

The Role of Race/Ethnicity and Gender in the Association between Inadequate Sleep and Hypercholesterolemia

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Abstract

Background: Evidence links aberrant sleep durations with elevated serum cholesterol levels or, hypercholesterolemia (HC), an established risk factor for coronary heart disease (CHD). Few studies have assessed the relationship between key sociodemographic indicators including gender and race/ethnicity and HC.

Methods: A total of 40,679 Americans who participated in the 2008-2009 National Health Interview Survey (NHIS) provided data for this cross-sectional analysis. Participants were recruited using a nationally representative cross-sectional household interview survey, which uses a multi-stage area probability design. Participants provided sociodemographic information, physician-diagnosed chronic conditions, and habitual sleep duration, categorized as <6 hours, or >8 hours, referenced to 7 hours. We used NHIS-provided weights to adjust for use of complex design.

Results: Of the total sample (n=40,679), 85% reported their race/ethnicity as non-Hispanic white and 15% as non-Hispanic black; 56% of the participants were female. Adjusted logistic regression analyses showed significant association between sleep duration and presence of HC among blacks, but not among whites. Blacks reporting short (<6 hours) or long sleep durations (>8 hours) had a greater risk of HC relative to blacks sleeping 7 hours habitually [OR=1.12, 95% CI: 1.11-1.13; OR=1.13, 95% CI: 1.12-1.14; p<0.001, respectively]. Black females reporting short or long sleep duration had greater risk of reporting HC compared with black males sleeping 7 hours [OR=1.11, 95% CI: 1.10-1.11; OR=1.10, 95% CI: 1.10-1.10; p<0.001, respectively].

Conclusion: Our study supports the relationship between inadequate sleep and traditional risk factors for CHD, namely, HC. Future lifestyle interventions should consider the role of sleep in addressing CHD risk and CHD morbidity.

Keywords: Inadequate sleep; Sleep duration; Hypercholesterolemia; Coronary heart disease; Race; Gender

Introduction

Sleep duration is an important risk factor to assess as clinicians strive to improve the health-related quality of life and management of chronic diseases in their patient population [1,2]. The effect of inadequate sleep duration on physiological mechanisms and body systems often manifest as disease processes including depression [3,4], obesity [5-7], diabetes mellitus [8-13], and hypertension [6,14,15]. In addition, several studies have evidenced associations, often preceded by aberrant lipid metabolism, between sleep duration and atherosclerosis [16-19].

Hypercholesterolemia (HC), an established risk factor of atherosclerosis and coronary heart disease, is highly prevalent in the U.S. In 2010, approximately 26% of adults reported high cholesterol placing them at risk for cardiovascular morbidity and mortality [20]. HC has been associated with inadequate sleep duration [18,21-23]; however, there are inconsistencies in the literature with some

reporting no association [24], and others reporting an association for short or long duration. In addition, most studies have been devoted to specific subgroups including adolescents [21] individuals with bipolar disorders [25] and longer time in bed/fragmented sleep among older individuals [22,26].

Studies exploring associations between HC and sleep duration have examined the role of gender and have shown that women reporting short sleep duration are at greater risk of developing HC. For example, Sabanayagam and Shankar [18] found that sleep duration <5 hours among women had positive associations. Gangwisch et al. [21] showed that each additional hour of sleep in women was associated with a significant decreased odds of being diagnosed with HC in young adulthood (OR=0.83, 95% CI: 0.73-0.95). But inconsistencies in the literature remain. In the Coronary Artery Risk Development in Young Adults (CARDIA) study, sleep duration was positively associated with total cholesterol, however, when reproductive-related factors were controlled for, the results were attenuated and no longer significant [23]. Williams et al. [13] found increased HDL in normotensive women, but not hypertensive women reporting short sleep duration.

Only a few studies have examined racial/ethnic differences. Sabanayagam et al. [18] reported a positive association between sleep duration and hypercholesterolemia was stronger in other ethnic groups, and did not observe a significant race/ethnicity interaction. However, the data did not characterize “other racial/ethnic groups” and it is unclear if these results are applicable to non-Hispanic blacks (hereafter referred to as blacks), Hispanics, or Asians. Similarly, the CARDIA study using a sample of 503 black and white adults did not find significant race interactions [23].

There is growing evidence that sleep duration varies across racial/ethnic groups [27,28]. Cross-sectional studies demonstrate that blacks [27] and other ethnic groups report shorter and longer sleep duration relative to whites. Of note, very few studies have explored race/ethnic interactions on the association between sleep duration and HC. This is particularly important given the disproportionate burden of cardiovascular disease morbidity and mortality among blacks [29]. Given the role of HC as a prominent risk factor for coronary heart disease and the high prevalence of inadequate habitual sleep duration in the U.S., we investigated the role of gender and race/ethnicity on the association between sleep duration and HC.

Methods

The National Health Interview Survey (NHIS) is an ongoing, cross-sectional, in-person household interview survey conducted annually by the Centers for Disease Control’s National Center for Health Statistics. NHIS uses a multistage area probability design, sampling non-institutionalized representatives of the civilian population of the U.S. Probability samples of the adult population of all 50 states and District of Columbia were obtained. Details on sample design are provided elsewhere [30].

We used data from 40,679 adults ≥ 18 who participated in the 2008-2009 NHIS for this cross-sectional analysis. Participants were recruited using a nationally representative cross-sectional household interview survey, which uses a multistage area probability design. Participants provided sociodemographic, physician-diagnosed chronic conditions and data on habitual sleep time. We used NHIS-provided weights to adjust for use of complex design.

Measures

HC was based on self-report of whether a physician had ever diagnosed the participant as having high cholesterol. Self-reported body mass index (BMI) was assessed as weight in kilograms/height in meters squared. A BMI in the range of 18.5 and 24.9 was considered normal; BMI ≥ 25 -29 was considered overweight, while a BMI ≥ 30 was considered obese. BMI was dichotomized as normal/underweight vs. overweight/obese. Age was measured as a continuous variable. Education was measured as 1) less than high school, 2) completed high school, or 3) greater than high school. Self-reported race/ethnicity was measured as non-Hispanic white, non-Hispanic black, Asian, and Hispanic. Sleep duration was measured with the question, “On average, how many hours of sleep do you get in a 24-hour period?” coded as <6 hours, or >8 hours referenced to 7-8 hours. Socioeconomic status was based on reported annual individual income ($< \$35,000$; $\$35$ - $\$55,000$; $> \$55,000$).

Analysis

Descriptive analysis was used to ascertain prevalence of variables of interest. In order to test the first hypothesis, we used multivariable

regression models. We also assessed if the associations varied by race and race-sex groups by adding interaction terms into separate fully adjusted models. A $p < 0.05$ value was considered as a significant. Analysis was conducted using SPSS, version 20.0 (SPSS Inc., Chicago, IL).

Results

Of the total sample of 40,679, 85% reported their race/ethnicity as white and 15% as black; 56% of the participants were female. Table 1 compares sociodemographic and health characteristics of participants who reported HC compared to those who did not. In unadjusted regression analysis showed that overall participants who reported long sleep duration (>8 hours) were more likely to have reported HC than individuals reporting habitual sleep duration of 7-8 hours [OR=1.28, 95% CI: 1.22-1.31 $p < 0.001$].

Variables	Reported HC (28.5%)	Reported No HC (71.5%)
Age (\pm SD)	58.2 \pm 14.9	45.2 \pm 17.4
Blacks	14.1	16.7
Female sex	56.1	56.7
Income $> \$35,000$	57	58.3
Married	80.8	61.9
Education, \geq HS	80.8	83.6
Smoking history	48.9	38.3
Current drinking	78.3	75.1
Cancer	13.7	6.5
Coronary heart disease	11.5	2.3
Diabetes	37.7	6.4
Heart Attack	8.8	2
Hypertension	58.1	22.4
Stroke	6.5	2
Obese	43	34.6
Arthritis	82.7	80.8
Vision Problems	16.7	9.2
Emotional distress	3.9	2.2
Walk $\frac{1}{4}$ mile	60.8	16.6
Healthy sleep 7 h	28.6	31.8
Short sleep <6 h	25.2	18.7
Long sleep >8 h	26.7	20

Table 1: Sociodemographic and health characteristics for HC.

However, no significant associations were observed for short sleep in the entire sample. Adjusted logistic regression analyses showed significant association between sleep duration and presence of HC among blacks, but not among whites. Blacks reporting short (<6 hours) or long sleep durations (>8 hours) had a greater risk of HC

relative to blacks sleeping 7 hours habitually [OR=1.12, 95% CI: 1.11-1.13; OR=1.13, 95% CI: 1.12-1.14; $p < 0.001$, respectively]. Black females reporting short or long sleep duration had greater risk of reporting HC compared with black males sleeping 7 hours [OR=1.11, 95% CI: 1.10-1.11; OR=1.10, 95% CI: 1.10-1.10; $p < 0.001$, respectively].

Discussion

Traditionally, most studies have focused on comparing whites to all other racial/ethnic groups, or controlling for race/ethnicity in regression models. Given, the increasing racial/ethnic disparities in health outcomes, and sleep duration, it is important to ascertain these differences, as policy makers and clinicians could develop and disseminate appropriate interventions, making such efforts a public health priority. Our results corroborate previous findings that short sleep duration in women is positively associated with HC, and this study went a step further in examining this association in black women. We focused on this population, as national prevalence rates indicate that blacks have two or more risk factors for cardiovascular disease [31] as compared to whites. The fact that black women reporting short or long sleep duration were more likely to report HC is quite alarming and should be a public health priority. Black women report several traditional risk factors for cardiovascular disease; yet, prevention efforts to reduce morbidity and early mortality have proven inadequate [32]. None of the previous studies on HC and sleep duration have reported these findings, and it is likely due to variations in methodological and statistical techniques.

These findings are consistent with other studies that have shown a pattern of association between sleep duration and HC. However, the association for the total sample was significant only for long sleep duration. Sabanayagam et al. [18] found a positive association among women reporting short sleep duration and the inverse among men. Gangwisch et al. [21] found an association in short sleep duration and adolescent females, but not among males. Notably, in our study, short and long sleep may increase risk of HC in black women. The reasons for the observed differences in studies are not clear, but are likely due to variations across studies, including older and young adults, and individuals with comorbidities. Sabanayagam et al. [18] also used the NHIS dataset, and finding that the observed differences in the results are likely due to approaches used in categorizing short and long sleep duration, and adjusting for different covariates. This raises the importance of establishing covariates and the need for large-scale investigations with large multi-ethnic groups.

Findings also highlight the need to address potential mechanism. Some evidence suggests that short sleep duration is associated with increased inflammation [33]. The inflammatory process is related to an increase in low density lipoprotein [23] molecules that accumulate in the blood stream, but the contribution of sleep to this development is not entirely clear. Conceivably, the relationship could be mediated by other social, lifestyle and environmental factors. The participants in this study with high cholesterol also reported several comorbidities including history of hypertension, current drinker, current smoker, and diabetes. These findings indicate that multilevel interventions for CHD that address sleep, is of growing importance in addressing racial/ethnic health disparities.

While the study does suggest the role of gender, particularly comparing black females with short or long sleep duration with black males with 7 hours of sleep, unlike the CARDIA study [23] we could not control for factors related to reproduction, which could account

for these findings. Other limitations of this study are that sleep duration are self-reported, which increases the likelihood of over- or underreporting of the actual hours slept. In addition, we could not assess other sleep disorders including sleep apnea and insomnia, both of which have been linked to CHD [34-37]. Despite these limitations, these findings are robust because we used a large nationally representative sample of the U.S. population and controlled for several covariates to explore this association.

Conclusions

This study represents a significant addition to the literature on the role of race and gender in HC. Our study supports the relationship between inadequate sleep and traditional risk factors for CHD, namely, HC. Future lifestyle interventions should consider the role of sleep in addressing CHD risk and CHD morbidity. It underlines the need for further research that could bring to light not just associations but possible mechanistic factors.

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