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Original Article

Disparities in sleep characteristics by race/ethnicity in a population-based sample: Chicago Area Sleep Study

Mercedes R. Carnethon [a,*], Peter John De Chavez [a], Phyllis C. Zee [b], Kwang-Youn A. Kim [a], Kiang Liu [a], Jeffrey J. Goldberger [c], Jason Ng [c], Kristen L. Knutson [d]

[a] Department of Preventive Medicine, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA
[b] Department of Neurology, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA
[c] Division of Cardiology, Department of Medicine, Feinberg School of Medicine, Northwestern University, Chicago, IL, USA
[d] Department of Medicine, University of Chicago, Chicago, IL, USA

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ABSTRACT

Background: Prior studies report less favorable sleep characteristics among non-Whites as compared with non-Hispanic Whites. However, few population-based studies have used objective measures of sleep duration, especially in more than two racial/ethnic groups. We tested whether objectively estimated sleep duration and self-reported sleep quality varied by race and whether differences were at least partially explained by the variability in clinical, psychological, and behavioral covariates.
Methods: Adults aged 35–64 years who self-identified as White, Black, Asian, or Hispanic were randomly sampled from Chicago, IL, and the surrounding suburbs. Our analytic sample included adults who had an apnea–hypopnea index <15 after one night of screening and who completed seven nights of wrist actigraphy for determination of sleep duration, sleep percentage, minutes of wake after sleep onset, and sleep fragmentation ($n = 495$). Daytime sleepiness was estimated using the Epworth Sleepiness Scale (ESS), and sleep quality was estimated from the Pittsburgh Sleep Quality Index (PSQI).
Results: Following statistical adjustment for age, gender, education, work schedule (ie, day vs. night shift), smoking status, depressive symptoms, body mass index (BMI), hypertension, and diabetes, sleep duration (minutes) was significantly (all $p < 0.01$) shorter in Black (mean = 399.5), Hispanic (mean = 411.7), and Asian (mean = 409.6) participants than in White participants (mean = 447.4). All remaining sleep characteristics were significantly less favorable among Black participants as compared with White participants. Asian participants also reported significantly more daytime sleepiness than did White participants.
Conclusions: Differences in sleep characteristics by race/ethnicity are apparent in a sample of adults with a low probability of sleep apnea and following adjustment for known confounders.

1. Introduction

There are notable and persistent disparities in the prevalence of major cardiovascular and metabolic disorders by race and ethnicity. Adverse health behaviors such as poor diet and physical inactivity account for a substantial proportion of these disparities [1]. Given research describing the contribution of sleep duration and quality to the development of obesity, hypertension, diabetes, cardiovascular disease, and mortality [2–7], it is equally plausible that differences in sleep characteristics by race/ethnicity contribute to disparities in cardiovascular disease and metabolic disorders.

Variability in short sleep duration and poor-quality sleep by sociodemographic characteristics has been observed in population research studies. Most often, non-White adults and adults from lower socioeconomic status groups report less favorable sleep characteristics including a higher prevalence of short and long sleep and poorer-quality sleep than White adults [8–16]. The limitations of prior research on sociodemographic variability in sleep include reliance on self-reported versus objectively determined sleep duration, limited racial/ethnic variability within studies (ie, most studies compare two groups), and potential confounding by the prevalence of sleep disorders such as obstructive sleep apnea (OSA), which are independently associated with shorter sleep and poorer-quality sleep [17].

Thus, the objective of our study was to describe and compare objectively measured sleep duration and quality via actigraphy and self-reported sleep quality and sleepiness in a population-based sample of White, Black, Hispanic, and Asian adults with a low probability of sleep apnea. An additional advantage over the previous studies is the ability to statistically adjust for potential behavioral and clinical confounders of the association between race/ethnicity

* Corresponding author. 680 N Lake Shore Drive, Suite 1400, Chicago, IL 60611, USA. Tel.: +1 (312) 503 4479; fax: +1 (312) 908 9588.
E-mail address: carnethon@northwestern.edu (M.R. Carnethon).

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and sleep characteristics. Our a priori hypothesis was that we would observe less favorable sleep characteristics in non-Whites versus Whites, but that these differences are at least partially accounted for by differences in clinical and behavioral covariates across groups.

2. Methods

2.1. Study participants and design

Analyses of the Chicago Area Sleep Study (CASS), a cross-sectional population-based epidemiologic study, were conducted. Men and women, ages 35–64 years, who were living in Chicago, IL, or the surrounding suburbs were identified via commercial telephone listings and contacted by mail and telephone. The CASS staff screened the participants via telephone to determine the likelihood of sleep apnea based on the Berlin Sleep Questionnaire [18], a modified STOP-BANG [19] (modified to use self-reported neck circumference for men) and body mass index (BMI). Adults were invited to participate if they met each of the following criteria: BMI < 35 kg/m^2, Berlin score <3 (women) or <2 (men), and a STOP-BANG <2 affirmative responses for women or <3 affirmative responses for men.

Eligible potential participants were invited to attend two clinical examinations approximately one week apart. Informed consent was obtained from all participants, and all protocols were approved by the Northwestern University Institutional Review Board. Women were scheduled to attend their first examination during the mid-follicular phase of their menstrual cycle. At the first examination, the staff explained the procedures for wearing the ApneaLink Plus® apnea-screening device and the wrist actigraph. The participants were also given a set of questionnaires to complete prior to the next examination, which was scheduled to take place a minimum of eight days later and a maximum of 14 days later.

2.2. Measurements

2.2.1. Race/ethnicity

The primary aim of the study was to include equal representation of adults from four race/ethnic groups. Because race/ethnicity is primarily a social and cultural construct, we relied on self-report to determine race/ethnicity. Potential study participants were recruited from geographic areas in Chicago, IL, and surrounding suburbs with a high proportion of the targeted racial/ethnic groups. The commercial telephone listings included an indicator of race/ethnicity, and telephone recruiters asked participants to confirm their race/ethnicity. In addition, when participants attended the clinical examination, they were also asked to complete sociodemographic questionnaires indicating their race (Black, White, and Asian) and whether or not they were of Hispanic ethnicity. Very few Hispanic participants reported both their ethnicity and their race, leading to a substantial lack of data on race among Hispanics. This was addressed by classifying all participants indicating Hispanic ethnicity as Hispanic for our study. In cases of disagreement between self-reports of race/ethnicity, participants were classified based on the race/ethnicity that they reported on the sociodemographic questionnaires. Based on prior research reporting disparities in cardiovascular and metabolic disorders in Asian ancestral groups, we attempted to reduce variability by targeting Asians who reported Chinese ethnicity. However, we were unable to identify a sufficient number of eligible Chinese participants, so the inclusion criteria were broadened to other East Asians (eg, Korean, Japanese, and Vietnamese) because South and Southeast Asians (eg, Filipinos and South Asian Indians) have a markedly different cardiovascular and metabolic profile [20].

2.2.2. Sleep characteristics

To restrict the sample to participants with a low likelihood of OSA, at the first visit, participants were asked to wear the ApneaLink Plus® apnea-screening device for one night. Post hoc exclusions for analysis were made for those participants with AHI <15, measured based on a minimum of 4 h of wear time and using a combination of devices including the nasal cannula, a chest belt to detect respiratory effort, and a pulse oximeter to measure oxygen saturation. The analyses were repeated in the subset of 361 participants with AHI ≤ 5 for the sensitivity analysis. High sensitivity (91%) and specificity (95%) were observed between ApneaLink Plus® and the laboratory polysomnograph [21].

At the first examination, participants took home the wrist-worn Actiwatch™ 2 device (Phillips Respironics, Bend, OR, USA). They were asked to wear the watch continuously for seven days and nights until the second clinical examination and to keep a daily sleep log to record their daily bedtime and wake time and any nap times during the preceding 24-h interval. The Actiware software program (version 5) and its built-in algorithm were used to analyze the actigraphy data. Automated scoring was not used because it has not been validated. Instead, a member of the research team identified bedtime and wake time using the sleep logs and the event markers. A proportion of the records (10%) were independently scored by KK, and comparisons were made to ensure data quality. Time in bed was determined based on the Actiwatch™ device marker, which the participants were asked to press when they went to bed to sleep and when they woke. If participants did not use the marker, the study staff estimated bedtimes and wake times based on self-reports recorded on the sleep log. Sleep duration was determined using the device software algorithms, which quantified the amount of movement during time in bed. Minutes of wake after sleep onset (WASO) were calculated. The percentage of time the participant was asleep during the sleep period (sleep onset to sleep end) was calculated (sleep percentage). Sleep fragmentation is an index of restlessness during the sleep period expressed as a percentage. It is calculated by summing the following two percentages: (1) the percentage of the sleep period spent moving (an epoch with >2 activity counts is considered moving) and (2) the percentage of the number of immobile phases (consecutive epochs with no movement) that are only 1 min long or less. The average values for each of the sleep characteristics were calculated for the seven days. Participants were asked to complete the Pittsburgh Sleep Quality Index (PSQI) [22]. Scores range from 0 to 21, with higher scores indicating worse sleep quality. Daytime sleepiness was measured using the eight-item Epworth Sleepiness Scale (ESS) [23], with higher scores (range 0–24) indicating greater sleepiness. Both the PSQI and ESS were treated as continuous variables in analyses.

2.2.3. Covariates

Participants were asked to fast for a minimum of 12 h prior to the second clinic examination and to bring all prescription medications and over-the-counter supplements that they were currently taking. All clinical measurements (ie, phlebotomy, blood pressure, and anthropometry) were collected between 7:30 am and 11:00 am. Blood was drawn from participants in the seated position into citrate Vacutainer tubes, centrifuged at 3000 rpm at 4 °C for 20 min, and stored at −70 °C. The fasting glucose level was determined from plasma using spectrophotometry. Whole blood was assayed for determining hemoglobin A1c using an immunoturbidimetric assay. Diabetes status was determined if fasting glucose was ≥ 126 mg/dL or hemoglobin A1c was ≥ 6.5%, or if participants reported taking medications to control diabetes [24]. Blood pressure was measured using an Omron automated cuff on participants while seated after 5 min of rest. Three measurements were collected and the final two were averaged. Hypertension was defined if participants had systolic blood pressure ≥ 140 or diastolic blood pressure ≥ 90, or if