

# Race-Ethnic Differences of Sleep Symptoms in an Elderly Multi-Ethnic Cohort: The Northern Manhattan Study

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## Key Words

Sleep symptoms · Snoring · Sleepiness · Sleep duration · Race · Ethnicity

## Abstract

**Background:** Sleep disorders are associated with stroke and may vary among elderly Hispanics, Blacks and Whites. We evaluated differences in sleep symptoms by race-ethnicity in an elderly population-based urban community sample. **Methods:** Snoring, daytime sleepiness and reported sleep duration were ascertained by standardized interviews as a part of the Northern Manhattan Study, a prospective cohort study of vascular risk factors and stroke risk in a multi-ethnic urban population. Sleep symptoms were compared amongst race-ethnic groups using logistic regression models. **Results:** A total of 1,964 stroke-free participants completed sleep questionnaires. The mean age was 75 ± 9 years, with 37% men, with 60% Hispanics, 21% Blacks and 19% Whites. In models adjusted for demographic and vascular risk factors, Hispanics had increased odds of frequent snoring (odds ratio, OR: 3.6, 95% confidence interval, CI: 2.3–5.8) and daytime sleepiness (OR: 2.8, 95% CI: 1.7–4.5) compared to White participants. Hispanics were more likely to report long sleep

(≥9 h of sleep, OR: 1.8, 95% CI: 1.1–3.1). There was no difference in sleep symptoms between Black and White participants. **Conclusion:** In this cross-sectional analysis among an elderly community cohort, snoring, sleepiness and long sleep duration were more common in Hispanics. Sleep symptoms may be surrogate markers for an underlying sleep disorder which may be associated with an elevated risk of stroke and may be modified by clinical intervention.

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## Introduction

One third of US adults report sleeping less than 7 h per night and 50–70 million have a sleep disorder [1]. Habitual snoring and daytime sleepiness are cardinal symptoms of sleep-disordered breathing (SDB) [2]. Daytime consequences of SDB include cognitive dysfunction, altered mood, sleepiness and fatigue [3]. Also, daytime sleepiness is a symptom of narcolepsy and circadian rhythm disorders. SDB may affect up to 17% of the adult population [4] and is linked to stroke [5, 6] and mortality [7]. Self-reports of sleep duration have a U-shaped relation with stroke [8–10] and mortality [11, 12], such that

short and long sleepers are at increased risk. There are race-ethnic disparities in mortality [13, 14] and stroke with increased risk in Hispanics and Blacks [15]. In spite of these associations there is limited information on race-ethnic differences in sleep symptoms. We have previously observed an increased frequency of snoring symptoms in Hispanics compared to Blacks and Whites [16]. The goal of this study is to examine race-ethnic differences in self-reported sleep symptoms, and identify race-ethnic groups that can potentially be at a high risk of sleep-related morbidity.

## Methods

### *Study Population*

The Northern Manhattan Study (NOMAS) is a prospective cohort study of stroke-free participants designed to determine stroke risk factors and outcomes using a multi-ethnic community-based sample [15, 17]. As previously described, the NOMAS cohort study of 3,298 stroke-free participants was randomly sampled from the northern Manhattan population in 1993. The mean age for the baseline cohort ( $n = 3,298$ ) was  $69 \pm 10$  years, with 63% women, 55% Hispanics, 24% non-Hispanic Blacks and 21% non-Hispanic Whites. From the original cohort a total of 2,266 participants were available for follow-up in 2004, as 1,032 of the participants had died. Of the 2,182 available stroke-free participants, 1,964 had data on sleep symptoms. Compared to the overall NOMAS sample there was a similar proportion of women (64%), and a greater proportion of Hispanics (61%), with 21% Blacks and 19% Whites, who answered questions about sleep. Of the 1,187 Hispanics available for this analysis, the majority were from the Dominican Republic (60%), and 96% reported Spanish as their primary language. The study was approved by the Columbia University Medical Center Institutional Review Board and by the University of Miami Institutional Review Board. All participants gave written informed consent.

### *Sleep Variables*

Self-reported sleep symptoms were derived from the NOMAS sleep questionnaire. The questionnaires were available in English and Spanish. The NOMAS sleep questionnaire contains a question about snoring (i.e. 'Do you know, or have you been told that you snore?'). Possible responses ranged from 1 to 5 with 1 = never and 5 = every night. Habitual snoring was defined as a self-report of snoring  $>4$  times per week, based on prior definitions of habitual snoring [18]. Sleepiness was assessed with the NOMAS Sleepiness Scale, which was derived from the Epworth Sleepiness Scale (ESS) [19] and adapted for relevance to the characteristics of people living in northern Manhattan. The NOMAS Sleepiness Scale rates self-reports of dozing off unintentionally during the day in sedentary situations, and responses ranged from 0 = rarely or never dozing off, 1 = sometimes dozing off, 2 = often, or moderate chance of dozing off, to 3 = most or all of the time dozing off. Participants were asked about dozing off while: (1) sitting and reading; (2) watching TV; (3) sitting inactive in a public place; (4) as a passenger in a car, train or bus; (5) sitting and talking to some-

one, and (6) sitting quietly after a lunch without alcohol. Daytime sleepiness was categorized as a sum score of  $\geq 10$  based on the established definition for daytime sleepiness [19–22].

Risk-predictive models have been used to identify individuals at high risk of SDB. One of the most commonly used is the Berlin questionnaire, which combines risk factors such as snoring, sleepiness, obesity and hypertension to reliably predict SDB from polysomnography [2]. These risk factors can be used to stratify patients into low- or high-risk categories for SDB. The presence of 2 out of the 4 factors in the Berlin questionnaire predicts SDB from polysomnography with a sensitivity of 86%, specificity of 77% and positive predictive value of 89%. Reports of frequent snoring and sleepiness were combined in our cohort to construct low- or high-risk categories for SDB.

Self-report of sleep duration was determined through the average hours of nightly sleep in the previous 4 weeks before the follow-up interview [23].

### *Definition of Race/Ethnicity*

Race and ethnicity were defined by self-identification based on questions modeled after the US census [15]. Race/ethnicity was categorized into mutually exclusive groups for these analyses as Black, White and Hispanic.

### *Risk Factors and Covariates*

Data were collected through interviews by trained bilingual research assistants using standardized data collection instruments [17, 24, 25]. Educational level was used as an indicator of socioeconomic status (SES) and classified into 2 categories: 'Less than eighth-grade education' included those who never went to high school and 'more than eighth-grade education' was used as the reference. Obesity was defined as a body mass index (BMI) of equal to or more than 30. Moderate consumption of alcohol was defined as  $>1$  drink per month and/or  $<2$  drinks per day. Physical activity was assessed by a questionnaire adapted from the National Health Interview Survey that recorded the frequency and duration of 14 activities during the prior 2 weeks. Physical activity was categorized as moderate to vigorous physical activity versus no physical activity. Hypertension was defined as a systolic blood pressure of 140 mm Hg, or a diastolic blood pressure of 90 mm Hg, or a patient's self-report of a history of hypertension or use of antihypertensive medications. Diabetes mellitus was defined as fasting blood glucose greater than or equal to 126 mg/dl, or the patient's self-report of such a history or use of insulin or hypoglycemic medications. Cardiac disease included a history of angina, myocardial infarction, coronary artery disease, atrial fibrillation, congestive heart failure or valvular heart disease. Psychoactive medication use (antidepressant, antiepileptic and/or antipsychotic) was categorized as either yes or no.

### *Statistical Analysis*

Statistical analyses were performed using SAS software version 9.2 (SAS Institute Inc., Cary, N.C., USA). ANOVA and  $\chi^2$  tests were done to examine the relation between self-reports of frequent snoring, sleepiness and sleep duration amongst the race-ethnic groups, and age, sex, marital status, BMI, moderate alcohol consumption, smoking, physical activity, hypertension, diabetes, cardiac disease and psychoactive medications.

We used logistic regression to evaluate the odds of frequent snoring and sleepiness in Hispanics and Blacks, with Whites as

**Table 1.** Self-reported sleep symptoms, demographics, lifestyle factors and cardiovascular risk factors across race-ethnic groups

	Total (n = 1,964)	White (n = 368)	Black (n = 409)	Hispanic (n = 1,187)
Self-reported sleep symptoms				
Sleepiness	322 (16)	27 (7)	47 (15)	240 (20)***
Frequent snoring	476 (28)	35 (12)	41 (12)	391 (39)***
7–8 h of sleep	885 (45)	161 (44)	157 (38)	545 (46)
Short sleep ( $\leq 6$ h)	657 (33)	123 (33)	151 (37)	369 (31)
Long sleep ( $\geq 9$ h)	251 (13)	30 (8)	36 (9)	181 (15)**
Demographics				
Mean age $\pm$ SD, years	75 $\pm$ 9	80 $\pm$ 9	78 $\pm$ 9	73 $\pm$ 8***
Men	734 (37)	160 (44)**	136 (33)	419 (35)
$\leq 8$ th grade	800 (40)	22 (6)	48 (12)	723 (61)***
Married	700 (35)	138 (38)	90 (22)***	459 (39)
Mean BMI $\pm$ SD	28 $\pm$ 5	27 $\pm$ 5***	29 $\pm$ 6	29 $\pm$ 5
Lifestyle factors				
Moderate-vigorous physical activity	202 (10)	64 (17)***	50 (12)	80 (7)
Moderate alcohol consumption	719 (36)	182 (50)***	144 (35)	374 (32)
Currently smoking	300 (15)	40 (11)	82 (20)**	172 (14)
Cardiovascular risk factors				
Hypertension	1,441 (72)	228 (62)	317 (78)	870 (73)***
Diabetes	303 (15)	28 (8)***	58 (14)	213 (18)
Cardiac disease	407 (20)	92 (25)	83 (20)	221 (19)*
Medications	141 (7)	24 (7)	16 (4)*	96 (8)

Values are patient numbers with percentages in parentheses. \*  $p < 0.05$ , \*\*  $p < 0.001$ , \*\*\*  $p < 0.0001$ .

the reference. We used sequential models to adjust for age, sex, marital status and BMI (model 1), moderate physical activity, moderate alcohol consumption and smoking (model 2), hypertension, diabetes, cardiac disease and psychoactive medications (model 3). Self-reported sleep hours (sleep duration) were categorized as  $\leq 6$  h (short sleep duration), 7–8 h (reference) and  $\geq 9$  h (long sleep duration). We used multinomial logistic regression, with the sequential models described, to evaluate the odds of short and long sleep duration in Hispanics and Blacks versus the reference [23].

## Results

The sleep symptoms, demographic, lifestyle and vascular risk factors overall and across the different race-ethnic groups are presented in table 1. The mean age at the time of sleep evaluation was 75  $\pm$  9 years. There were race-ethnic differences in sleep symptoms, with Hispanics reporting an increased frequency of sleepiness, frequent snoring and long sleep duration. Hispanics were 5–8 years younger than the other race-ethnic groups and the majority of Hispanics had less than an eighth-grade

education. Hispanic and Black participants had an increased frequency of hypertension and diabetes, and a higher BMI compared to Whites.

Six percent ( $n = 124$ ) of the overall sample and 9% of Hispanics were at high risk of SDB by combining symptoms of frequent snoring and daytime sleepiness (Berlin risk model). The majority of participants considered at high risk of SDB were Hispanics (89%,  $n = 110$ ).

Hispanics had increased odds of frequent snoring and sleepiness compared to the reference when adjusting for age, sex, marital status, BMI, physical activity, alcohol consumption, smoking, hypertension, diabetes, cardiac disease, and psychoactive medications. There were no differences in sleep symptoms in Blacks versus the reference (table 2). Secondary analysis adding frequent snoring as an explanatory variable showed that Hispanics had increased odds of reporting sleepiness (odds ratio, OR: 2.6, 95% confidence interval, CI: 1.5–4.5). Additionally, in the fully adjusted model frequent snoring was associated with sleepiness (OR: 2.1, 95% CI: 1.5–2.8). We performed a sensitivity analysis restricted to the participants that were currently married at the time of the data collec-

**Table 2.** Race-ethnic differences in snoring and daytime sleepiness

	Frequent snoring	Sleepiness
Hispanic		
Model 1	3.6 (2.4–5.3)	2.8 (1.9–4.2)
Model 2 <sup>1</sup>	3.5 (2.4–5.2)	2.8 (1.9–4.3)
Model 3 <sup>2</sup>	3.6 (2.3–5.8)	2.8 (1.7–4.5)
Black		
Model 1	0.8 (0.5–1.2)	1.4 (0.9–2.2)
Model 2 <sup>1</sup>	0.7 (0.5–1.2)	1.4 (0.9–2.3)
Model 3 <sup>2</sup>	0.7 (0.4–1.1)	1.4 (0.8–2.3)

Values are OR with 95% CI in parentheses. White was the reference group. All models were adjusted for age, sex, education, marital status and BMI.

<sup>1</sup> Also adjusted for smoking, physical activity and alcohol consumption.

<sup>2</sup> In addition to the parameters of models 1 and 2, also adjusted for hypertension, diabetes, cardiac disease and medications.

tion (n = 1,500), assuming that self-reports of snoring would be more accurate in this group. The race-ethnic differences described above remained unchanged (data not shown).

Hispanics had increased odds of reporting long sleep duration ( $\geq 9$  h) that persisted when frequent snoring was added to the fully adjusted model (OR: 2.4, 95% CI: 1.3–4.6). Hispanics did not have increased odds of reporting short sleep duration and no differences in sleep duration were observed between Blacks and the reference (table 3).

Further analysis with years of residence (mean 23  $\pm$  13 years) in the USA as a surrogate of acculturation did not change the race-ethnic differences described above and did not predict any of the sleep symptoms in Hispanics (data not shown).

## Discussion

We observed race-ethnic differences of sleep symptoms in an urban elderly community-based cohort. Self-reports of frequent snoring, sleepiness, long sleep duration and high risk of SDB were observed in Hispanics. Although the reasons for these disparities are not yet known, they raise the possibility that Hispanics may be at greater risk of sleep disorders that often go unrecognized. Physician-diagnosed SDB has been least reported in Hispanics [26]. Therefore, Hispanics may benefit from screening programs for the detection and treatment of

**Table 3.** Race-ethnic differences in short ( $\leq 6$  h) and long ( $\geq 9$  h) sleep relative to 7–8 h of sleep

	Model 1	Model 2 <sup>1</sup>	Model 3 <sup>2</sup>
Reported short sleep duration			
Hispanic	0.8 (0.6–1.1)	0.8 (0.6–1.0)	0.7 (0.5–1.1)
Black	1.3 (0.9–1.7)	1.2 (0.9–1.7)	1.0 (0.7–1.4)
White	–	–	–
Reported long sleep duration			
Hispanic	2.0 (1.3–3.2)	2.1 (1.3–3.3)	1.8 (1.1–3.1)
Black	1.3 (0.8–2.2)	1.3 (0.8–1.2)	1.1 (0.6–2.1)
White	–	–	–

Values are OR with 95% CI in parentheses. All models were adjusted for age, sex, education, marital status and BMI.

<sup>1</sup> Also adjusted for smoking, physical activity and alcohol consumption.

<sup>2</sup> In addition to the parameters of models 1 and 2, also adjusted for hypertension, diabetes, cardiac disease and medications.

any underlying sleep disorder, which is an important problem as sleep disorders have a negative impact on cognition and risk of stroke, but are treatable [3].

Our findings are in accordance with the Sleep Heart Health Study (SHHS) [27], a population-based study that evaluated the race-ethnic differences of various sleep complaints. The SHHS showed a higher prevalence of snoring symptoms in Hispanics compared to Whites. However, the number of Hispanics in the SHHS was relatively small. In contrast to our study, the SHHS showed more frequent snoring in Blacks than Whites [28]. A similar prevalence of SDB has been observed between elderly Blacks and Whites with objective measures of sleep (i.e. polysomnography) [29, 30]. Hispanics had increased sleepiness compared to Whites, with no difference between Black and White participants. In a different cohort, Blacks reported increased sleepiness compared to Whites across different age groups [31]. Comparison of the ESS between Blacks and Whites showed that changes in the ESS could be related to sociocultural differences in the interpretation of the items of the ESS [31]. Daytime sleepiness can be related to a sleep disorder or be due to poor health. However, Hispanics in our cohort did not have a greater prevalence of vascular risk factors compared to Blacks. Therefore, sleepiness in Hispanics could potentially be related to a primary sleep disorder.

There was a higher prevalence of snoring, sleepiness and high risk of SDB in Hispanics when taking into account risk factors for SDB like the BMI. These differenc-



es could be attributed to an unmeasured cultural variation in reporting sleep complaints [13] or cephalometric differences that may affect the prevalence of SDB among the different race-ethnic groups [32].

Epidemiological studies have shown that extremes of sleep duration ( $\leq 6$  or  $\geq 9$  h) are linked to increased mortality and cardiovascular disease [10–12, 33–37].

The effects of sleep duration are different at each end of the U curve, with short sleep linked to impaired insulin sensitivity and an increased sympathetic tone [35, 36], while long sleep duration is linked to cardiovascular comorbidities and low SES [38].

The prevalence of long sleep duration is estimated to be 1.4–9.5% [23, 39]. In our study, long sleep duration ( $\geq 9$  h) was reported by 13% of the overall sample and 15% of Hispanics. Long sleep duration is more prevalent in the elderly [12] and in those with multiple vascular and non-vascular risk factors of mortality [37, 38]. A U-shaped relation has been observed between SES and sleep duration, raising the possibility that groups of low SES are more vulnerable to the effects of abnormal sleep patterns [38, 40]. Sleep duration can vary among the different Hispanic communities in the USA and some suggest that it can be difficult to disentangle race-ethnicity from SES [13, 14, 23, 41]. Short sleep duration is more common in urban areas [23], but our participants reside in the same urban community, and therefore this would likely not explain the differences across race-ethnic groups.

Long sleep duration can be a surrogate for SDB, and the relation between long sleep duration and adverse health outcomes is in part driven by SDB [37, 42]. In the elderly, long sleep duration has been correlated to daytime sleepiness [43], a cardinal symptom of SDB [2].

Hispanics reported increased snoring and sleepiness after controlling for the main confounders. Frequent snoring (3–7 nights/week) predicted moderate to severe SDB (OR: 2.9, 95% CI: 2.1–3.9) in a population-based sample [18]. Furthermore, the Berlin risk model shows indirect evidence that Hispanics in our cohort could be at a greater risk of polysomnography-confirmed SDB.

The strengths of our study include the evaluation of a race/ethnically diverse community-based cohort with a large proportion of Hispanics and Blacks who are considered to be at a higher risk of stroke and cardiovascular events. However, several limitations should be noted. First, all sleep variables were self-reported, and therefore misclassification of snoring symptoms is possible, especially in participants without a bed partner. However, we do not believe this was a major source of bias in the current analysis as the results remained unchanged when the

analysis was restricted to married individuals. Histories obtained from bed partners may be more informative, but were not collected in our cohort.

Daytime sleepiness could have been underestimated in our sample. We used the established research and clinical cutoff ( $\geq 10$ ) for sleepiness with a narrower range of scores compared to the original ESS. This could bias our results to mainly represent severe sleepiness, and consequently underestimate the prevalence of participants at high risk of SDB.

Sleep duration (hours of sleep) was self-reported. However, epidemiologic association studies of reported long sleep and adverse health outcomes are mainly based on subjective reports from sleep questionnaires [8, 12, 38, 39]. Long sleep duration might represent an increase in sleep time or increased time in bed, which cannot be determined from the current data. However, an association between mortality and sleep has been shown across measures of time in bed and actual sleep time [44, 45]. Finally, objective measurements of sleep (i.e. polysomnography) were not obtained in this study. Because the current analysis is cross-sectional, potential race-ethnic differences in the trajectory of sleep symptoms cannot be elucidated and should be examined in prospective studies.

In conclusion, we have found race-ethnic differences in self-reported sleep symptoms and an increased risk for SDB in a diverse race-ethnic, elderly cohort.

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### Disclosure Statement

The authors have nothing to disclose.

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