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Unequal burden of sleep-related obesity among black and white Americans

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ABSTRACT

Background: This study ascertained whether individuals of the black race/ethnicity are unequally burdened by sleep-related overweight/obesity.
Methods: Analysis was based on data obtained from Americans (ages, 18-85 years) in the National Health Interview Survey (1977-2009). Sleep duration was coded as either very short sleep (VSS) (≤5 hours), short sleep (SS) (5-6 hours), or long sleep (>8 hours), referenced to 7-8-hour sleepers. Overweight was defined as body mass index (BMI) ≥25.0 and ≤29.9 kg/m^2 and obesity, BMI ≥30 kg/m^2, referenced to normal weight (BMI = 18.5-24.9 kg/m^2).
Results: Multivariate-adjusted regression analyses indicated that, among whites, VSS was associated with a 10% increased likelihood of being overweight and 51% increased likelihood of being obese, relative to 7-8-hour sleepers. Short sleep was associated with a 13% increased likelihood of being overweight and 45% increased likelihood of being obese. Long sleep was associated with 21% increased likelihood of being obese. Among blacks, VSS was associated with a 76% increased likelihood of being overweight and 81% increased likelihood of being obese. Short sleep was associated with a 16% increased likelihood of being overweight and 32% increased likelihood of being obese. As for the white stratum, long sleep was associated with a 25% increased likelihood of being obese.
Conclusion: Our investigation demonstrates strong linkages between inadequate sleep and overweight/obesity among black and white Americans. Although it cannot be said that insufficient sleep causes overweight/obesity, individuals of the black race/ethnicity sleeping ≤5 hours may be unequally burdened by sleep-related overweight/obesity.
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Introduction

The notion that inadequate sleep (short sleep [SS] or long sleep [LS]) is a sufficient cause for overweight/obesity has been the subject of much controversy.[1-8] This controversy is spurred by mixed epidemiologic evidence, with cross-sectional and longitudinal studies showing independent associations of inadequate sleep with overweight/obesity,[9-17] whereas others seem to indicate no significant associations.[11,18-21] Plausibly, differences in study design, sampling techniques, and definitional criteria for exposure and outcome variables are the reasons for observed discrepancies. The case for causal associations seems stronger when considering experimental sleep curtailment evidence.[22-24,13,25,26] However, subgroup analyses potentially revealing important clues as to which populations may be at greatest risk could not be rigorously performed in such studies because of inherently small sample sizes.

Evidence from large-scale controlled trials delineating causal links of inadequate sleep to overweight/obesity is not yet available. Although awaiting such evidence, it is important to address the concern that varying racial/ethnic strata in the US population may be differentially affected. Individuals of the black, relative to the white race/ethnicity, may be at greater overweight/obesity risk burden[27] conferred by inadequate sleep.[28,29] Addressing this concern is all the more important from a health equity standpoint, if indeed causality is demonstrated. Interventions aiming at reducing cardiovascular morbidity and mortality, which are significantly higher among blacks,[30-32]

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would of necessity target both inadequate sleep and overweight/obesity as modifiable risk factors.

The National Health Interview Survey (NHIS), a surveillance study of the health of the US population, provides a unique data set to ascertain the strength of linkages between inadequate sleep, defined as very short (<5 hours), short (5-6 hours), or long (>8 hours) sleep, and overweight/obesity. Specifically, we ascertained whether inadequate sleep places unequal burden on individuals of the black race/ethnicity, relative to their white counterparts, by examining its influence on body mass index (BMI), a widely used cardiometabolic risk marker. These stratified analyses are anchored by converging evidence that prevalence estimates of both inadequate sleep and overweight/obesity are alarmingly greater among blacks.

Materials and methods

The NHIS is an ongoing, cross-sectional, in-person household interview survey conducted annually by Centers for Disease Control and Prevention's National Center for Health Statistics. The NHIS uses a multistage area probability design, sampling noninstitutionalized representatives of US civilian population. Probability samples of the adult population of all 50 states and the District of Columbia were obtained.[33]

During face-to-face interviews, respondents provided sociodemographic data, health risks, and professionally diagnosed chronic conditions. Participants estimated habitual sleep duration (using full-hour increments) by responding to the following question: "On average, how many hours of sleep do you get in a 24-hour period?" Sleep duration was coded as either very SS (VSS) (≤5 hours), SS (5-6 hours), or LS (>8 hours), referenced to 7-8 hours as healthy sleep over a 24-hour period.[34] These cutoff points showed significant associations with health risks.[35,36] Body mass index, obtained by computing the ratio of self-reported weight and height, was coded as overweight (BMI = 25-29.9 kg/m^2) and obesity (≥30 kg/m^2), referenced to normal weight (BMI = 18.5-24.9 kg/m^2). Participants rated their mood within the last 30 days based on the K6 scaling system[37]; a score ≥13 indicated emotional distress. The K6 is a widely used scale that asks participants how often they experienced symptoms of psychological distress (eg, "so depressed that nothing could cheer you up"). Participants were asked how often they do light or moderate or vigorous physical activity. If participants reported either moderate activity or vigorous or both, they were classified as having engaged in physical activity (defined as ≥150 minutes/wk of moderate physical activity or ≥75 minutes/wk of vigorous activity).

Statistical analysis

Analyses were based on NHIS data obtained from 1977 to 2009. Because the NHIS data set includes data from different samples using a multistage area probability sampling design, all analyses used Centers for Disease Control and Prevention–provided weights. These weights represent a product of weights for corresponding units computed in each of the sampling stages.

Because the study hypothesis focused on black and white respondents, data from other race/ethnic strata were excluded; we should also note that cells from other ethnic groups were too small to support

Table 1
Characteristics of white participants in the NHIS study (1977-2009).

Characteristics	1977	1983	1985	1990	2004	2005	2006	2007	2008	2009
n	16,429	8576	23,756	29,028	19,357	19,510	14,089	13,720	12,814	16,281
Sex, female (%)	54.2	55.8	51.3	51.2	49.9	49.9	49.5	49.3	49.5	49.8
Age, y (mean ± SD)	42 ± 15	40 ± 15	40 ± 17	41 ± 17	42 ± 17	42 ± 17	42 ± 17	43 ± 18	43 ± 18	43 ± 19
Education, ≥ HS (%)	73.0	78.6	81.2	83.5	88.1	88.3	87.7	88.7	88.5	88.8
Marital status										
Married	74.5	69.6	69.5	69.6	62.1	61.8	60.9	59.9	59.3	57.9
Widowed, divorced, & separated	12.3	13.0	11.7	12.6	15.2	15.3	15.7	15.5	16.1	16.4
Single	13.2	17.4	18.8	17.8	22.7	22.9	23.4	24.6	24.6	25.7
Total family income, ≥$35K (%)	–	23.7	32.0	48.3	66.6	67.8	67.9	71.5	72.9	72.5
Poverty status, below (%)	–	6.6	8.8	7.3	9.1	9.0	10.2	9.5	10.3	10.8
Ever smoked, yes (%)	58.8	56.3	56.5	52.5	44.2	44.3	44.0	43.7	44.2	44.6
Alcohol consumption										
Never drinkers	–	–	–	13.0	19.6	19.0	19.6	18.3	16.3	15.3
Former drinkers	–	–	–	9.0	13.2	12.8	12.9	13.1	12.4	13.1
Current drinkers	–	–	–	78.0	67.2	68.2	67.5	68.6	71.2	71.5
BMI (mean ± SD)	24.3 ± 4.3	24.4 ± 4.5	24.6 ± 5.1	25.0 ± 5.1	26.6 ± 5.6	26.8 ± 5.7	27.1 ± 6.4	27.0 ± 6.3	27.3 ± 6.4	27.3 ± 6.8
Obesity	9.1	10.3	10.8	12.9	22.9	23.9	25.7	25.5	26.8	26.8
Physical activity, yes (%)	–	–	–	–	10.9	11.4	11.2	11.3	11.5	12.5
Emotional stress, yes (%)	–	–	–	–	3.3	3.0	3.1	2.7	3.6	3.5
Comorbid conditions:										
Diabetes	–	3.4	–	–	5.9	6.5	6.6	6.2	7.1	7.9
Hypertension	–	20.7	21.4	19.9	20.3	20.4	22.3	22.0	23.9	23.4
Cancer	–	3.2	–	–	5.5	6.1	5.8	6.1	6.6	6.8
Coronary heart disease	–	1.8	–	–	2.7	3.1	2.9	2.9	2.7	3.2
Heart attack (MI)	–	–	–	–	2.2	2.4	2.3	2.1	2.5	2.3
Stroke	–	0.9	1.2	1.2	1.5	1.2	1.4	1.5	1.8	1.6
Kidney disease	–	–	–	–	1.2	1.2	1.1	1.0	1.2	1.4
Sleep measures:										
Hours of sleep (mean ± SD)	7.4 ± 1.2	7.3 ± 1.2	7.4 ± 1.4	7.3 ± 1.4	7.1 ± 1.4	7.1 ± 1.5	7.1 ± 1.3	7.1 ± 1.4	7.1 ± 1.5	7.1 ± 1.7
Categories of sleep quantity										
VSS	1.5	1.7	1.1	1.4	2.0	2.1	2.1	1.8	2.3	2.3
SS	19.3	20.1	20.2	22.3	26.0	26.0	26.2	24.7	25.6	25.4
Normal sleep	68.0	69.0	68.7	68.2	64.9	64.9	64.9	66.9	64.9	64.5
LS	11.2	9.1	10.0	8.1	7.0	7.0	6.8	6.6	7.2	7.8

Abbreviation: HS, high school; MI, myocardial infarction.
Legend: Note that several health factors were not collected before 2004.

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