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Exploring the mechanisms of the racial disparity in drowsy driving

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ABSTRACT

Objective: Drowsy driving is a significant cause of traffic accidents and fatalities. Although previous reports have shown an association between race and drowsy driving, the reasons for this disparity remain unclear.
Study design: A cross-sectional analysis of responses from 193,776 White, Black, and Hispanic adults participating in the US Behavioral Risk Factor Surveillance System from 2009 to 2012 who answered a question about drowsy driving.
Measurements: Drowsy driving was defined as self-reporting an episode of falling asleep while driving in the past 30 days. All analyses were adjusted for age, sex, and medical comorbidities. Subsequent modeling evaluated the impact of accounting for differences in health care access, alcohol consumption, risk-taking behaviors, and sleep quality on the race–drowsy driving relationship.
Results: After adjusting for age, sex, and medical comorbidities, the odds ratio (OR) for drowsy driving was 2.07 (95% confidence interval [CI] 1.69-2.53) in Blacks and 1.80 (95% CI 1.51-2.15) in Hispanics relative to Whites. Accounting for health care access, alcohol use, and risk-taking behaviors had little effect on these associations. Accounting for differences in sleep quality resulted in a modest reduction in the OR for drowsy driving in Blacks (OR = 1.55, 95% CI 1.27-1.89) but not Hispanics (OR = 1.74, 95% CI 1.45-2.08).
Conclusion: US Blacks and Hispanics have approximately twice the risk of drowsy driving compared to whites. Differences in sleep quality explained some of this disparity in Blacks but not in Hispanics. Further research to understand the root causes of these disparities is needed.

Introduction

Drowsy driving is an important cause of traffic accidents and traffic fatalities and is associated with a large financial cost. The National Highway Traffic Safety Administration estimates there are 83,000 motor vehicle accidents and 886 deaths annually in the United States at least in part attributable to *drowsy driving*, defined as driving while "drowsy, sleepy, asleep, or fatigued."[1] However, because of underreporting, the prevalence is almost certainly greater, with credible estimates as high as 328,000 crashes and 6400 deaths annually.[2] Overall, sleepiness is a factor in 2.2%-19% of crashes resulting in a fatality or hospitalization.[1,3–5] The economic burden is high; analyses suggest that drowsy driving–related crashes resulted in total costs of $15.9 billion in the United States in the year 2000.[6]

There is a significant racial disparity in drowsy driving–related crashes. Compared to whites, racial minorities in the United States are more than twice as likely to be in an accident caused by sleepiness.[7] Blacks and Hispanics also have a higher prevalence of falling asleep while driving than Whites. Previous analyses of data from the Behavioral Risk Factor Surveillance System (BRFSS) have reported an age-adjusted prevalence of falling asleep while driving in the past 30 days of 3.2% in Whites, 6.1% in Blacks, and 5.9% in Hispanics.[8] This analysis was limited to only 2009 and 2010 and did not explore potential causes of the disparities.

The determinants of the drowsy driving disparity remain poorly described, although several mechanisms have been proposed.[9] There is evidence that both daytime sleepiness and short sleep duration are strongly associated with drowsy driving in the general population.[3,10–12] US Blacks, in particular, tend to report more daytime sleepiness than US Whites, and both Blacks and Hispanics

Abbreviations: BMI, body mass index; BRFSS, Behavioral Risk Factor Surveillance System; CDC, Centers for Disease Control and Prevention; OSA, obstructive sleep apnea.

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have increased prevalence of short sleep duration.[13–18] These disparities in sleep health may be additionally compounded by reduced access to health care, which is more likely to be reported by Blacks and Hispanics compared to Whites.[19,20] Without regular access to medical care, signs and symptoms of sleep disorders such as sleep apnea that are known contributors to drowsy driving risk[21] may not be evaluated, delaying diagnosis and treatment. Reduced access to medical care may also lead to fewer opportunities to receive counseling from a health care professional on healthy sleep habits or to be advised against drowsy driving. Differences in alcohol use may be another mechanism contributing to drowsy driving disparities, as alcohol acts synergistically with sleepiness via psychomotor depressant effect to increase the risk of falling asleep while driving and also exacerbates preexisting sleep disorders in afflicted individuals.[22–25] Finally, differences in risk-taking behaviors may be a potential explanation for disparities in drowsy driving. Persons with higher risk tolerance or lower perception of the risk of drowsy driving are likely more willing to drive despite overwhelming fatigue.[26,27]

We sought to better understand the association between race and prevalence of drowsy driving in a nationally-representative population. We hypothesized that the elevated risk for drowsy driving in US minority populations would be explained, at least in part, by differences in access to health care, alcohol use, risk-taking behavior, and sleep characteristics.

Participants and methods

Study population

The BRFSS is an annual telephone survey of US adults conducted by the Centers for Disease Control and Prevention (CDC) and administered by the states. Potential participants are selected by random dialing using stratified sampling of landline phone numbers. In addition, since 2011, cellular phone numbers have been included in sampling. After a standardized set of questions asked of all respondents, states can use any of several optional modules covering specific topics not included in the core component. Of interest to this investigation, states could include a module on “Inadequate Sleep” from 2009 to 2012, which asked participants about sleep behaviors and characteristics including drowsy driving. The module was asked of respondents in 23 states, the District of Columbia, and Puerto Rico. Data from Puerto Rico were excluded because this analysis focuses on minorities living in the mainland United States. Some jurisdictions chose to use the module in multiple years, for a total of 35 state-year administrations.

The study protocol was reviewed by the University of Pittsburgh Institutional Review Board and deemed exempt from human subject research review requirements due to the use of deidentified public data.

Study measures

Our primary exposure was self-reported race and ethnicity. Respondents were asked if they were of Hispanic ethnicity and then to select the best descriptor for their race. Because of the relatively low number of respondents reporting race and ethnicity other than Hispanic, non-Hispanic White, and non-Hispanic Black, we chose to limit our cohort to individuals in 1 of these 3 categories.

Our primary outcome variable was the response to the question, “During the past 30 days, have you ever nodded off or fallen asleep, even just for a brief moment, while driving?” Possible responses were “yes,” “no,” “don't drive,” “don't have a license,” or otherwise refused. Individuals who did not answer “yes” or “no” were excluded.

Covariates

Demographic data including age (categorized as 18-24, 25-34, 35-44, 45-54, 55-64, 65-74, ≥75 years), sex, height, weight, and smoking status (any current smoking vs no current smoking) were obtained by self-report. Body mass index (BMI) was calculated as the ratio of weight to the square of height and categorized as <18.5, 18.5-25.0, 25.0-30.0, 30.0-35.0, 35.0-40.0, or >40.0 kg/m^2. Self-report of physician diagnoses of coronary artery disease and diabetes was also obtained. Mental health was assessed by asking respondents how many days of the previous 30 did they feel their mental health was not good and categorized as 0, 1-7, 8-29, or 30 days. Health care access was quantified using a question on current health insurance status (insured vs uninsured) and a question on whether the respondent had avoided being seen by a doctor in the previous 12 months due to cost (yes/no). Alcohol use was quantified by asking the number of alcoholic drinks consumed per month (categorized as 0, 1-29, or ≥30 drinks per month) and whether the respondent had engaged in binge drinking (≥5 drinks per occasion for men; ≥4 drinks per occasion for women) in the past month (yes/no). Risk-taking behavior was quantified using a question on frequency of driving after having too much to drink in the past 30 days (categorized as never, 1, or ≥2 occasions) and a question on frequency of using seatbelts (categorized as always, almost always, or less than almost always). The risk-taking behavior assessment questions were both available only in 2010 and 2012, comprising 13 of the 35 state-year administrations. Four questions that addressed sleep characteristics and symptoms were used as an assessment of sleep quality: the number of days in the past 30 respondents had found themselves unintentionally falling asleep during the day (categorized as 0, 1-6, or ≥7 days), the number of days in the past 30 that they did not feel they got enough sleep (categorized as 0, 1-6, or ≥7 days), the average amount of sleep they typically get per day (categorized as <5, 5, 6, 7, 8, or ≥9 hours), and whether they snore (yes/no).

Statistical analyses

Preliminary analyses stratifying data by state and year did not show significant interaction by state or by year on the relationship between race and drowsy driving. As a result, data across states and years were combined for analytic purposes. All analyses were weighted to account for the complex survey design of the BRFSS using sampling weights provided by the CDC.[28] BRFSS weights are intended to account for nonresponse bias in certain difficult-to-reach or undersurveyed populations to generalize survey responses to that state's entire population. All reported percentages and other analyses use sampling weights to reflect results for the entire population.

Baseline characteristics in racial groups and among those reporting drowsy driving or not were compared using analysis of variance or χ^2 tests. Multivariable logistic regression was used to assess the association between race and drowsy driving after adjustment for potential mediators using a series of 6 models. The baseline model included state, year, age, sex, coronary artery disease, diabetes, BMI, mental health, and smoking as covariates. Model 2 additionally included measures of access to health care (health insurance status and whether cost had precluded the respondent from seeing a physician). Model 3 added measures of alcohol use (drinks per day and binge drinking) to the baseline model. Model 4 added measures of risk-taking behaviors (seatbelt use and drinking and driving) to the baseline model. Analyses for this model were restricted to only the years 2010 and 2012 because data were not available for 2009 and 2011. Model 5 added measures of sleep quality (daytime sleepiness, insufficient sleep, sleep duration, and snoring) to the baseline model. Two fully-adjusted models were generated: one that included

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