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Original Article

Ethnic-specific associations of sleep duration and daytime napping with prevalent type 2 diabetes in postmenopausal women

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ABSTRACT

Objective: The objective of this study was to evaluate ethnic differences in the associations of nighttime sleep and daytime napping durations with prevalent type 2 diabetes.
Methods: Samples of White ($n = 908$), Filipina ($n = 330$), and Black ($n = 371$) community-dwelling, postmenopausal women aged 50–86 years were evaluated with cross-sectional data obtained during 1992–1999 including self-reported duration of nighttime sleep and daytime napping, behaviors, medical history, and medication use. The prevalence of type 2 diabetes was evaluated with a 2-h 75-g oral glucose tolerance test.
Results: Overall, 10.9% of White, 37.8% of Filipina, and 17.8% of Black women had type 2 diabetes. Average sleep durations were 7.3, 6.3, and 6.6 h and napping durations were 16.8, 31.7, and 25.9 min for White, Filipina, and Black women, respectively. Sleep duration showed a significant ($p < 0.01$) nonlinear association with type 2 diabetes in Filipina women, with increased odds of diabetes at both low and high sleep durations independent of age, body mass index (BMI), triglyceride to high-density lipoprotein (HDL) ratio, hypertension, and daytime napping duration. Daytime napping duration was associated with type 2 diabetes only among White women; those napping ≥ 30 min/day had 74% (95% confidence interval (CI) = 10%, 175%) higher odds of diabetes compared to non-nappers independent of covariates including nighttime sleep duration.
Conclusions: Results suggest ethnic-specific associations of nighttime sleep and daytime napping durations with type 2 diabetes.

1. Introduction

The role of sleep duration in healthy aging has received increased attention in recent years, due, in part, to the sharp rise in the prevalence of short sleep duration [1]. Short and long sleep durations are associated with numerous adverse health outcomes, including obesity, hypertension, cardiovascular disease, and all-cause mortality [2–6].

Short and long sleep durations have also been linked to an increased risk of diabetes [7–9]. In a meta-analysis of >100,000 men and women, short (≤5–6 h sleep/night) and long (>8–9 h/night) sleepers had a 28% and 48% increased risk of type 2 diabetes, respectively [10]. However, limited studies have evaluated ethnic variations in the relationship between sleep duration and diabetes [11–13]. Investigating ethnic differences in the sleep–diabetes association is important, given that Blacks have higher rates of short and long sleep compared to Whites, as well as a higher risk of diabetes [1,14]. To our knowledge, no study has included a sample of Filipinos, a group with a disproportionately high diabetes prevalence compared to both Whites and Blacks [15].

Although less studied, daytime napping, which is common among older adults, has also been linked to poor health outcomes including diabetes [16–19]. However, the majority of these studies have been conducted in Chinese populations, and it is currently unknown whether the relationship between daytime napping and diabetes may differ by ethnicity.

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The purpose of this cross-sectional study was to evaluate ethnic differences in the associations of nighttime sleep duration and daytime napping duration with type 2 diabetes in a large sample of older, community-dwelling White, Filipina, and Black postmenopausal women. The prevalence of type 2 diabetes was ascertained by an oral glucose tolerance test, an important consideration in studies of older women, many of whom have isolated post-challenge hyperglycemia that would otherwise be missed [20].

2. Methods

2.1. Participants

Between 1972 and 1974, the Rancho Bernardo Heart and Chronic Disease Study enrolled 6629 community-dwelling residents aged 30–79 years from the southern California community of Rancho Bernardo [21]. Participants were predominantly White, middle class, and relatively healthy. This study uses cross-sectional data from 1082 women aged 30–98 years who attended the 1992–1996 follow-up research clinic visit in which oral glucose tolerance tests, body fat composition, and other measurements (eg, height, weight, and lipids) were obtained.

Two ethnic comparison cohorts of Filipina and Black women were enrolled between 1993 and 1999. An effort was made to recruit Filipina and Black women of similar education and social class to the participants of the Rancho Bernardo cohort. Briefly, community-dwelling Filipina women aged 40–86 years ($n = 453$) were recruited to participate in a cross-sectional study assessing the prevalence of chronic diseases including osteoporosis, type 2 diabetes, and cardiovascular disease [22]. Convenience sampling was employed because Filipinos were not identified separately from Asians in the 1990 census. Most of the Filipina women lived in Mira Mesa, a middle-class community located in North San Diego County with a high proportion of Filipino residents. This population was chosen because it is located 10 miles from our research clinic in Rancho Bernardo, the residence of the White cohort. Black women aged 50–88 years ($n = 443$) were recruited between 1993 and 1997 to participate in the Health Assessment Study of African-American Women (HASAAW), a cross-sectional study on the prevalence of chronic diseases including type 2 diabetes [23]. Black women were chosen to select for white-collar workers to minimize confounding due to social class and access to health care when comparing ethnic differences.

This study was limited to postmenopausal women between 50 and 86 years of age ($n = 1658$) in order to have similar age groups across samples. After excluding women with a missing diabetes diagnosis ($n = 31$), diagnosed with type 1 diabetes ($n = 8$), and missing data on nighttime sleep and/or daytime napping durations ($n = 10$), there remained 908 White, 330 Filipina, and 371 Black postmenopausal women who are the focus of this study. All participants provided written informed consent prior to participation. This study was approved by the Human Research Protections Program of the University of California, San Diego (UCSD) and the Institutional Review Board of San Diego State University.

2.2. Procedures

Clinical evaluations were performed at the UCSD Rancho Bernardo Clinic for White and Filipina women and at the UCSD Clinical Research Center for Black women. The same research protocols and diagnostic laboratories were used for all ethnic cohorts.

A standardized self-administered questionnaire obtained information on nighttime sleep and daytime napping durations using the following two questions: (1) "How many hours do you sleep each night?" and (2) "How many hours do you nap each day?" The questionnaire also obtained information on demographics, medical history, age at last menstrual period, smoking status (never/past/current), alcohol consumption ≥3 drinks/week (yes/no), and exercise ≥3 times/week (yes/no). Occupation was asked as an open-ended question and coded in groups, such that "nurses" were in the same group as teachers and managers (ie, those requiring a bachelor's degree). A trained interviewer obtained information on current use of diabetes, hypertension, and sleep-related medications (eg, sedating antidepressants, antianxiety drugs, and sedative hypnotics). Use of medications in the month before the clinic visit was validated with pills and containers brought to the clinic for that purpose.

In the clinic, height and weight were measured in participants wearing lightweight clothing without shoes. BMI was calculated as weight (kg)/height (m^2). Waist circumference was measured at the natural bending point. Total percentage body fat was measured by dual energy X-ray absorptiometry (DEXA; model QDR-2000; Hologic, Waltham, MA, USA). Systolic and diastolic blood pressures were measured twice in participants after they had been seated quietly for 5 min, using the Hypertension Detection and Follow-Up Program protocol.

Blood samples were collected from participants between 8 and 11 am after an 8-h minimum fast. Participants were administered a 75-g oral glucose tolerance test; blood was collected by venipuncture at 0 and 2 h. Plasma glucose levels were measured by the glucose-oxidase method, and insulin levels by radioimmunoassay (Fineberg Laboratory, Indiana University, Indianapolis, IN, USA). Insulin resistance was estimated with the homeostasis model assessment [24]. Fasting plasma lipids, lipoproteins, and triglycerides were measured with enzymatic techniques (Lipid Research Clinics Program Manual of Laboratory Operations).

2.3. Statistical analysis

Type 2 diabetes was defined by fasting plasma glucose ≥126 mg/dl, 2-h post-challenge glucose ≥200 mg/dl, physician-diagnosed type 2 diabetes, or treatment with an oral hypoglycemic agent or insulin. Hypertension was defined as systolic blood pressure ≥130 mmHg, diastolic blood pressure ≥85 mmHg, or use of antihypertensive medications. Based on the existing literature [4,6,9], nighttime sleep duration was categorized as follows: < 6 h (short), 6–6.9 h, 7–7.9 h (reference), 8–8.9 h, and ≥9 h (long); daytime napping duration was categorized as follows: 0 min (reference), <30 min, and ≥30 min.

Descriptive statistics are presented as percentages or means (standard errors) for categorical and continuous covariates, respectively. For continuous covariates, normality was assessed using frequency distributions, normal probability plots, and measures of skewness and kurtosis. Log-transformed variables are presented as geometric means (95% CI). The mean values of continuous covariates were compared using independent *t*-tests or analysis of variance (ANOVA) in unadjusted comparisons, and general linear models in covariate-adjusted comparisons. Pearson's λ^2 test or Fisher's exact test was used to compare categorical covariates. The Cochran–Armitage test for trend was used to assess dose–response associations.

Univariate associations of duration of nighttime sleep and daytime napping and other variables with diabetes were assessed using logistic regression. The possibility of a U-shaped association of nighttime sleep duration with diabetes was tested using a quadratic term centered on the mean value to avoid multicollinearity. In multivariable logistic regression analysis, separate models were fit for White, Filipina, and Black women. The full multivariable models included nighttime sleep and daytime napping durations, as well as variables marginally associated ($0.05 \le p < 0.10$) with nighttime sleep duration, daytime napping duration, and/or diabetes in the univariate analyses (ie, age, BMI, triglyceride to HDL ratio, hypertension, exercise, alcohol, and medication use for depression, anxiety, or insomnia medications). The final models were derived using stepwise backward elimination with assessment for confounding; if the