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Independent and joint associations of race/ethnicity and educational attainment with sleep-related symptoms in a population-based US sample

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ABSTRACT

Objective. Prior studies have documented disparities in short and long sleep duration, excessive daytime sleepiness, and insomnia by educational attainment and race/ethnicity separately. We examined both independent and interactive effects of these factors with a broader range of sleep indicators in a racially/ethnically diverse sample.

Methods. We analyzed 2012 National Health Interview Survey data from 33,865 adults aged ≥18 years. Sleep-related symptomatology included short sleep duration (≤6 h), long sleep duration (≥9 h), fatigue >3 days, excessive daytime sleepiness, and insomnia. Bivariate analyses with chi-square tests and log-linear regression were performed.

Results. The overall age-adjusted prevalence was 29.1% for short sleep duration, 8.5% for long sleep duration, 15.1% for fatigue, 12.6% for excessive daytime sleepiness, and 18.8% for insomnia. Educational attainment and race/ethnicity were independently related to the five sleep-related symptoms. Among Whites, the likelihood of most sleep indicators increased as educational attainment decreased; relationships varied for the other racial/ethnic groups. For short sleep duration, the educational attainment-by-race/ethnicity interaction effect was significant for African Americans ($p < 0.0001$), Hispanics ($p < 0.0001$), and Asians ($p = 0.0233$) compared to Whites. For long sleep duration, the interaction was significant for Hispanics only ($p = 0.0003$).

Conclusions. Our results demonstrate the importance of examining both educational attainment and race/ethnicity simultaneously to more fully understand disparities in sleep health. Increased understanding of the mechanisms linking sociodemographic factors to sleep health is needed to determine whether policies and programs to increase educational attainment may also reduce these disparities within an increasingly diverse population.

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Introduction

Health disparities often reflect differences in socioeconomic status (SES), race/ethnicity, gender, and foreign-born status (Berkman and Kawachi, 2000). In the United States, most health behaviors tend to follow an SES gradient, where unhealthy behaviors are more prevalent among lower SES and some racial/ethnic groups (Williams and Collins, 1995). Furthermore, racial/ethnic differences in health behaviors are often linked to inequalities in socioeconomic resources (Williams et al., 1994). Individuals of various social statuses lead very different lifestyles and often live, play, work, and learn in vastly different social environments (Berkman and Kawachi, 2000; Williams and Collins, 1995).

In the United States, increasing the proportion of adults who obtain sufficient sleep remains a Healthy People 2020 national objective for sleep health. Growing evidence demonstrates that sleep is as fundamental to health as diet and physical activity (Institute of Medicine, 2006; Perry et al., 2013). Hundreds of billions of dollars are spent each year in direct costs associated with insufficient sleep for doctor visits, hospital services, prescriptions, and over-the-counter medications (Institute of Medicine, 2006). Cost estimates for insomnia alone range from $30 billion to $107.5 billion (Institute of Medicine, 2006; Stoller, 1994; Walsh and Engelhardt, 1999). Furthermore, the number of office visits for which any sleep related diagnosis was recorded increased by 266% from 1999–2010 (Ford et al., 2014). Furthermore, in prior epidemiologic studies, researchers have observed a relationship between sleep duration and chronic conditions such as anxiety, obesity, diabetes, depression, heart disease, and hypertension and a U-shaped relation between sleep duration and mortality, suggesting that short and long sleep duration are both unfavorable (Cappuccio et al., 2011; Chapman et al., 2013b; Grandner et al., 2010a; Liu et al., 2013a,b).

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Prior studies have also documented disparities in sleep indicators by race/ethnicity and SES factors (Adenekan et al., 2013; Baron et al., 2010; Chapman et al., 2013a; Grandner et al., 2010b, 2013; Jean-Louis et al., 2008; Liu et al., 2014; Nunes et al., 2008; Patel et al., 2010; Stamatakis et al., 2007; Tomfohr et al., 2010). For the most part, these prior studies examining the effects of race/ethnicity and SES on sleep-related symptoms have examined these two factors independently and often only included three or fewer racial/ethnic groups (Baron et al., 2010; Grandner et al., 2010b, 2013; Jean-Louis et al., 2008; Nunes et al., 2008; Tomfohr et al., 2010). In general, lower social status has been associated with more sleep-related symptoms. Mixed results, however, have been observed. One factor that could account for the conflicting findings is the multidimensional nature of adverse sleep-related symptoms. For example, according to recent meta-analyses, African Americans have shorter, less efficient sleep but fewer insomnia symptoms than do Whites (Ruiter et al., 2010, 2011). Furthermore, findings from the 2005 National Health Interview Survey (NHIS) indicated that African Americans were more likely to report short and long sleep duration than Whites while findings from the 2006 Behavioral Risk Factor Surveillance System indicated that Whites and people with less education reported more sleep complaints (Grandner et al., 2010b). Thus, it remains unclear whether differences in sleep-related symptoms are best understood as effects of race/ethnicity, SES, or some interaction of the two.

Using data from the 2012 NHIS, we examined the independent and joint associations of race/ethnicity and educational attainment with the prevalence of five separate adverse sleep-related symptoms, namely short sleep duration, long sleep duration, fatigue, excessive daytime sleepiness, and insomnia in a large, nationally representative sample of US adults. One major step towards increasing the proportion of adults who get sufficient sleep is the lessening of existing disparities. Therefore, a better understanding of how SES and race/ethnicity are associated with sleep-related symptoms is critical for improving sleep health. The prevalence of these adverse sleep-related symptoms may be reduced by identifying high-risk groups and offering specific preventive measures.

Methods

We examined cross-sectional data from the 2012 NHIS, a nationally representative household interview survey of the noninstitutionalized US population. Participants were selected using multistage probability sampling. Sampling weights were constructed based on probabilities of selection with adjustments for nonresponse and post-stratification. We used publicly available 2012 NHIS data for these analyses. Our analytic sample included data on 33,865 adults aged ≥18 years.

Educational attainment, which was based on the highest level of school completed or the highest degree received, was used as an indicator of SES. Although a number of indicators of SES (e.g. educational attainment, occupation, income, wealth) can be used with various implications, educational attainment was used in the present study because it is the most stable indicator of SES (Adler et al., 1994; Berkman and Kawachi, 2000). For descriptive statistics, we categorized educational attainment in years as less than high school, graduated high school or completed the general educational development (GED) certificate, and more than high school. For inferential statistics, educational attainment was examined continuously as years of completed schooling.

During the course of the in-person interview, participants self-identified their race/ethnicity. Participants were asked, "What race or races do you consider yourself to be?" Participants were also asked about their national origin or family ancestry. In this analysis, participants are categorized as one of five different racial/ethnic categories: non-Hispanic White, Hispanic, non-Hispanic Black or African American, Asian, and other race/ethnicity. Participants may have specified other specific racial group. Additionally, the other race/ethnicity category includes non-Hispanic American Indians and Alaska Natives and individuals of multiple races. Participant characteristics also included age groups (18–44, 45–54, 55–64, or ≥65 years), gender (men or women), and foreign-born status (US-born or foreign-born).

The following five sleep health indicators were examined separately as outcome variables: short sleep duration; long sleep duration; fatigue; excessive daytime sleepiness; and insomnia. Each respondent was asked about their usual sleep duration during a 24-hour period. Short sleep duration was defined as ≤6 h of sleep in an average 24-hour period and long sleep duration was defined as ≥9 h of sleep in an average 24-hour period because the National Institutes of Health recommends 7–8 h of sleep per day for healthy adults (http://www.nhlbi.nih.gov/health/health-topics/topics/sdd/howmuch). Fatigue was measured as a response to the question "During the past 12 months, have you had fatigue or lack of energy more than 3 days?" Excessive daytime sleepiness was measured as a response to the question "During the past 12 months, have you regularly had excessive sleepiness during the day?" Insomnia was measured as a response to the question "During the past 12 months, have you regularly had insomnia or trouble sleeping?" Although many of the sleep health indicators examined here are related, a composite indicator was not created because a unidimensional scale is unlikely to capture the multidimensional nature of adverse sleep-related symptoms as clearly as separate indicators.

We utilized SAS (SAS Institute, Cary, NC) and SAS-callable SUDAAN version 11.0 (Research Triangle Institute, Research Triangle Park, North Carolina) to analyze the data. Descriptive statistics included the examination of selected categorical characteristics and differences in these characteristics by race/ethnicity using Chi-square tests. The prevalences of the five sleep-related indicators by educational attainment within the five racial/ethnic groups were estimated and age-standardized to the 2000 United States projected population using four age groups. Orthogonal polynomial contrasts were used to test for significant linear trends. Differences and contrasts were considered significant at $p < 0.05$.

To examine the associations of race/ethnicity and educational attainment with the prevalences of the five sleep-related indicators, we fitted two sets of log-linear regression models for each of the indicators separately. The main effects models present the betas for the independent associations of race/ethnicity and educational attainment. The interaction models present the betas for the joint associations of race/ethnicity and educational attainment. That is, we examined the race/ethnicity by educational attainment statistical interaction with the prevalences of the five sleep-related indicators. Age, gender, and foreign-born status were included as covariates in all adjusted regression models.

In addition, we examined independent associations of sleep duration with fatigue, excessive daytime sleepiness, and insomnia and also statistical interactions with race/ethnicity using log-linear regression models. All interactions were considered significant at $p < 0.10$ because this is a commonly accepted endpoint for statistical significance of interactions in the literature (Lu et al., 2005).

Results

The overall age-adjusted prevalence was 29.1% for short sleep duration, 8.5% for long sleep duration, 15.1% for fatigue, 12.6% for excessive daytime sleepiness, and 18.8% for insomnia. Table 1 presents the distributions of selected characteristics by race/ethnicity. Gender, age, foreign-born status, educational attainment, and all sleep-related indicators differed significantly ($p < 0.001$) by race/ethnicity.

Fig. 1 shows age-adjusted percentages for the five sleep indicators varying by race/ethnicity. Asians had the lowest age-adjusted prevalence for four of five indicators. Short sleep duration was the most reported sleep-related indicator. Fig. 2 shows age-adjusted percentages for the five sleep indicators by educational attainment. Adults with less than high school education had significantly higher age-adjusted prevalences for long sleep duration, excessive daytime sleepiness, and insomnia.

Table 2 presents the age-adjusted percentages for the sleep-related indicators by educational attainment and race/ethnicity. Among Whites, the prevalences of short sleep duration, long sleep duration, fatigue, excessive daytime sleepiness, and insomnia were lower among those with higher education ($p < 0.01$). Results were less consistent among African Americans, Hispanics, Asians, and other race/ethnicity adults. The prevalence of short sleep duration was higher among African Americans with more than high school compared with African American high school graduates or those with GED certificates ($p = 0.013$). Among