# RELATIONSHIP BETWEEN ALCOHOL CONSUMPTION AND SLEEPING DISORDER AMONGST BLACKS (U.S.A)

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# ABSTRACT

## Study Objectives

To review evidence of association between alcohol consumption and sleeping disorder amongst Blacks

## Design

In this cross-sectional study, data on Alcohol use and Sleep disorder was derived from the 2017-2018 NHANES datasets.

## Measurements and Results

Only 1048 participants met the inclusion criteria and were included. Several statistical analyses were conducted on the datasets derived from NHANES, these analyses include univariate, chi-square, bivariate and multivariate analyses. The relationship between alcohol use and sleeping disorder amongst blacks was tested and analyzed. The result shows a statistically significant association between sleeping disorders and alcohol consumption amongst the black population.

## Discussion

The relationship between alcohol use disorders and sleep disorders remains understudied, but there is a relationship between sleep problems and alcohol-consuming individuals. Perhaps longitudinal studies could disentangle whether sleep disturbance is a non-causal indicator of an underlying process that predisposes individuals to affective disorders and/or alcoholism, or whether insomnia has a causal role in the development of these disorders. At present, we can only say that in some patients, alcohol use and sleep disorders co-exist

**Keywords:** sleeping disorders, alcohol consumption.

**Chapter One: Introduction**

**Background of sleep disorder**

The consequences of sleep loss and sleep disorders are far from benign with the most visible consequences being errors in judgment that contribute to disastrous occurrences such as accidents. The less visible consequences of sleep loss and sleep disorders are far more prevalent. They take a toll on nearly every indicator of public health including mortality, morbidity, performance, accidents, and injuries, functioning and quality of life, family wellbeing, and health care utilization. Some of these public health consequences such as car crashes occur within the hours or minutes of the sleep disorder and are relatively easy to associate with sleep problems. However, other consequences such as obesity may take months and years of chronic sleep problems (Walsh et al., 2005).

According to the International Classification of Sleep Disorders, there are around 90 sleep disorders. However, most sleep disorders are associated with symptoms such as excessive daytime sleepiness, difficulties in initiating or keeping sleep, or other abnormal events such as snoring in sleep (Colten & Altevogt, 2006).

Sleeping disorder is a common complaint in medical settings. Inadequate sleep is estimated to affect about one in five adults (Krueger & Friedman, 2009). It is estimated that 10 million people consult health care practitioners for sleep disorders (Stein & Friedmann, 2005).

 In addition to causing or worsening somatic symptoms that contribute to the decline of the quality of life, insomnia has been associated with subsequent morbidity and mortality. Symptoms of insomnia such as short sleep and disturbed sleep have been associated with an increased risk

of a wide range of health conditions such as hypertension as well as all-cause mortality (Jackson et al., 2018; Britton, Fat & Neligan, 2020).

Sleeping disorder is a common complaint in medical settings. For example, in the Medical Outcomes Study, 16% of persons reported severe insomnia and 34% reported mild insomnia over the prior 4 weeks, and a substantial proportion of the remaining 50% of the sample reported symptoms of sleep disturbance (Katz et al.,1998). At two-year follow-up, 59% of persons with mild insomnia and 83% of patients with severe insomnia still had sleep problems. Insomnia has been associated with subsequent morbidity and mortality, in addition to causing or worsening somatic symptoms that contribute to quality-of-life decline (Katz et al.,1998).

Chronic insomnia is generally defined as difficulty initiating or maintaining sleep for a period longer than three weeks. Briefer periods of sleep disturbance are most often stress-related or due to acute illness (Kupperman et al.,1995). Insomnia frequently has a mix of contributing causes, and clinicians need to assess psychological (e.g., depression and anxiety), medical (e.g., pain and obstructive sleep apnea), and lifestyle-related (e.g., caffeine consumption) risk factors (Klink et al.,1992). Substance use problems underlie approximately 10–15% of chronic insomnia. Of adult Americans, as many as 70% drink alcohol, and half of these experience an alcohol-related problem at some point in their lives. These problems are likely to be more prevalent among the 10% of Americans who drink alcohol daily (Schuckit et al., 1988).

Historically, alcohol has been used as a sedative. However, recognition of the complexities of the relationship between alcohol and insomnia is important for several reasons. Sleep disturbance may be a sign of alcohol abuse or dependence. As such, clinical alertness to insomnia as a symptom of alcohol problems might facilitate timely intervention. Sleep disturbance is common among patients in remission from alcohol use disorders and understanding this relationship may

help clinicians assist patients in recovery. Recognition of alcohol problems among insomniacs might also lead clinicians to alter their treatment of sleep complaints, limiting, for example, their use of sedative-hypnotic agents.

Possible confounders include Age, gender, weight category, blood pressure, cholesterol level. People who are obese are more likely to report sleeping disorders than those who are not obese. There is also evidence to suggest that obesity is associated with increased daytime sleepiness and fatigue (Pearson et al.,2006). Studies show trouble sleeping, especially trouble falling asleep, may be associated with high blood pressure (Doyle,2015).

Recent findings show women have better sleep quality compared with men, with longer sleep times, shorter sleep-onset latency and higher sleep efficiency. Despite this, women have more sleep-related complaints than men (Krishnan,2006).

Insomnia is linked to high blood pressure and heart disease. Over time, poor sleep can also lead to unhealthy habits that can hurt your heart, including higher stress levels, less motivation to be physically active, and unhealthy food choices (CDC,2021).

As people age, they tend to have a harder time falling asleep and more trouble staying asleep. Older people spend more time in the lighter stages of sleep than in deep sleep. As the circadian mechanism in older people becomes less efficient, their sleep schedule is shifted forward. Even when they manage to obtain 7 or 8 h sleep, they wake up early, as they have gone to sleep quite early. The prevalence of sleep disorders is higher among older adults (Gulia et al.,2018).

**Scope of current knowledge**

Study findings have indicated that consumption of alcohol disrupts sleep quality and intensifies the feeling to consume more alcohol (Stein & Friedmann, 2005). Historically, alcohol has been used as a sedative (Colrain, Nicholas & Baker, 2014). Individuals who experience sleep

disorders such as insomnia tend to self-medicate, using alcohol to induce sleep. Findings of previous studies have indicated that prolonged or perpetual use of alcohol is counterproductive, disrupts sleep, and increases the urge to consume more alcohol (Stein & Friedmann, 2005; Hartwell et al., 2015). Consumption of alcohol among elderly people has been rising and studies have indicated that the prevalence of insomnia with age (Britton Fat & Neligan, 2020).

Obstructive Sleep Apnea (OSA) which is a spectrum of disorders that cause breathing pauses during sleep leading to sleep behaviors such as snoring during sleep. Studies have indicated that OSA is found in at least 4% of men and 2% of women in the middle-aged workforce. The prevalence of this sleep disorder increases with age. Studies have also indicated that chronic OSA causes elevation of daytime blood pressure, which is responsible for hypertension (Young et al., 2002a; Young and Javaheri, 2005).

Sleep loss is associated with increased age-specific mortality. Three large cohort population-based studies (Kripke et al., 2002; Tamakoshi & Ohno, 2004; Patel et al., 2004) depicted a u-shaped, which indicates that sleep disorders are associated with increased mortality. Epidemiological studies have suggested that this increase in mortality is associated with acute heart attacks (Colten & Altevogt, 2006).

The relationship between alcohol use and sleep is complex. Some sleep disorders associated with alcohol use include poor sleep quality, sleep disturbances, and short sleep duration. Observations have also been made where people snore after taking alcohol. (Britton et al., 2020).

Study findings have established that prolonged use of alcohol can degrade sleep quality. For instance, high alcohol consumption has been associated with a decrease in rapid-eye-movement (REM) sleep, sleep continuity, and sleep latency, which refers to the time that one falls asleep and sleep duration (Chaput et al., 2012). Studies have also indicated that the effects of alcohol

on sleep remain even after cessation of alcohol consumption particularly in terms of decreased deep sleep (Irwin et al., 2002). Previous studies have also indicated that the effect of alcohol consumption on sleep varies by race or ethnicity. In this regard, it has been established that black male alcoholics are most likely to experience severe sleep disorders such as longer sleep latency and lower deep sleep than their white counterparts are (Irwin et al., 2000).

**Gaps that the study seeks to fill**

Although many studies (Walsh et al., 2005; Colten & Altevogt, 2006; Rod et al., 2014) have been published exploring the consequences of sleep loss and sleep disorders on humans associating it with poor health conditions such as the increased risk for obesity, coronary heart disease, cancer, diabetes, and all-cause mortality and also, studies have indicated that inadequate sleep is associated with alcohol use among men (Morrison, McGee & Stanton, 1992; Wolfson and Carskadon, 1998). It is not clear from the existing cross-sectional studies whether alcohol use influences sleep disorders or vice versa. The available epidemiological data is insufficient to determine the extent to which sleep loss and sleep disorders are caused by pathology or behavioral components (Colten & Altevogt, 2006).

In most cases, sleep loss and sleep disorders have been associated with poor health outcomes such as body aches and psychological conditions such as anxiety, stress, and depression (Drake, Pillai & Roth, 2014; Einar, Rhonda & Michelle, 2019). However, studies have indicated that individuals who experience sleep disorders such as insomnia tend to self-medicate using alcohol to induce sleep (Stein & Friedmann, 2005). Therefore, it is believed that alcohol consumption can address problems of sleep disorders yet at the same time, alcohol consumption is a causal agent for sleep loss and sleep disorder (Hartwell et al., 2015). Considering the above study

findings, published studies are not conclusive on the nature of the relationship between alcohol consumption and sleep disorders.

**Purpose of the study**

This study aims to examine the relationship between alcohol consumption and sleep disorders. Therefore, recognition of the complexities of the relationship between alcohol and insomnia is essential for several reasons. The relationship between alcohol use disorders and sleep disorders remains understudied, but studies have pointed to the existence of a relationship between alcohol consumption and sleep problems. Perhaps longitudinal studies could disentangle whether sleep disturbance is a non-causal indicator of an underlying process that predisposes individuals to affective disorders and/or alcoholism, or whether insomnia has a causal role in the development of these disorders. At present, we can only say that in some patients, alcohol use and sleep disorders co-exist.

**Chapter Two: Methods**

**Study Population**

In NHANES 2017-2018 dataset, 16,211 persons were selected from 30 different locations. Of those selected, 9,254 completed the interview. Participating in NHANES was an invitation-only opportunity. The participants were chosen randomly using a statistical process from the U.S. census database. The age of participants was 18 years and above and the study included both males and females. Only the Black race was considered for this study. All observations in the database were being included. Records with missing data on key variables recorded with "don't know" and "refused" were excluded from the data used for the study. Our final analytic sample was 1,048.

**Interview Setting and Mode of Administration**

Trained interviewers using the computer-Assisted Personal Interview (CAPI) system collected family and personal demographics of the participants online. The respondents were allowed to select their preferred language in the interview (English or Spanish) or an interpreter was involved in the event the respondents could not subscribe to any of these languages. Hand cards showing response choices or information that survey participants needed to answer were used for some questions. The hand cards were printed in English, Spanish, Mandarin, Chinese (both traditional and simplified), Korean, and Vietnamese. The interviewer directed the respondents to the appropriate hand card during the interview. When necessary, the interviewer further assisted the respondent by reading the response choices listed on the hand cards.

**Quality Assurance and Quality Control**

The CAPI system is programmed with built-in consistency checks to reduce data entry errors. CAPI also uses online help screens to assist interviewers in defining key terms used in the questionnaire. After collection, the NHANES field office staff reviewed interview questions for accuracy and completeness of the selected items. The interviewers were required to record interviews periodically and NHANES staff and interviewers reviewed the interviews.

**Data Processing and Editing**

NHANES 2017-2018 dataset is based on a complex, multi-stage probability sample design. The participating sample can be extrapolated to the entire population by the sample weight variables. The sample weights incorporate the differential probabilities of selection and include adjustments for non-coverage and non-response. The sample weight is used to produce correct population

estimates of prevalence and associated variances because each sample person do not have the same probability of selection. Several types of sample weights are provided by the NHANES 2017-2018 to produce correct population estimates. The strata and PSU pairings from the sample design must be considered. These pairings were used to estimate variances and test for statistical significance.

Frequency counts were checked, "skip" patterns were verified, and the reasonableness of question responses was reviewed. Edits were made to some variables to ensure the completeness, consistency, and analytic usefulness of the data. Edits were also made, when necessary, to address data disclosure concerns.

**Instrumentation**

The questions analyzed in this study were selected from NHANHES 2017-2018 questionnaires measuring key variables involved in this study. These questionnaires were compressed to form five key parts. The first comprises the demographic details, which contain information about the gender, age, and race of participants. The second part includes the weight history of the participants. The third part of the questionnaire comprises blood pressure & cholesterol levels, which entails measurements of blood pressure, and cholesterol level of each participant. The fourth part comprises the Alcohol use behaviors and the fifth part of the questionnaire consist of is the sleeping disorders measuring key sleeping variables including Snorting, Snoring, Sleeping trouble.

 **Measurement and manipulation of variables**

Dependent/Outcome variable: Sleeping disorder (defined as snore or stopped breathing, snore, or had trouble sleeping)

Independent Variable: Alcohol use (Ever had a drink of any kind of alcohol)

Possible confounders: Age, gender, weight category, blood pressure, cholesterol level

The CLASS statement was used instead of dummy variables for the reference category. For manipulation of variable codes, categories "missing", "refused", and "don't" know were removed. For the sleeping disorder category, snorting, sleeping troubles, and snoring would be merged (participants with "Yes" on snoring or snorting or sleeping troubles would be regarded as having the Sleeping disorder, others would be regarded as "No". Only the Black race category was included.

**Data Analysis**

The SAS v9.3 software was used for data analysis. The data set was imported and cleaned to remove "missing", "don't know", and "refused". For univariate analysis, n (%) were reported for categorical variables, while means, minimum and maximum would be recorded for continuous variables.

The NHANES dataset has five categories for all variables, and these were merged into two categories. The analysis included cross-tabulation of the relationship of sleeping disorder and alcohol, gender, high blood pressure, high cholesterol level. Bivariate logistic regression analysis was conducted to examine the relationship between the independent variable (alcohol) and the outcome (sleeping disorder). Multivariate logistic regression analysis was performed to adjust for potential confounders like age, gender, high blood pressure, high cholesterol level, and weight. The 2-year sample weights (WTINT2YR, WTMEC2YR) were used for all analyses.

**Results**

In table 1 and 2, we present the sociodemographic characteristics of the study population. Out of the 1048 participants whose responses were used in the study, 505 (46.1%)were male, while 543 (53.9%)were female. The study sample was age-representative, as it comprised of both young, middle-aged, and old participants. A majority of the participants in the study were middle-aged with a mean of 46 years. The study also involved aged participants with the oldest participant being 80 years. The study also incorporated young people with a minimum of 18 years.

Majority of the participants has consumed alcohol at a point in their lifetime (90%) while 10% have not. About 73.4% snore while sleeping while 26% do not snore. Participants that snort (24.5%) are lesser than participants that do not snort (75.4%). 25.%1 of the participants have complained to their doctor about having troubles sleeping as opposed to 74.9% of participants who do not have trouble sleeping.

There are 533 participants who recorded being overweight (50.8%) and 49.1% are underweight or normal weight. 37.8% of the participants have high blood pressure while 62.2% has no high blood pressure. 26.2% recorded having high cholesterol while 73.8% do not have high cholesterol.

Table 3 shows the results of relationship between several variables and sleeping disorder.

72.2% of participants who take alcohol have sleeping disorder, while 17.7% of participants who consume alcohol do not have sleeping disorder. While 6.3% of participants who do not consume alcohol have sleeping disorder and this finding is statistically significant (p=0.002).

36.9% of male participants have sleeping disorder, while 9.2% of male participants do not have sleeping disorder. While 41.7% of female participants have sleeping disorder and this finding is not statistically significant (p=0.2915).

33.3% of participants who have high blood pressure all have sleeping disorder, while 4.5% of participants who have high blood pressure do not have sleeping disorder. While 6.3% of participants who do not have high blood pressure have sleeping disorder and this finding is statistically significant (p<0.001).

22.3% of participants who have high cholesterol all have sleeping disorder, while 3.8% of participants who have high cholesterol do not have sleeping disorder. While 56.2% of participants who do not have high cholesterol have sleeping disorder and this finding is statistically significant (p<0.03).

22.3% of participants who have high cholesterol all have sleeping disorder, while 3.8% of participants who have high cholesterol do not have sleeping disorder. While 56.2% of participants who do not have high cholesterol have sleeping disorder and this finding is statistically significant (p<0.03).

44.5% of participants who are overweight have sleeping disorder, while 6.3% of participants who are overweight do not have sleeping disorder. While 34.1% of participants who are underweight or have normal weight have sleeping disorder and this finding is statistically significant (p<0.03).

In Table 4, we present the results of the adjusted regression model. Compared to black people who take Alcohol, black people who do not take alcohol have 53.3% lower odds of having sleeping disorders (OR: 0.47; 95% CI: 0.28-0.77). This result indicates that there is a statistically

significant relationship between alcohol and sleeping disorders in black people with (P-value =0.003) while adjusting for possible confounders such as weight, gender, age, high blood pressure, high cholesterol.

Compared to black people who are underweight or about the right weight, black people who are overweight have 6.7% higher odds of having sleeping disorders (OR: 3.067; 95% CI: 2.036-4.619). This result indicates that there is a statistically significant relationship between body weight and sleeping disorder with (P-value <0.0001).

Compared to black males, black females have 63% lower odds of having sleeping disorders. (OR: 0.63; 95% CI: 0.48-0.84) This result indicates that there is a statistically significant relationship between gender and sleeping disorder with P-values =0.001)

For every unit increase in age (years) of a black person, the odds of having sleeping disorders increases by 1% (OR: 0.630; 95% CI: 0.99-1.02). This result indicates no statistically significant relationship between age and sleeping disorder with (P value=0.691).

Compared to black people who have high blood pressure, black people who do not have high blood pressure have 48% lower odds of having sleeping disorders. (OR: 0.480: 95% CI: 0.33-0.70) These results indicate that there is a statistically significant relationship between high blood pressure and sleeping disorder with P-value <0.0001).

Compared to black people who have high cholesterol levels, black people who do not have high cholesterol levels have 91.3% lower odds of having sleeping disorders (OR:0.913 ; 95% CI: 0.485-1.717). These results indicate that there is no statistically significant relationship between high cholesterol level and sleeping disorder with (P-value =0.7775)

**Discussion**

Generally, the findings of this study indicate that compared to black people who take alcohol, black people who do not take alcohol are less likely to experience sleep disorders. The study found the following on the influence of the confounders of age, gender, weight category, blood pressure, and cholesterol level. On gender, the study established that compared to black males, black females are less likely to experience sleep disorders. On weight category, the study found that compared to black people who are underweight or about the right weight, black people who are overweight are more likely to experience sleep disorders. On blood pressure, the study established that compared to black people who have high blood pressure, black people who do not have high blood pressure have a lower likelihood of experiencing sleeping disorders. On cholesterol level, the study found that compared to black people who have high cholesterol levels, black people who do not have high cholesterol levels have a lower tendency to experience

sleeping disorders; therefore, there is no statistically significant relationship between high cholesterol levels and sleeping disorder

The findings of this study compare in numerous ways with previous studies on the relationship between alcohol use, sleep disorders, and the confounders of age, gender, weight category, blood pressure, and cholesterol level as follows. The findings of this study that compared to black people who take alcohol, black people who do not take drink are less likely to experience sleeping disorders concur with the study's findings by Britton et al. (2020). In a cross-sectional analysis that involved older adults, Britton et al. (2020) found that drinking men (more than 21 units per week) could experience disturbed sleep than men that do not drink. This study indicated that people with hazardous drinking patterns tend to have worse sleeping profiles marked with waking up several times and waking tired. This study found that for every unit increase in Age (years) of a black person, chances of experiencing sleeping disorders increases

The finding of this study that black males are more likely to experience sleeping disorders than black females is a bold finding given that other studies such as Jackson et al. (2018) and Britton et al. (2020) have not been able to conclusively report. Their studies have not engaged incomparable research about the influence of gender in the relationship between alcohol consumption and sleep disorders. However, the same findings are implied in previous studies. For instance, in their study on alcohol's effect on insomnia, Stein & Friedmann (2005) indicated that males are 1.37 times as likely as women to use alcohol as a sleep aid are. In a study whereby the Whitehall II participants were asked for the reason for changing drinking alcohol over the past 10 years, Britton et al. (2020) found that an increase in consumption to get sleep was higher among men (6%) than women (5%). Given that people tend to use alcohol to get sleep, the studies imply that females have a lower tendency to experience sleep disorders.

The findings of this study that black people who are overweight are more likely to experience sleeping disorders than black people who are underweight or about the right weight echo many previous studies include the study by Pearson, Johnson & Nahin (2006) whose findings indicate that people with obesity are significantly more likely to experience insomnia or difficulty with sleep. Both findings concur with the findings of the study by Hargens, Kaleth, Edwards & Butner (2013) who in their 7.5 years follow-up established that obese people are more likely to experience chronic insomnia. Perla, Melissa & Elias (2014) replicate these findings in the study, which linked sleep disorders (sleep disturbance, sleep duration, sleep quality) to overweight conditions. Although these findings agree that overweight is associated with sleep disorders, the study by Perla et al. (2014) intimates a causal relationship implying that sleep disorders might cause overweight or obesity. The study findings that chance of experiencing sleeping disorders increase with age among black people concur with previous studies such as Stein & Friedmann (2005) and Britton et al. (2020) whose findings indicate that insomnia tends to increase with age. This study established that compared to black people who have high blood pressure are more likely to experience sleeping disorders than those who do not resonate with other studies that have established a causal relationship between sleep disorders and hypertension. For instance, Calhoun & Harding (2010), in their study found that sleep deprivation and insomnia are linked to an increase in incidence and prevalence of hypertension. Similar findings intimating a causal relationship between sleep disorders and hypertension were reported in the studies of Hargens et al. (2013) and Li & Shang (2021). The findings of this study that there is no statistically significant relationship between high cholesterol levels and sleeping disorders among black people concur with the findings of the study by Marlot et al., (2017). In their study, they were also unable to find supportive evidence to conclude that there is exists a statistically significant

relationship between high cholesterol (which leads to the development of dyslipidemia) and sleep disorders.

The study used the NANHES data set, which is a reputable data set for secondary data analysis. The participants in the study were randomly selected from over 30 locations. Random selection of participants eliminates the chances of bias and inclusion of participants from different locations increases the representativeness of the sample population to the entire population. The study used the CAPI system which is a built-in system to ensure data consistency and reduce data entry errors that may change the findings of the study. These contribute significantly to the credibility and generalizability of the findings of the study to a larger population.

Computer administered surveys show fewer mistakes, blank items, and refusals as experienced in paper surveys. They allow standardization and anonymity which is important in maintaining the confidentiality and privacy of participants. However, such study designs tend to be expensive for small populations and pose software compatibility issues when using different devices. They limit participants' flexibility to give explanations to support their position denying the researcher the opportunity to understand the underlying beliefs, assumptions, and perceptions that inform a participant's position on the subject matter (Nayak & Narayan, 2019).Limitations of the study design

A cross-sectional study cannot be used to determine the cause and effect among the variables of the study, as it is difficult to establish where the outcome or exposure that came first, in some cases, the associations identified may be difficult to interpret. Cross-sectional study is not suitable for studying rare diseases or those with a short duration. It is appropriate in studying prevalent rather than incident cases and is susceptible to biases such as the responder's bias, interviewer bias, recall bias or social acceptability bias (Setia, 2016).

**Chapter Three: Conclusion and Recommendations**

Although in low or moderate doses, alcohol consumption can promote sleep, scientific studies have indicated that prolonged consumption of high volumes of alcohol will cause sleep disorders. This study has established that alcohol consumption may be associated with sleep disorders among the black community in the United States. The study has also established that other confounding factors such as age, gender, weight category, and blood pressure increase the likelihood of black men experiencing sleep disorders. However, the study could not establish a significant influence of cholesterol on sleeping disorders. Therefore, people experiencing sleeping disorders, particularly black men who have a higher tendency of using alcohol to get sleep are advised to consider reducing alcohol consumption.

The findings that sleeping disorders may be a sign of alcohol abuse or dependence have great clinical or public health implications. For instance, clinical alertness to insomnia as a symptom of alcohol problems might facilitate timely intervention. Sleeping disorder is common among patients in remission from alcohol use disorders and understanding this relationship may help

clinicians assist patients in recovery. Recognition of alcohol problems among insomniacs might also lead clinicians to alter their treatment of sleep complaints, limiting, for example, their use of sedative-hypnotic agents. Sleeplessness has been identified as one of the public health concerns in the United States. For instance, diagnoses of sleeping disorders led by insomnia, which appear to be increasing have been significantly associated with poor health outcomes costing the country hundreds of billions of dollars annually in health services, accidents, and lost productivity among other public health implications.

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