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Prevalence of pre-stroke sleep apnea risk and short or long sleep duration in a bi-ethnic stroke population

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Abstract

Background—The ethnic disparity in ischemic stroke between Mexican Americans (MAs) and non-Hispanic whites (NHWs) may be partly attributable to disparities in sleep and its disorders. We therefore assessed whether pre-stroke sleep apnea symptoms (SA risk) and pre-stroke sleep duration differed between MAs and NHWs.

Methods—MA and NHW ischemic stroke survivors in the Brain Attack Surveillance in Corpus Christi (BASIC) project reported sleep duration, and SA symptoms on the validated Berlin questionnaire, both with respect to their pre-stroke baseline. Log binomial and linear regression models were used to test the unadjusted and adjusted (demographics, vascular risk factors) associations of high-risk Berlin scores and sleep duration with ethnicity.

Results—Among 862 subjects, 549 (63.7%) were MA, and 514 (59.6%) had high risk for pre-stroke SA. The MA and NHW subjects showed no ethnic difference, after adjustment for potential confounders, in pre-stroke SA risk (risk ratio [95% CI]: 1.06 [0.93,1.20]) or in pre-stroke sleep duration (on average MAs slept 2.0 fewer minutes than NHWs, 95%CI: -18.8, 14.9 minutes).

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Conclusions—Pre-stroke SA symptoms are highly prevalent, but ethnic differences in SA risk and sleep duration appear unlikely to explain ethnic stroke disparities.

Keywords

ethnicity; stroke; sleep apnea; sleep duration; sleep disordered breathing; insufficient sleep; Mexican American; cerebrovascular accident

1. Introduction

Mexican Americans (MAs), the largest subgroup of Hispanics, have a higher risk for first and recurrent stroke than do non-Hispanic whites (NHWs), with nearly double the risk at younger ages.[1] Reasons for this ethnic disparity are uncertain, but could include an increased prevalence of sleep disorders, such as sleep apnea (SA), an independent stroke risk factor.[2] Similarly, self-reports of short (< 7 hours) or long (> 9 hours) sleep duration are associated with an increased risk of stroke.[3] Studies suggest that Hispanics may have a higher prevalence of SA and higher odds of longer sleep compared to NHW.[4, 5]

Information about pre-stroke SA and sleep duration would allow hypotheses to be generated about the contributions of short or long sleep or disordered sleep to elevated stroke risk in MAs compared with NHWs. Our aim was to compare pre-stroke SA and sleep duration in MAs and NHWs included in a population-based stroke study. We hypothesized that MAs would have a higher prevalence of pre-stroke SA and shorter or longer sleep duration than NHWs.

2. Methods

Subjects were recruited between 7/8/2010 - 1/20/2014 from the Brain Attack Surveillance in Corpus Christi (BASIC) Project, an ongoing, population-based stroke surveillance study conducted in the bi-ethnic community of Nueces County, Texas. Our hospital surveillance captures nearly all cases of ischemic stroke and detailed methods have been published previously.[1, 6, 7] Briefly, stroke cases from all 7 acute care hospitals in Corpus Christi are identified through active surveillance of Emergency Department and hospital logs and passive surveillance of ICD-9 codes. Complete case capture is facilitated through the geographic isolation of the community with only sparsely populated surrounding areas. The lack of an academic medical center in the area limits referral bias. Study neurologists validate each case based on review of source documentation. The current analysis is restricted to ischemic stroke cases who agreed to undertake a study interview. The Institutional Review Boards of the University of Michigan and the local hospitals approved this project. Informed consent was obtained from each subject or surrogate.

Demographics and medical history were obtained from the medical record and a baseline interview, with the subject or a proxy if the subject was unable to participate. Ethnicity was defined by chart designation, which we have previously shown has a 96.3% agreement with self-report in this community.[8] During the baseline interview, the Berlin questionnaire, a validated SA screening tool, and a sleep duration question (“How many hours of sleep do you usually get a night (or when you usually sleep)?”) were asked in reference to the pre-

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stroke state.[9] The Berlin questionnaire has an 89% positive predictive value for detecting sleep apnea (apnea/hypopnea index (AHI)≥5) and 71% negative predictive value (detecting no sleep apnea with AHI<5) in a primary care setting.[9] The Berlin questionnaire was used to screen for sleep apnea in the Sleep in America 2005 poll and other studies.[10-13] The questionnaire consists of three categories that query snoring/apneas (category 1), sleepiness (category 2), and hypertension and body mass index (BMI)>30 (category 3). Each category is scored as low (0) or high risk (1) and an individual is considered high risk if two or more category scores are high risk. Total reported sleep duration was further categorized as short (≤6 hours), long (≥ 9 hours), or normal (7-8 hours), based on typical classifications.[14] With an estimated 50% prevalence for overall high risk pre-stroke SA, we had 82% power to detect a risk ratio of 1.2 for pre-stroke SA in MAs compared with NHWs given our sample size.

Descriptive statistics summarized baseline characteristics, Berlin scores, and sleep duration. Unadjusted ethnic comparisons for categorical and continuous variables, including sleep duration (hours), were made by chi-square and Kruskal-Wallis tests. Log binomial regression with robust standard errors was used to test the unadjusted and adjusted associations between high risk Berlin score overall and Berlin category scores and ethnicity. Two separate models (model 1 and model 2) were used to adjust for pre-specified potential confounders including age (continuous), sex, current smoking status, current alcohol intake (categorical: <1, 1-14, >14 drinks per week), diabetes, high cholesterol, atrial fibrillation, hypertension, and BMI (quintiles). Model 1 tested the adjusted association between high risk Berlin score overall or category 3 and ethnicity. Hypertension and BMI were not included in model 1 since these variables are part of the definitions of category 3 and the overall score. Hypertension and BMI were additionally included in model 2, which tested the adjusted association between category 1 or 2 and ethnicity. Linear regression with robust standard errors tested the unadjusted and adjusted (same pre-specified confounders) difference in sleep duration (≤6 hours, 7 or 8 hours, ≥ 9 hours) by ethnicity. SAS version 9.3 (SAS Institute, Cary, N.C., USA) was used for analyses.

3. Results

During the study period, there were 1,419 validated ischemic strokes among MAs and NHWs. There were 134 patients excluded because greater than 6 months elapsed between stroke and the interview, the interview was pending or they completed the interview, but not the sleep questions. Of 1,285 eligible patients with validated ischemic strokes, 862 (67.1%) completed the interview that included sleep questions; 549 (63.7%) of these subjects were MA. Baseline characteristics are shown in Table 1. Proxies completed the surveys for 272 (31.5%) of subjects, with no ethnic difference (p= 0.30). MAs had a greater prevalence of diabetes, hypertension, and a higher BMI, but a lower prevalence of atrial fibrillation, smoking, and lower use of alcohol compared with NHWs. MAs were also less likely to complete high school or post-high school education than NHWs.

Overall, 514 (59.6%) subjects had a high risk of pre-stroke SA, which was more common in MAs (61.9%) than NHWs (55.6%), but not significantly (p=0.07). Among the three Berlin categories, only high risk category 3 was more prevalent among MAs, given their higher

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average BMI and prevalence of hypertension (Table 2). After adjustment, no ethnic differences in SA risk or in the symptom-based categories, category 1 and 2 were found. Approximately half of all subjects reported normal sleep duration (7 or 8 hours), with no difference in sleep duration category distribution by ethnicity (Table 1). No difference in sleep duration was found by ethnicity before or after adjustment (Table 2). Additional post-hoc adjustment for education level did not significantly change the relationship between SA risk or sleep duration and ethnicity.

4. Discussion

In this population-based stroke study, we found that a high risk of pre-stroke SA is common in stroke patients, but the prevalence of pre-stroke SA and short or long sleep duration was not higher in MAs than NHWs. Given our sample size, we had 82% power to detect a risk ratio of 1.2 for pre-stroke SA in MAs compared to NHWs, a small but clinically meaningful difference. These results suggest that differences between MA and NHW stroke patients in sleep duration and SA risk are unlikely explanations for important disparities observed in their cerebrovascular health. Such disparities could still be explained, in theory, by more severe SA in MAs or a stronger association between SA and stroke among MAs,[2] and an alternative study design that included control subjects might have been more informative. However, the current negative results help to address a compelling question of vital importance that has never been investigated previously in a community sample of similar size.

One prior bi-ethnic study (n=176) did assess pre-stroke SA risk, by the Berlin questionnaire, among 77 Hispanic (mostly Cuban decent) and 21 NHW subjects and found a similar proportion of Hispanics (60%) at high risk for SA, but a lower proportion of high-risk NHWs (33%).[15] With adjustment, Hispanics had higher odds of SA. Differences in our results may relate to our larger sample, baseline differences in characteristics of NHWs, or our population-based design.

The main limitation of this study was the absence of objective measures for SA and sleep duration prior to stroke. Although the Berlin questionnaire may not be a good predictor of SA post-stroke, it has been validated in general populations, and our use was in reference to the pre-stroke state.[16] Therefore, we would anticipate that it would perform as well as in the general population, though using it in reference to the pre-stroke state may introduce recall bias. Because some stroke patients were unable to complete questionnaires due to aphasia or other stroke-related issues, some questionnaires were completed by proxies. However, bed partner responses to the Berlin questionnaire may predict sleep apnea based on polysomnographic criteria better than the patient, there is fair patient-proxy agreement for high risk pre-stroke SA based on Berlin questionnaire, and no ethnic difference in the use of proxies was identified (p=0.30).[17, 18] Self-report of sleep duration is variably correlated with more objective measures of total sleep time, and may better reflect other constructs such as sleep quality or time in bed.

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This population-based study provides evidence for a high prevalence of pre-existing SA in stroke patients. However, no ethnic differences were identified in the prevalence of pre-stroke SA or sleep duration.

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Highlights

- High risk of pre-stroke SA is common in ischemic stroke patients.
- The prevalence of high pre-stroke SA risk was not higher in MAs than NHWs.
- Short or long sleep duration prevalence was not higher in MAs than NHWs.
- Sleep duration and pre-stroke SA risk does not explain bi-ethnic stroke disparities.

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Table 1

Baseline characteristics and pre-stroke sleep duration among stroke subjects in BASIC

	All n=862 n (%)	Mexican American n=549 n (%)	non-Hispanic Whites n=313 n (%)	p-value
Female	419 (48.6)	272 (49.5)	147 (47.0)	0.47
Age, median (IQR)	69 (59, 80)	67 (58, 79)	71 (61, 82)	0.003
Health insurance				
Nueces County, self pay, or not insured	125 (14.5)	83 (15.1)	42 (13.4)	<0.001
Medicare/Medicaid, VA/Tricare/Champs	211 (24.5)	158 (28.8)	53 (16.9)	
HMO,PPO or HMO, PPO and Medicare	526 (61.0)	308 (56.1)	218 (69.6)	
Education				
<High school	340 (39.5)	299 (54.7)	41 (13.1)	<0.001
High school	231 (26.9)	134 (24.5)	97 (31.0)	
>High School	289 (33.6)	114 (20.8)	175 (55.9)	
Current alcohol use				
none	212 (24.6)	169 (30.8)	43 (13.7)	<0.01
<1	380 (44.1)	242 (44.1)	138 (44.1)	
1-14	220 (25.5)	108 (19.7)	112 (35.8)	
>14	50 (5.8)	30 (5.5)	20 (6.4)	
Current smoker	182 (21.1)	98 (17.9)	84 (26.8)	0.002
Proxy response	272 (31.5)	180 (32.8)	92 (29.4)	0.3
BMI: n, median (IQR)	859, 27.44 (24.37, 32.42)	547, 28.53 (24.96, 33.28)	312, 26.32 (23.70, 30.27)	<0.001
NIH score, median (IQR)	4 (2, 9)	4 (2, 9)	4 (2, 10)	0.72
Diabetes	403 (46.8)	313 (57.0)	90 (28.8)	<0.001
Hypertension	699 (81.1)	467 (85.1)	232 (74.1)	<0.01
Atrial fibrillation	140 (16.2)	70 (12.8)	70 (22.4)	<0.01
Congestive heart failure	94 (10.9)	60 (10.9)	34 (10.9)	0.98
Coronary artery disease	270 (31.3)	169 (30.8)	101 (32.3)	0.65
Stroke/TIA history	257 (29.8)	173 (31.5)	84 (26.8)	0.15
Sleep duration				
Total (hours), median (IQR)	8 (6, 8)	8 (6, 8)	8 (6, 8)	0.52

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	All n=862 n (%)	Mexican American n=549 n (%)	non-Hispanic Whites n=313 n (%)	p-value
Short, ≤6 h	268 (31.4)	177 (32.4)	91 (29.6)	0.67
Normal, 7-8 h	424 (49.7)	269 (49.3)	155 (50.5)	
Long , ≥ 9 h	161 (18.9)	100 (18.3)	61 (19.9)	

Abbreviations: IQR = interquartile range, VA = veterans administration, HMO = health maintenance organization, PPO = preferred provider organization

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Table 2

Ethnic differences in pre-stroke Berlin score and sleep duration

	All n=862	Mexican Americans n=549	Non-Hispanic Whites n=313	Unadjusted RR or mean difference (95%CI)	Model 1 RR or mean difference (95%CI)	Model 2 RR or mean difference (95%CI)
Sleep apnea risk						
High risk overall	514 (59.6)	340 (61.9)	174 (55.6)	1.11 (0.99, 1.26)	1.06 (0.93, 1.20)	-
High risk category 1	470 (54.5)	311 (56.6)	159 (50.8)	1.12 (0.98, 1.27)	1.09 (0.95, 1.25)	1.05 (0.91, 1.20)
High risk category 2	276 (32.0)	176 (32.1)	100 (31.9)	1.01 (0.82, 1.24)	0.87 (0.7, 1.07)	0.86 (0.69, 1.07)
High risk category 3[a]	743 (86.2)	495 (90.2)	248 (79.2)	1.13 (1.06, 1.21)	1.11 (1.04, 1.18)	-
Sleep duration (minutes)	-	-	-	-5.4 (-22.1, 11.3)	-0.9 (-17.7, 15.8)	-2.0 (-18.9, 14.9)

[a] $p<0.001$

Model 1 adjustment: age (continuous), sex, current smoking status, current alcohol intake (categorical: <1, 1-14, >14 drinks weekly), diabetes, hyperlipidemia, atrial fibrillation.

Model 2 additionally adjusted: BMI (quintiles) and hypertension. Overall Berlin score and category 3 scores were not adjusted for BMI and hypertension because they are part of the score itself.