2020

Insufficient Sleep in 2020: Where Does Ohio Stand?

Daniel Masters
Wright State University - Main Campus, masters.19@wright.edu

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Dr. Amber Todd, Medical Education

Population and Public Health

Scholarship in Medicine Final Report

☒ By checking this box, I indicate that my mentor has read and reviewed my draft proposal prior to submission (I am in the May "super short course")

Abstract

Objective: To determine the impact of insufficient sleep on premature death and mental health as well as see how the levels of insufficient sleep in Ohio compare to previous years and to other states in the US. *Methods:* Data on insufficient sleep, premature death, smoking, food environment index, physical inactivity, and poor mental health days was all collected from County Health Rankings and then analyzed. *Results:* Insufficient sleep was found to be moderately correlated to years of potential life lost in a positive manner in Ohio in 2020. Insufficient sleep has risen in Ohio from 2016 (35.76%) to 2020 (37.04%). Ohio was found to have the highest level on insufficient sleep compared with select other states (37.04%), and Colorado was found to have the lowest (26.93%). Smoking was positively correlated with insufficient sleep in Ohio in 2020. Food environment index and physical inactivity were able to

predict poor mental health days, but insufficient sleep was found not to be a contributor in our model.

Key Words: insufficient sleep, smoking, Ohio, mental health, physical inactivity

Introduction

Typically, Americans should be spending about 1/3 of their life sleeping, with recommend adult sleep durations of 7-9 hours according to the National Sleep Foundation.[1] It has been found that nearly 33% of Americans report having sleep duration of 6 hours or less.[2] Insufficient sleep and too much sleep has been linked to many adverse outcomes in the literature including: obesity, diabetes, cardiovascular events, dyslipidemia, sustained inflammatory response, depression, decreased neurocognitive functioning, and suicide.[2–6] Smoking has been associated with sleep related issues in a Canadian study and is currently under investigation to further determine its effects.[7] It has not been studied in Ohio in 2020, and this is an area that should be explored further.

Cardiovascular events and metabolic disease are two of the most studied areas of adverse outcomes caused by poor sleep.[6,8–10] The associate between cardio-metabolic risk factors/outcomes and short sleep duration has been heavily supported in the literature. Large relative risks have supported the associations may show a causal relationship. There is good support for a temporal sequence of insufficient sleep preceding adverse outcomes. Studies of different populations with different end-point measures shows that the evidence is consistent across different groups.[10] Insufficient sleep is a public health crisis worthy of some v intervention from the medical community.

Insufficient sleep has been examined geographically in the United States and has demonstrated interesting trends as to which populations have more people getting inadequate sleep.[11] It has not been revisited in the last five years, and the previous studies did not focus its examination on Ohio. No recent literature has look into the trends of sleep in Ohio over the past five years to determine what trend exists. In addition, the variation of insufficient sleep across different states in the United States should be reexamined.

Adequate sleep as part of a healthy lifestyle including exercise and food has been shown to improve mental health.[12] Research continues to be performed in this area to better identify sleep's role in mental health. Sleep, exercise, and healthy eating has not been studied in Ohio in 2020 to determine their connection to mental health outcomes. This study will look into these measure as a way of predicting poor mental health days to identify if there is a relationship between these factors. Given the importance of these measure, where is Ohio currently? The lack of assessment of the state of Ohio in 2020 and the implications for public health policy made researching insufficient sleep and its outcomes of great importance.

Research Questions

Our goal in this study is to examine the current state of sleep health in Ohio and how does it compare over time and to other states in the United States. We will also identify if it can be a predictive measure of poor mental health outcomes. Our research questions are:

RQ1: How does insufficient sleep correlate with premature death in 2020 in Ohio?

RQ2: How have the levels of insufficient sleep changed in Ohio in the years 2016, 2018, and 2020?

RQ3: How does the level of insufficient sleep vary across Ohio, California, Texas, New York, Washington, and Colorado in 2020?

RQ4: How does smoking impact insufficient sleep in 2020 in Ohio?

RQ5: How do insufficient sleep, food environment index, and physical inactivity predict poor mental health days in Ohio in 2020?

Methods

Context & Data Collection

All measures and data were gathered using County Health Rankings. Insufficient sleep was defined as less than 7 hours of sleep on average per night. It is presented on a per county basis as a percentage of people who said they received less than 7 hours of sleep on average at night. Premature death was defined as years of potential life lost (YPLL) before age 75 per 100,000 in the population. YPLL is age adjusted based on the 2000 US population data. Smoking was defined as the percentage of adults who currently smoke every day or have smoked at least 100 cigarettes in their lifetime. Physical inactivity is the percentage of adults age 20 and older who did not report any leisure-time physical activity in the past month.

Food environment index is a scaled index ranging from 0 (worst) to 10 (best) and is based on two main factors: limited access to healthy foods and food insecurity. Limited access to healthy foods is an estimate of the percentage of adults who are below the federal poverty line and do not live close to a grocery store (10 miles for rural counties, 1 mile for urban counties). Food insecurity is defined as the percentage of adults who did not have a reliable source of food during the past year and is estimated using County Health Rankings model that draws data from the Community Population Survey, Bureau of Labor Statistics, and American Community

Survey. Poor mental health days are the average number of mentally unhealthy days in the past 30 days and is age-adjusted.

Insufficient sleep, poor mental health days, and smoking were collected using a random phone survey (the Behavioral Risk Factor Surveillance System) and was last collected in 2016 (insufficient sleep and smoking) and 2017 (poor mental health days). Data for 2018 and 2020 is estimated by County Health Rankings. Premature death data was collected from the National Center for Health Statistics and current estimates are based on 2016-2018 data. Food environment index was estimated using data from 2015 and 2017. Physical inactivity is estimated using 2016 data from the United States Diabetes Surveillance System. No data from County Health Ranking is excluded in our analyses.

The states chosen for the analysis were chosen to compare Ohio to states across the US and attempt to capture the diversity of the US. For example, California in the West, Texas in the South, New York in the Northeast, etc. Sample sizes for the states are the number of counties which are: Ohio = 88, California = 58, Colorado = 64, New York = 62, Texas = 254, Washington= 39.

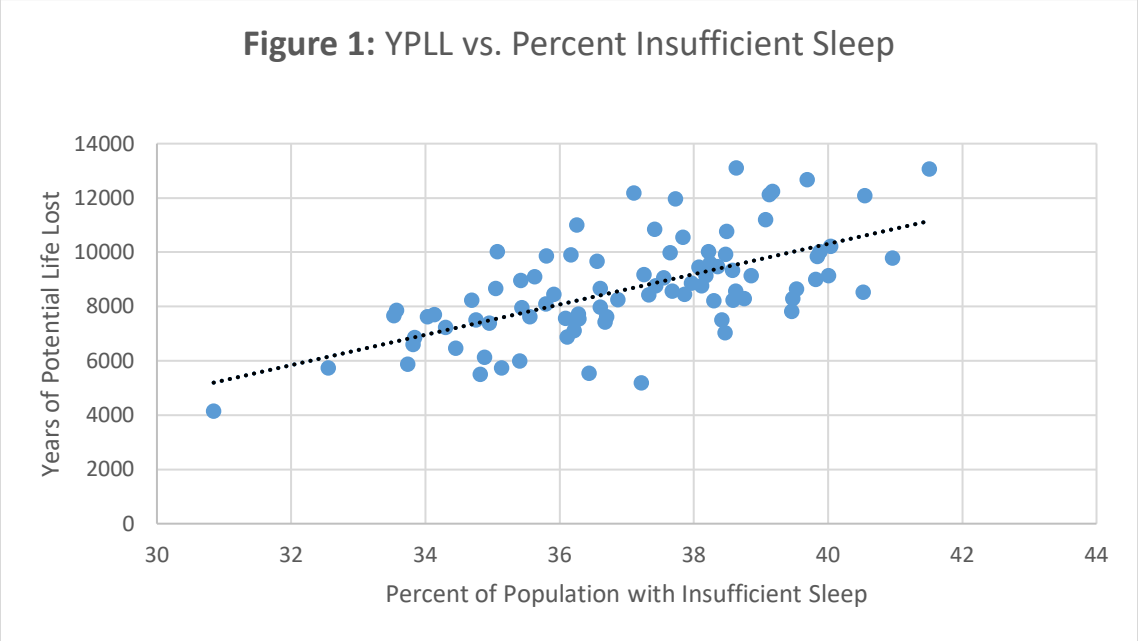
Data Analysis

The insufficient sleep and premature death metrics were correlated using a Pearson correlation analysis. Insufficient sleep in Ohio in 2016,2018, and 2020 was analyzed using an ANOVA with posthoc test. Insufficient sleep in the different selected states across the USA was analyzed using an ANOVA with posthoc test. Smoking and insufficient sleep were correlated using a Pearson correlation analysis. A stepwise linear regression was used, and the outcome was

poor mental health days. The independent variables include insufficient sleep, physical inactivity, and food environment index.

Results

When comparing premature death (YPLL) with the percent of the population of Ohio in 2020 with insufficient sleep, a Pearson correlation found a statistically significant moderate correlation ($r = .636$, $p < 0.001$). This shows that as levels of insufficient sleep rise so does the amount of premature deaths (Figure 1).



Years of Potential Life Lost (YPLL) vs. Percent Insufficient Sleep. A positive, moderate that is significant was identified ($r = .636$, $p < 0.001$).

Insufficient sleep in Ohio was compared across the years 2016, 2018, and 2020 using an ANOVA, and a significant difference was found between the years ($F_{2,261} = 11.35$, $p < .001$). Posthoc test revealed that 2016 had a slightly lower percent of insufficient sleep (35.76%) when compared to 2018 (37.04%) and 2020 (37.04%) with $p < .001$. No difference was established between 2018 and 2020 (Table 1).

Table 1: Percent of Insufficient Sleep in Ohio Across Years

Year	N	Mean	SD
2016	88	35.76%	1.96%
2018	88	37.04%	2.10%
2020	88	37.04%	2.10%

Year to year comparison of insufficient sleep levels in Ohio.

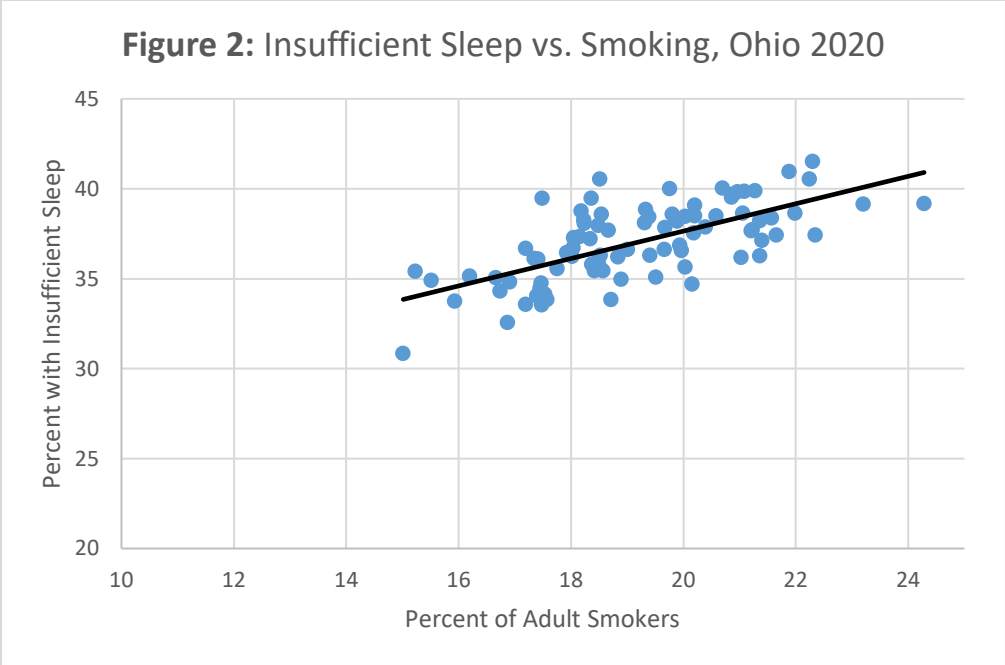
State to state analysis of insufficient sleep in 2020 with ANOVA showed a significant difference ($F_{5,559} = 200.76$, $p < .001$). Posthoc testing showed that all states displayed statistically differing means from each other (all at $p < .001$), with Ohio having the highest percent of its population with insufficient sleep (37.04%) and Colorado having the lowest percentage (26.93%). See Table 2 below.

Table 2: Percent of Insufficient Sleep Across Selected States in 2020

State	N	Mean	SD
Ohio	88	37.04%	2.10%
California	58	31.93%	2.50%
Colorado	64	26.93%	2.22%
New York	62	35.06%	2.77%
Texas	254	31.77%	1.77%
Washington	39	29.75%	2.62%

State to state comparison of percentage of population with insufficient sleep ($p < .001$ for all state comparisons).

Smoking was correlated with the percent of the population of Ohio in 2020 with insufficient sleep. A Pearson correlation found a statistically significant moderate-strong correlation ($r = .675$, $p < 0.001$). This is an indication that smoking is positively correlated with higher rates of insufficient sleep (Figure 2).



Percent of population with insufficient sleep correlated with the percent of adult smokers in Ohio in 2020 ($r = .675$, $p < .001$).

The model to predict poor mental health days in Ohio in 2020 included: insufficient sleep, food environment index, and percent of physical inactivity. A significant best fitting model was identified using a stepwise linear regression ($F_{2,85} = 73.53$, $p < .001$). The model was able to account of 79.6% of the variance in poor mental health days. Food environment index was the largest contributing factor ($B = -.260$, $t = -7.869$, $p < .001$) with percent physical inactivity also contributing ($B = .035$, $t = 6.564$, $p < .001$). Insufficient sleep did not significantly contribute in the model to poor mental health days.

Discussion

It has been well studied in the literature that insufficient sleep and even too much sleep is associated with many health consequences.[2,4,5,8] Based on our data correlating YPLL and insufficient sleep, this hold true within the state of Ohio in 2020 (See Figure 1). When comparing

Ohio year to year, an upward trend for insufficient sleep was observed. Although the increase of poor sleep was very slight, it does give the impression that Ohio overall is not positively impacting insufficient sleep on the population level in recent years. Because only the years 2016, 2018, and 2020 were chosen to be included in the study, no conclusion can be made comparing insufficient sleep in Ohio to years further in the past and what trends might be seen there (see Table 1).

In the 2020 state to state comparison, all data for the different states were found to be statistically different from each other. Ohio was found to have the highest amount of insufficient sleep and Colorado has the lowest (see Table 2). While this a multifactorial matter, this may be due to the overall culture of Colorado possibly being more focused on outdoor activities and healthy living. More investigation would have to be conducted as to why Ohio has the highest amount of people with insufficient sleep as there are likely many contributing factors. These findings appear to be consistent with the findings in Grandner's study which found that the hotspots for insufficient sleep were in West Virginia, Kentucky, and part of Ohio.[11]

The results of our study showed a positive correlation between smoking and insufficient sleep that was statistically significant (see Figure 2). This finding is supported in the literature which has shown that smoking has been associated with sleep-related issues and disorders.[7] Finally, our model to predict poor mental health days reveal the most surprising results. While as expected food environment index and physical inactivity were contributors to poor mental health days, insufficient sleep was not found to be a significant contributor to the model. The literature has suggested that sleep and mental health have great connection and sleep is even used in the diagnosis of major depressive disorder.[12] It is possible that poor mental health days is not the best variable to compare with insufficient sleep to reveal this connection. More research would

need to be performed as to what measure of mental health would better represent this previously established connection.

Based on the data found in the body of literature that already exists, it is clear that insufficient sleep leads to greater risk of adverse health outcomes. With levels of short sleep duration on the rise in Ohio, this will lead to increased morbidity and mortality due to the sequelae of poor sleep. There will be an increased health system burden due to the complications of these rising levels of insufficient sleep in the coming years and intervention at some level is needed. Investigation would be needed to identify if intervention at a population health level or at the provider level is more beneficial for catalyzing change. Ohio should investigate what some states that are showing better levels of sleep like Colorado are doing differently on a population level to encourage good sleep habits.

Conclusion

Overall from our study of insufficient sleep in Ohio in 2020, it can be seen that insufficient sleep is a continuing public health concern. Levels appear to be rising with time and Ohio has more insufficient sleep than other states. Our study has some limitations including that data was only used from 2016-2020 for comparing Ohio year to year. Also, poor mental health days is just one measure of mental health, and it may not envelope all aspects of it. This might account for why insufficient sleep was not a contributing factor. In the future, broadening the scope of variables may help us gain new insights. Also, our study focused on insufficient sleep contributing to adverse outcomes. It might be of interest to investigate what factors contribute to insufficient sleep. Our study overall has supported the greater body of literature on poor sleep and the adverse outcomes associated with it. It is a growing public health crisis and must be tackled in the clinics, schools, and homes of Ohio.

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