Final Report

The Impact of Sleep Patterns on Body Mass Index and Blood Pressure: Study from NHANES dataset

Background

Sleep quality has been recognized as a critical component of overall health. Insufficient or poor quality sleep (e.g., less than 6 hours of sleep, frequent awakenings) has been linked to numerous health issues, including obesity and hypertension. This study focuses on understanding how sleep patterns, including sleep duration, snoring frequency, and daytime sleepiness, relate to Body Mass Index (BMI) and blood pressure. By analyzing data from the NHANES dataset, this study aims to provide insights that could contribute to lifestyle interventions and public health strategies aimed at improving sleep cycles and managing health risks associated with poor sleep.

Methods

Data Source: Data will be extracted from the National Health and Nutrition Examination Survey (NHANES).

Study Parameters: The study focuses on adults, using data on sleep patterns (e.g., sleep duration, snoring frequency, daytime sleepiness), BMI, blood pressure, and demographic variables such as age, gender, and ethnicity. So far, below are the parameters identified from the NHANES dataset, that will be needed for this analysis:

1. **Sleep Patterns:** Sleep duration (SLD012) Usual sleep time on weekdays (SLQ300) Usual wake time on weekdays (SLQ310)Snoring frequency (SLQ030)Daytime sleepiness (SLQ120)
2. **Health Outcomes:** BMI (BMXBMI)Systolic blood pressure (BPXSY1)Diastolic blood pressure (BPXDI1)
3. **Demographic Variables:** Age (RIDAGEYR)Gender (RIAGENDR)Ethnicity (RIDRETH1)

Statistical Analysis:

Descriptive statistics will be used to summarize the key characteristics of the dataset, such as mean, median, and standard deviations for continuous variables, and proportions for categorical variables. Other analyses include:

1. **Correlation Analysis:** To evaluate the strength and direction of associations between sleep behaviors and health outcomes.

2. **Regression Models:** Multiple linear regression will be employed to analyze the relationships between sleep patterns (e.g., SLD012, SLQ030, SLQ120) and health outcomes (BMI, blood pressure), while adjusting for confounders like age and gender.
3. **Subgroup Analysis:** This will include stratification by demographic factors (e.g., age groups, gender, and ethnicity) to identify patterns within different population subgroups.

Results (Hypothetical, expected to find)

1. The study found that shorter sleep duration was associated with higher BMI, suggesting that individuals who sleep less than 6 hours on average tend to have higher body weight.
2. Frequent snoring was linked to increased systolic and diastolic blood pressure, which could indicate a connection to conditions like sleep apnea that impact cardiovascular health.
3. Individuals reporting excessive daytime sleepiness were more likely to have higher BMIs, possibly due to reduced physical activity or metabolic changes linked to poor sleep quality.
4. Demographic analyses showed that the association between sleep patterns and BMI was more pronounced in younger adults, while the link between poor sleep quality and high blood pressure was stronger in older adults. Additionally, gender differences were observed, with a slightly stronger association between poor sleep and high blood pressure in males compared to females.

Discussion & Conclusion

The study shows how important good sleep is for keeping a healthy BMI and stable blood pressure. It suggests that not getting enough sleep or having poor sleep can lead to a higher risk of obesity and hypertension. This highlights the need for ways to help people improve their sleep habits. Apps like Rise can support this by helping users track their sleep and providing tips for better sleep hygiene.

While the study offers useful insights, it's important to note that it only shows associations, not causes. To fully understand these links, future research should take a longer view, looking at changes over time.

Overall, improving sleep quality should be a priority for both individuals and healthcare providers. By addressing sleep issues, we can help prevent obesity and hypertension, leading to better health for everyone. It’s essential to promote awareness about the importance of sleep and its impact on overall well-being.

References

Patel, S. R., & Hu, F. B. (2019). Short Sleep Duration and Risk of Obesity: A Systematic Review. Obesity Reviews, 20(3), 217-224. doi:10.1111/obr.12755

Li, C., & Shang, S. (2021). Relationship between Sleep and Hypertension: Findings from the NHANES (2007–2014). International Journal of Environmental Research and Public Health, 18(15), 7867. https://doi.org/10.3390/ijerph18157867

Wu, Y., Zhai, L., & Zhang, D. (2014). Sleep duration and obesity among adults: a meta-analysis of prospective studies. Sleep medicine, 15(12), 1456–1462. https://doi.org/10.1016/j.sleep.2014.07.018

Jaiswal, S. J., Quer, G., Galarnyk, M., Steinhubl, S. R., Topol, E. J., & Owens, R. L. (2020). Association of Sleep Duration and Variability With Body Mass Index: Sleep Measurements in a Large US Population of Wearable Sensor Users. JAMA internal medicine, 180(12), 1694–1696. https://doi.org/10.1001/jamainternmed.2020.2834

Fobian, A. D., Elliott, L., & Louie, T. (2018). A Systematic Review of Sleep, Hypertension, and Cardiovascular Risk in Children and Adolescents. Current hypertension reports, 20(5), 42. https://doi.org/10.1007/s11906-018-0841-7

Guo, X., Zheng, L., Wang, J., Zhang, X., Zhang, X., Li, J., & Sun, Y. (2013). Epidemiological evidence for the link between sleep duration and high blood pressure: A systematic review and meta-analysis. *Sleep Medicine*, 14(5), 331-341. https://doi.org/10.1016/j.sleep.2012.12.001

Analysis Plan - First Draft

Background and Rationale/Unmet Need

Getting enough sleep is very important for good physical and mental health. However, many adults have sleep problems and poor sleep quality. Studies show that not getting enough sleep can lead to health issues, like higher Body Mass Index (BMI) and higher blood pressure. Poor sleep can also affect mood, cognitive function, and overall quality of life.

In today's fast paced world, many people prioritize work, social activities, and technology over sleep, leading to chronic sleep deprivation. This study aims to look at these connections using the NHANES dataset. We want to understand how sleep behaviors affect overall health and find ways to encourage better sleep habits. By identifying the links between sleep and health, we can help create targeted interventions to promote healthier lifestyles and reduce the risk of sleep-related health problems

Study Aims

Primary Study Aim

We want to study how sleep patterns (like how long people sleep, how often they snore, and how sleepy they feel during the day) relate to key health measures (BMI and blood pressure) in adults.

Secondary Study Aims

We will check if demographic factors (like age, gender, and ethnicity) affect the link between sleep behaviors and health outcomes.

We will look at how often different sleep quality indicators appear in various demographic groups.

Study Hypotheses

Primary Outcome

Shorter sleep times and poor sleep quality (like frequent snoring and feeling very sleepy during the day) are linked to higher BMI and increased blood pressure.

Secondary Outcome

The links between sleep patterns and health measures might differ based on demographic factors, with possible variations across age groups, genders, and ethnicities.

Null Hypothesis (H0)

Primary Null Hypothesis: There is no significant relationship between sleep patterns (duration, snoring frequency, and daytime sleepiness) and Body Mass Index (BMI) and blood pressure levels inadults.

Secondary Null Hypothesis: Demographic factors (age, gender, ethnicity) do not influence the relationship between sleep behaviors and health outcomes (BMI and blood pressure).

Study (Alternative) Hypotheses (H1)

Primary Study Hypothesis: Shorter sleep durations and poor sleep quality (such as frequent snoring and high levels of daytime sleepiness) are associated with higher BMI and increased blood pressure levels in adults.

Secondary Study Hypothesis: Demographic factors (age, gender, ethnicity) influence the relationship between sleep behaviors and health outcomes, leading to variations in the associations observed across different groups.

Data Extraction and Analysis Plan

Study Cohort Definitions

I**nclusion Criteria:** Adults aged 18 and older, with data on sleep patterns, BMI, and blood pressure from the NHANES dataset.

Exclusion Criteria: Participants with missing data or diagnosed sleep disorders that greatly affect sleep (like obstructive sleep apnea).

Analyses to Perform

1. **Descriptive Statistics of Baseline Parameters**

   Objective: To summarize the baseline characteristics of the study population, including BMI, blood pressure, and sleep patterns.

   Method:

   a. Calculate averages, standard deviations, and ranges for continuous variables (like BMI and blood pressure).
   b. Provide counts and percentages for categorical variables (like how often people snore and daytime sleepiness).
   c. Summarize and break down these metrics by demographic factors (age, gender, ethnicity).

2. **Statistical Analysis**
   a. ***Correlation Analysis***

      Objective: To assess the strength and direction of the relationship between sleep variables and health outcomes (BMI and blood pressure).

      Method: Use correlation coefficients (e.g., Pearson or Spearman) to evaluate how closely related sleep duration, snoring frequency, and daytime sleepiness are to BMI and blood pressure levels.

   b. ***Regression Models***

      Objective: To determine the effect of sleep patterns on health outcomes while controlling for demographic factors.

      Method: Employ multiple linear regression analysis to examine the impact of sleep patterns (e.g., SLD012, SLQ030, SLQ120) on BMI and blood pressure, adjusting for potential confounding variables such as age, gender, and ethnicity.

c. ***Subgroup Analysis***

Objective: To explore how different demographic factors influence the relationships between sleep behaviors and health outcomes. This will include stratification by these demographic factors to identify patterns within different population subgroups.

Method: Include interaction terms in the regression models to investigate how demographic variables (age, gender, ethnicity) modify the observed effects of sleep patterns on BMI and blood pressure.

d. ***Analysis of Variance and t-tests***

Objective: To compare health metrics between different sleep duration groups to identify significant differences.

Method: Conduct Analysis of Variance to analyze mean differences in BMI and blood pressure between multiple groups (e.g., high vs. low sleep duration categories) and use t-tests for pairwise comparisons where applicable.