

Sleep Association With Borderline Diabetes Hypertension: A Cross-sectional Analysis

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ABSTRACT

Short and long sleep (< 6 or >9 hours) are associated with increased odds ratio for diabetes and hypertension and depend on race. However, less is known about the relationships when diabetes and hypertension are in their borderline states. A cross-sectional study using the 2013–2014 National Health Interview Survey and NHANES datasets showed associations between non-midrange sleep duration and borderline disease status that differ from the full-disease associations. Advanced practice providers may use these results to include sleep duration assessment and possible sleep disorder screening in care plans for borderline diabetic and hypertensive patients.

Keywords: diabetes mellitus, hypertension, screening, sleep, sleep-wake disorders

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Sleep health, diabetes, and heart disease have been identified as national health concerns,^{1,2} each with its own set of objectives for improving outcomes.^{3–5} However, the 3 conditions are also intertwined because poor sleep is associated with increased risk of both diabetes and heart disease.^{6–12} This suggests that awareness of sleep health may be warranted when treating diabetes and/or cardiac conditions. For example, short (≤ 6 hours) or long (≥ 9 hours) self-reported sleep durations, as defined by Buxton and Marcelli,⁷ are associated with increased risk of having diabetes,^{6,7,9,12,13} elevated hemoglobin A1c,^{14,15} and impaired glucose tolerance.^{16–18} Similarly, short and long sleep times are associated with increased risk of hypertension.^{8,10} That is, the associations are “U-shaped,” with lowest risk in the middle (ie, sleep times between 6 and 9 hours) and higher risks on both sides (short and long sleep times). Physiologic explanations for the sleep–diabetes association are supported by epidemiological and research study data,¹⁸ although similar explanations for the sleep–hypertension association are less clear.¹⁰ Given the strength of sleep–diabetes associations, some have suggested that sleep disturbance assessments should be incorporated into clinical guidelines for diabetes.^{6,11} Given this evidence, health care providers may want to consider

sleep-time assessments for patients with both diabetes and hypertension.

It may be possible that similar associations between short and long sleep times and disease status are also present at the pre-disease or borderline states of diabetes and hypertension. If so, then sleep duration might be an indicator that hypertension and/or diabetes are imminent. The purpose of this study was to explore the possibility of associations between short and long sleep times and borderline disease states for both diabetes and hypertension in the general US population. Because disease status tends to vary according to race,^{4,5,7,9,12,19,20} sleep–borderline disease status associations were explored for the population as a whole and according to race category.

METHODS

Study Design

This is a secondary analysis of 2 cross-sectional survey data sets collected in the United States during 2013–2014: (1) the 2014 National Health Interview Survey (NHIS)²¹ and (2) the 2013–2014 National Health and Nutrition Examination Survey (NHANES).²² The NHIS comprises annual household interviews conducted by the Census Bureau. The NHIS interviews yield self-reports of socioeconomic, demographic, health status, and

health care access characteristics. Questionnaire contents and associated results are publicly available as downloadable databases through the NHIS website.²¹ The NHANES interviews, run by the National Center for Health Statistics, occur in participants' homes and provide self-reports of socioeconomic, demographic, dietary, and health-habit characteristics. NHANES participants are volunteers who are recruited through advertising and participation incentives. The NHANES examinations occur in mobile units staffed by health professionals and provide physiological measurements and laboratory results. Questionnaire contents, physical examination parameters, and associated results are publicly available as downloadable databases through the NHANES website.²² For this secondary analysis, data were downloaded from public websites and weighted according to their respective protocols. All sample sizes reported here are the effective sample sizes extracted from the complex datasets. IBM SPSS Statistics version 23 software was used for all analyses.

Study Sample. Samples for NHIS and NHANES were characterized separately by sample size, age, sex, race, sleep category (short, midrange, long) and disease status (borderline or full for both diabetes and hypertension). For individual analyses (as described subsequently), sample sizes depended on the number of respondents for the variables under consideration. Results for white, black/African American, Hispanic/Latino, and Asian races were reported because there was sufficient data for these races in both datasets to allow for valid odds ratio (OR) calculations.

Sleep Variables. Both datasets had variables capturing the amount of sleep individuals reported getting per night. Sleep was recoded into categories as (1) short if reported sleep per night was ≤ 6 hours per night, (2) long if > 9 hours per night, and (c) midrange if from 6 to 9 hours per night.

Diabetes Variables. Both datasets included variables on whether a person had been told by a doctor or other health professional that they have diabetes or borderline diabetes. These variables were recoded as (1) full diabetes (for "yes, I have been told I have diabetes") and (2) and borderline diabetes (for "yes, I have been told I have borderline diabetes").

Hypertension Variables. The 2014 NHIS incorporated a series of supplemental questions asking whether the person had been told by a doctor whether his or her blood pressure was high, low, borderline, or normal. A similar question on hypertension was not included in NHANES. These NHIS variables were recoded as (1) full hypertension (for high blood pressure) and (b) borderline hypertension (for borderline blood pressure).

Study Analyses

Associations between disease states (borderline or full) and sleep duration (short, midrange, and long) were determined by examining prevalence of disease in each sleep duration category (subdivided according to race) and by calculating cross tabs parameters. Associations between sleep duration and full disease status, although not the primary focus of this study, were included to enable internally consistent comparisons between borderline and full status sleep-risk associations. Prevalence of individuals with the borderline and full disease status (diabetes and hypertension) who were short, midrange, and long sleepers were visualized as bar charts for the composite group and for each race category. Prevalence was represented as percent of individuals within each race category who fell within each sleep range. Odds ratios with 95% confidence intervals were calculated from crosstabs for short and long sleepers compared with those in the midrange for each disease condition/race category.

RESULTS

Sample Characteristics

The combined sample size was $N = 485,105,015$ ($n = 239,688,457$ for NHIS and $n = 245,416,558$ for NHANES; see Table). The 2 samples were approximately 48% male with an average age of about 45 years ($SD \sim 18$ years). For both data sets, white participants made up the majority (65%–66%), followed by Hispanic/Latino ($\sim 15\%$), black/African American (11%–12%), and Asian ($\sim 5\%$) participants. These trends are similar to US Census Bureau's description of the US population as being 49.2% male, 61.3% white/non-Hispanic, 17.8% Hispanic/Latino, 13.3% black/African American only, and 5.7% Asian only (only median, not mean,

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