattern of results changes. Income of < \$20,000 or \$25-35,000, < 9th grade education, less than high school education, public insurance only, and very low food security are no longer associated with < 5 h of sleep ($P = 0.11, 0.10, 0.06, 0.06, 0.10,$ and $0.80,$ respectively). Being born in Mexico, being divorced, and very low food security are no longer associated with 5-6 h ($P = 0.05, 0.13,$ and $0.15,$ respectively). These findings suggest that the variance explained in sleep duration by these factors is at least partially explained by sleep disturbance. It may be that these factors lead to sleep disturbance, which overlaps with short sleep, or it may be that they lead to both sleep disturbance and short sleep. In either case, the pathways overlap.

DISCUSSION

The present study aimed to examine whether ethnicity and socioeconomic status are independently associated with self-reported sleep duration. Using data from the 2007-2008 NHANES Survey, the study found that minority status (i.e., black/African American, Asian/other, or other Hispanic/Latino) and certain socioeconomic factors (including country of origin,

acculturation, education, annual income, insurance type and food security) were significantly associated with both short and long sleep duration. These relationships persisted when controlling for overall health status.

Race/ ethnicity has long been identified as an important predictor of both sleep duration and overall health status.^{30,43} However, given the complexity of the variables used to assess various dimensions of race/ ethnicity and their relationships among one another, it is difficult to determine likely causation and correlation. Past research has provided ample evidence that blacks⁴⁴ and other racial minorities, including Hispanics and non-Hispanic "others," are more likely than whites to report sleep durations associated with increased mortality.^{25,29,30} However, these studies have also shown that the association between minority status and sleep duration is reduced when controlling for socioeconomic, sociodemographic, and health variables, suggesting that race/ethnicity may actually be secondary to these items in predicting sleep duration. While the present analysis produced similar results, it is important to note that the relationship between minority status and sleep duration remained significant when controlling for all confounding variables, plus overall health status, in the fully adjusted model. This suggests that a distinct relationship exists between race/ ethnicity and sleep duration that cannot be explained by overall health alone. This finding opens another avenue for the exploration of probable causative and/ or correlative underlying pathways between these two variables, beyond socioeconomics.

For certain ethnic minorities, country of origin and level of acculturation also appear to play a small yet significant role in self-reported sleep duration. The present study found that, compared to US-born respondents, those born in Mexico were less likely to report short sleep. This finding is in agreement with previous research, which has not only demonstrated that Mexico-born U.S. immigrants tend to have more favorable sleep than US-born Mexican Americans,³⁴ but also shown that US-born Mexican Americans are actually 40% more likely to be short sleepers than their Mexico-born immigrant counterparts.³⁵ Furthermore, the present study found that Spanish-only speakers were less likely to report very short sleep in the fully adjusted model; however, no other relationships were identified in terms of acculturation. This suggests that becoming assimilated to US culture may be associated with an increased likelihood of shorter sleep duration.

In addition to race/ ethnicity and acculturation level, socioeconomic status has also been shown to correlate significantly with sleep duration, whereby the socioeconomically disadvantaged tend to report shorter sleep durations than their more affluent and better-educated counterparts.⁴⁵ In accordance with previous research demonstrating that lower education level is associated with non-normative sleep,^{46,47} the present study found that respondents with an education level of anything less than "completed college" were significantly more likely to report both very short and short sleep duration, with the exception of those completing less than ninth grade, who only reported more very short sleep. In contrast with earlier research finding that those completing high school or less had an increased incidence of long sleep, the current study found no significant relationship between education level and long sleep duration. While the reason for this discrepancy cannot be fully determined, it

is likely a result of employing a nationally representative data set in the present analysis (whereby past research has only surveyed regional or otherwise limited cohorts).

Like education level, annual income is a pivotal component of socioeconomic status that, when sufficient, has even been shown to mediate the effects of education on sleep and health.⁴⁸ Indeed, past research demonstrated a significant correlation between income level and sleep duration, whereby lower income levels have been associated with, and even thought to predict, an increased incidence of both short^{2,49} and long sleep.^{2,32} The present study found that respondents with an annual income of < \$20,000-25,000 were more likely to report both short and long sleep duration, a finding that replicates previous research⁴⁶ and expands it to a nationally representative sample. Furthermore, the current analysis found that those earning \$25,000-35,000 or \$65,000-75,000 annually reported more very short sleep than those earning > \$75,000 per year. It is interesting to note the inclusion of the \$65,000-75,000 annual income bracket in the group of very short sleepers, as this result appears to break the assumption that the higher the income, the lower the likelihood of non-normative sleep duration. A more detailed analysis would be required to fully examine the root of this relationship.

In addition to education and income, other aspects of socioeconomic status, namely insurance type and food security, were found to be significantly related to non-normative sleep duration in the fully adjusted model of the present study. Although no relationship was found between private insurance and sleep duration, those with public insurance were more likely than the uninsured to report both very short and long sleep duration. It is interesting to note that this relationship persisted in Models 2 and 3 of the analysis, as access to private health insurance may be an indicator of socioeconomic status. This finding suggests that a previously unexplored correlative pathway exists between insurance type and sleep duration. Furthermore, the present study found that those with marginal and very low, but not necessarily low, food security were more likely to report very short and short sleep in the fully adjusted model. Though not significant in models 2 or 3, low food security was associated with non-normative sleep duration in the unadjusted model, suggesting that this level of food security has no independent associations with sleep duration that cannot be explained by SES and/or health status. Similarly, home ownership was only found to be significantly related to sleep duration in Model 1, suggesting that any relationship between these variables can be fully explained by other socioeconomic factors.

Sleep duration, socioeconomic status, and race/ ethnicity are each important indicators of health. However, due to the complexities of these variables and their relationships with one another, it can become difficult to identify specific associations between individual variables and particular health outcomes. Indeed, past research has suggested that social factors may be potential confounders in the relationship between self-reported sleep duration and health.² The present study found that the relationships between education, income level, race/ ethnicity, and sleep duration maintained significance even when controlling for overall health status. When considered jointly with past research, these findings suggest that each variable may work on both an individual and collective level when it comes

to influencing a person's overall health, disease profile, and risk of mortality. In fact, past research has also suggested that sleep may be conceptualized not only as a marker of socioeconomic disadvantage, but also of psychosocial and/ or emotional stressors associated with minority status and/ or socioeconomic disadvantage (such as racism,⁵⁰⁻⁵² decreased autonomy,⁵³⁻⁵⁵ and occupational factors⁵⁶⁻⁵⁸), which also strongly relate to negative health outcomes.⁵⁹⁻⁶¹ Although the present study is cross-sectional and thus cannot provide any information regarding causality, it provides helpful data suggesting direct relationships between socioeconomic status, race/ ethnicity, and sleep duration. Further, although the present study did not look at health outcomes, it did identify several socioeconomic factors that are linked to sleep duration. Many of these factors, such as specific education and income levels, immigrant status, language spoken at home, access to insurance, and food security, have been poorly defined in past research linking self-reported sleep duration and medical outcomes. As such, the inclusion of these specific variables in future research may suggest novel social factors that play a role in the relationship between sleep duration and health.

Limitations

There are several important limitations to this study. First, this analysis was cross-sectional. Therefore, no determinations regarding causality can be drawn. Since demographic and socioeconomic variables are largely determined before adulthood, it is more plausible to suggest that they predate the sleep patterns; however, it is unclear whether they are directly causally related or related to other factors that determine sleep. Second, sleep duration was measured using a single survey item. Although this item has proven useful in a number of previous studies, it has not been validated against standard measures of sleep, and it is unclear what this item actually measures (e.g., it may better represent time in bed). Third, adjusted models may minimize observed effects, since many of the independent variables correlate with each other—if only unique effects are examined, variance that is shared is excluded. Also, several relationships may be difficult to interpret in the context of adjustment. For example, low education attainment may be confounded by immigration status. Fourth, although nationally representative data, such as those collected from the NHANES survey, provide certain benefits such as reliability and generalizability, they may also result in the aggregation of a heterogeneous sample. Respondents living in different parts of the country may experience differential levels of racism, which has been shown to have a negative effect on overall health⁶² and sleep.⁵⁰⁻⁵² Future studies may need to address regional variation.

CONCLUSIONS

The present study found that, in agreement with past research, both minorities and the socioeconomically disadvantaged were significantly more likely than others to report both very short and short sleep duration. This trend was maintained when controlling for overall health status in the fully adjusted model, indicating that the relationships between race/ ethnicity, socioeconomic status, and sleep duration cannot be explained by overall health status alone. Future studies should focus on specific health items in order to better determine the role that

health plays in the relationship between race/ ethnicity, socioeconomic position, and sleep duration.

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SUPPLEMENTAL MATERIAL

Table S1—Associations between age, sex, ethnoracial group, sociodemographics, and socioeconomic position and sleep duration category (adjusted with overall health, probable insomnia, and probable sleep apnea)

Variable	Category	Very Short Sleep (< 5 Hours)			Short Sleep (5-6 Hours)			Long Sleep (≥ 9 Hours)		
		RRR	95% CI	P	RRR	95% CI	P	RRR	95% CI	P
Ethnoracial Group	Black/African American	3.38	(2.18, 5.20)	< 0.001	1.95	(1.58, 2.30)	< 0.001	0.95	(0.64, 1.40)	0.800
	Mexican American	1.15	(0.50, 2.60)	0.747	1.29	(0.88, 1.80)	0.188	0.39	(0.15, 0.90)	0.047
	Other Hispanic/Latino	3.56	(1.28, 9.90)	0.015	1.50	(0.94, 2.30)	0.092	0.68	(0.24, 1.80)	0.455
	Asian/Other	4.81	(1.76, 13.10)	0.002	2.43	(1.50, 3.90)	< 0.001	0.81	(0.27, 2.40)	0.713
	Non-Hispanic White		Reference			Reference			Reference	
Immigrant Status	Born in Mexico	0.86	(0.27, 2.70)	0.794	0.64	(0.40, 1.00)	0.055	0.84	(0.39, 1.80)	0.652
	Born in Other Spanish-Speaking Country	0.86	(0.27, 2.70)	0.794	1.02	(0.61, 1.60)	0.953	0.53	(0.21, 1.30)	0.178
	Born in Other Country	0.38	(0.09, 1.50)	0.182	0.68	(0.41, 1.10)	0.141	1.13	(0.54, 2.30)	0.738
	Born in the US		Reference			Reference			Reference	
Language Spoken at Home	English + Spanish	0.43	(0.17, 1.10)	0.079	0.77	(0.51, 1.10)	0.205	1.88	(0.74, 4.70)	0.185
	Spanish	0.22	(0.07, 0.70)	0.010	0.82	(0.49, 1.30)	0.455	1.79	(0.64, 5.00)	0.267
	Other	1.76	(0.34, 9.20)	0.501	1.01	(0.54, 1.80)	0.971	0.52	(0.14, 1.80)	0.312
	English		Reference			Reference			Reference	
Income	< \$20,000	1.78	(0.87, 3.60)	0.111	0.94	(0.70, 1.20)	0.695	1.02	(0.58, 1.70)	0.949
	\$20,000-\$25,000	1.89	(0.82, 4.30)	0.137	1.02	(0.73, 1.40)	0.905	1.98	(1.07, 3.60)	0.030
	\$25,000-\$35,000	1.82	(0.90, 3.60)	0.098	1.01	(0.74, 1.30)	0.960	1.70	(0.99, 2.90)	0.053
	\$35,000-\$45,000	1.53	(0.70, 3.30)	0.285	0.88	(0.63, 1.20)	0.426	1.13	(0.62, 2.00)	0.686
	\$45,000-\$55,000	1.36	(0.56, 3.30)	0.503	0.79	(0.56, 1.10)	0.168	1.32	(0.68, 2.50)	0.415
	\$55,000-\$65,000	1.35	(0.53, 3.40)	0.529	0.87	(0.60, 1.20)	0.437	1.24	(0.62, 2.40)	0.545
	\$65,000-\$75,000	2.39	(1.05, 5.40)	0.037	0.85	(0.59, 1.20)	0.381	1.07	(0.51, 2.20)	0.861
	> \$75,000		Reference			Reference			Reference	
Education	Less Than High School	2.01	(0.96, 4.20)	0.065	1.03	(0.71, 1.50)	0.867	1.45	(0.80, 2.60)	0.217
	Some High School	1.95	(0.97, 3.90)	0.062	1.48	(1.10, 1.90)	0.009	1.46	(0.86, 2.40)	0.163
	High School Graduate	2.25	(1.20, 4.20)	0.012	1.50	(1.15, 1.90)	0.003	1.09	(0.68, 1.70)	0.714
	Some College	2.31	(1.24, 4.20)	0.008	1.47	(1.14, 1.80)	0.002	1.09	(0.70, 1.70)	0.700
	College Graduate		Reference			Reference			Reference	
Insurance	Public Insurance Only	1.52	(0.93, 2.40)	0.098	1.06	(0.80, 1.40)	0.702	1.88	(1.15, 3.00)	0.011
	Private Insurance	1.10	(0.66, 1.80)	0.701	1.12	(0.88, 1.40)	0.357	1.25	(0.78, 2.00)	0.356
	Uninsured		Reference			Reference			Reference	
Home Ownership	No	0.89	(0.59, 1.30)	0.565	0.96	(0.77, 1.10)	0.677	0.87	(0.59, 1.20)	0.472
	Yes		Reference			Reference			Reference	
Food Security	Marginal	1.86	(1.01, 3.40)	0.045	0.99	(0.74, 1.30)	0.953	0.90	(0.50, 1.60)	0.716
	Low	0.91	(0.55, 1.50)	0.699	1.08	(0.81, 1.40)	0.607	0.91	(0.51, 1.60)	0.759
	Very Low	1.08	(0.59, 1.90)	0.806	1.32	(0.90, 1.90)	0.151	1.27	(0.58, 2.70)	0.555
	High		Reference			Reference			Reference	
Age	18-24	1.62	(0.54, 4.80)	0.390	1.14	(0.69, 1.90)	0.606	0.76	(0.38, 1.50)	0.428
	25-44	1.57	(0.68, 3.60)	0.287	1.12	(0.75, 1.60)	0.595	0.35	(0.20, 0.60)	< 0.001
	45-64	1.34	(0.64, 2.80)	0.438	1.10	(0.75, 1.60)	0.630	0.32	(0.18, 0.50)	< 0.001
	65-79	0.89	(0.41, 1.90)	0.766	0.92	(0.63, 1.30)	0.648	0.58	(0.36, 0.90)	0.025
	≥ 80		Reference			Reference			Reference	
Sex	Female	1.17	(0.80, 1.70)	0.414	1.21	(1.02, 1.40)	0.031	0.67	(0.49, 0.90)	0.013
	Male		Reference			Reference			Reference	
Marital Status	Widowed	1.11	(0.57, 2.10)	0.756	1.16	(0.81, 1.60)	0.417	0.90	(0.55, 1.40)	0.673
	Divorced	1.22	(0.68, 2.10)	0.497	1.26	(0.93, 1.70)	0.132	0.91	(0.52, 1.60)	0.751
	Separated	1.97	(1.02, 3.70)	0.042	1.07	(0.65, 1.70)	0.787	1.09	(0.38, 3.10)	0.873
	Never Married	0.78	(0.44, 1.30)	0.386	1.30	(0.98, 1.70)	0.074	1.89	(1.21, 2.90)	0.005
	Living with Partner	0.94	(0.47, 1.90)	0.874	0.91	(0.64, 1.30)	0.627	1.66	(0.90, 3.00)	0.107
	Married		Reference			Reference			Reference	

*Adjusted for all other sociodemographic and socioeconomic variables as well as health: age, sex, race/ethnicity, marital status, immigration status, income, education, private insurance, household food security, general health, probable insomnia (difficulty falling asleep or difficulty maintaining sleep 15 days/month or more), and probable sleep apnea (diagnosed sleep apnea, or frequent snoring, or any choking/gasping during sleep).