Insufficient Sleep in Ohio and Its Complication in Risky Behaviors

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Abstract

Background
Insufficient sleep is a major public health concern in the United States. Lack of sufficient sleep causes impaired decision making that can increase the chance of participating in risky behavior.

Methods
County Health Rankings data from Ohio in 2016 and 2022 were reviewed for percentage of insufficient sleep and risky behaviors. We identified excessive alcohol use, driving deaths due to alcohol, drug overdose mortality, and percentage of smokers as risky behaviors. Urban and rural counties were identified via HRSA.

Results:
There was a significant increase in insufficient sleep from 2016 to 2022 in Ohio. Smoking and drug overdose mortality were positively correlated with insufficient sleep, while excessive alcohol use was negatively correlated with insufficient sleep. No differences in sleep or risky behaviors were seen in urban and rural counties.

Conclusion:
This study examines the link between insufficient sleep and engagement in risky behaviors such as drug overdose, a pressing issue in Ohio, highlighting the importance of implementing screening and intervention programs to improve sleep in order to potentially reduce the likelihood of participating in such risky behaviors, with implications for both medical practitioners and patients.
Insufficient Sleep in Ohio and Its Complication in Risky Behaviors

Introduction

Getting an adequate amount of sleep can lead to better decision making, but a large percentage of Americans are not getting the sleep they need. This impaired decision making due to lack of sleep may cause individuals to be more likely to participate in risky behaviors, which we define as behaviors that increase the risk of injury or disease. While several studies have explored the link between insufficient sleep and risky behaviors, there is a lack of studies observing how insufficient sleep and risky behaviors have changed over time. Also, little is known about the differences in these variables in rural versus urban areas. Examining the link between insufficient sleep and risky behaviors is important for prevention, and possibly intervention, of behaviors such as substance abuse.

Insufficient sleep, especially among adolescents, is increasingly recognized as a major public health concern in the United States. As shown by a recent study using nationally representative longitudinal data, sleep deficiency in adolescence may be an independent risk factor for risky behaviors later in life. The study revealed that adolescents reporting chronic insufficient sleep, chronic unrestful sleep, and insomnia symptoms were at higher risk for prescription opioid misuse in adulthood, even after accounting for other known risk factors. This builds on previous cross-sectional research showing connections between insufficient sleep and substance use. As both sleep deficiency and prescription opioid misuse have sharply increased among Ohio population in recent years, investigating the impact of insufficient sleep on risky behaviors in this population represents an important next research step. Examining urban-rural differences and trends over time could provide insight into potential causes of insufficient sleep
and provide intervention targets to improve sleep health and reduce engagement in risky substance use behaviors.

Recent studies\(^3\) demonstrated more substance use in adolescents with insufficient sleeping, including marijuana, alcohol, and vaping (e-cigarettes). Moreover, the study underscored the differential impact of substance use on sleep patterns based on demographic factors such as age and gender. Younger students were found to be more influenced by marijuana use than older students, and male students were more swayed by marijuana use compared to their female counterparts.\(^3\) The document also emphasized the bidirectional relationship between substance use and sleep disturbances, suggesting a complex interplay between these factors that may contribute to adverse health outcomes in adolescence.\(^3\)

A large percentage of Americans are not getting adequate sleep. The CDC estimates that 34.4% of children, and 34.8% of adults are not getting the amount of sleep that is recommended.\(^8\) Sleep is known to be an essential function for optimal cognitive functions, and lack of sleep can lead to many neurocognitive deficits. While studying the direct effects of sleep on risk taking has been difficult, emerging studies are showing promising results. In one study, researchers found that lack of sleep diminishes the brain's responsiveness to the consequences of risky decisions.\(^4\) More concentrated evidence has shown that locally decreased sleep restoration over the right prefrontal cortex may lead to increased risk taking.\(^5\) This evidence highlights the importance of sleep in cognitive functions related to engaging in, or not engaging in, risky behaviors. Thus, this study would examine the relationship and provide valuable insights on promoting sound decision-making and mitigating risky behaviors in various aspects of life.
Research Questions

**RQ1.** How have rates of insufficient sleep changed from 2016 to 2022 in Ohio?

**RQ2(a-d).** How have the rates of risky behaviors (excessive alcohol use (a), driving deaths due to alcohol (b), drug overdose mortality (c), and percent of smokers (d)) changed in Ohio from 2016 to 2022?

**RQ3(a-d).** What is the relationship between insufficient sleep and risky behaviors (excessive alcohol use (a), driving deaths due to alcohol (b), drug overdose mortality (c), and percent of smokers (d)) in Ohio?

**RQ4.** What is the difference in insufficient sleep between urban and rural counties in Ohio in 2022?

**RQ5(a-d).** What is the difference in risky behavior (excessive alcohol use (a), driving deaths due to alcohol (b), drug overdose mortality (c), and percent of smokers (d)) between urban and rural counties in Ohio in 2022?

**RQ6.** How does insufficient sleep, unemployment, and mental distress predict the variance in excessive alcohol in Ohio in 2022?

Methods

**Context/Protocol**

For this research, we use excessive alcohol use, driving deaths due to alcohol, drug overdose mortality, percent of smokers as a measure of risky behavior. We use % insufficient sleep as our measure for insufficient sleep. The above variables were acquired through County Health Rankings 2016 and 2022 Data Set. We use List of Rural Counties And Designated Eligible Census Tracts in Metropolitan Counties from The Health Resources & Services
Administration (HRSA) to compare urban and rural counties in Ohio. We also adjusted the dataset for unemployment and frequent mental distress to account for potential factors that could impact excessive alcohol use.

Data Collection

In this study, we are looking at the Ohio population using data from the 88 counties in Ohio for all of our variables. We use data from the County Health Rankings 2016 and 2022 Data Set. Six of eighty eight Ohio counties for drug overdose mortality rate in 2022 were excluded due to missing data in that category and 14 of 88 Ohio counties in 2016 were excluded due to missing data in that category. County Health Rankings collected their data through participant self-reporting and utilized a cluster sampling approach to composite health outcome data. The data source was from the National Center for Health Statistics (NCHS).

Data Analysis

Using the County Health rankings data, we used a paired T test to determine how the rates of insufficient sleep have changed in Ohio from 2016 to 2022 (RQ1). We then used a paired t test to determine how the rates of risky behaviors (excessive alcohol use (2a), driving deaths due to alcohol (2b), drug overdose mortality (2c), and percent of smokers (2d)) have changed in Ohio from 2016 to 2022 (RQ2). We used multiple, separate Pearson/Spearman correlation tests to determine the relationship between insufficient sleep and excessive alcohol use (3a), driving deaths due to alcohol (3b), drug overdose mortality (3c), and percent of smokers in Ohio in 2022 (3d) (RQ3). We also looked at the difference in insufficient sleep in rural and urban counties by using an independent t test in Ohio in 2022 (RQ4). We then looked at the difference in risky
behaviors (excessive alcohol use (5a), driving deaths due to alcohol (5b), drug overdose mortality (5c), and percent of smokers (5d)) in rural and urban counties by using an independent t test (RQ5). Finally, we used a multiple linear regression to determine how insufficient sleep accounts for excessive alcohol use when taking into consideration unemployment and frequent physical distress in Ohio in 2022 (RQ6).

**Results**

The data showed that the percent of people in Ohio getting insufficient sleep significantly increased from 35.76% in 2016 to 40.45% in 2022 \((t = -22.99, p < .001)\) (Table 1). Paired t-test

**Table 1. Percentage of Adults with Insufficient Sleep in Ohio**

<table>
<thead>
<tr>
<th>Year</th>
<th>n</th>
<th>Mean (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>88</td>
<td>35.76</td>
<td>1.96</td>
</tr>
<tr>
<td>2022</td>
<td>88</td>
<td>40.45</td>
<td>2.03</td>
</tr>
</tbody>
</table>

The data showed that the rates of excessive drinking in Ohio from 2016 to 2022 significantly increased from 17.34% to 19.01% in 2022 \((t = -14.14, p < .001)\) (Table 2). Paired t-test

**Table 2. Percentage of Adults who Excessively Drink in Ohio**

<table>
<thead>
<tr>
<th>Year</th>
<th>n</th>
<th>Mean (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>88</td>
<td>17.34</td>
<td>1.18</td>
</tr>
<tr>
<td>2022</td>
<td>88</td>
<td>19.01</td>
<td>1.19</td>
</tr>
</tbody>
</table>

The data showed that the rates of driving deaths with alcohol involvement in Ohio from 2016 to 2022 did not significantly decrease from 33.91% to 30.49% in 2022 \((t = 2.52, p = .013)\) (Table 3). Paired t-test
Table 3. Percentage of Driving Deaths with Alcohol Involvement in Ohio

<table>
<thead>
<tr>
<th>Year</th>
<th>n</th>
<th>Mean (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>88</td>
<td>33.91</td>
<td>1.00</td>
</tr>
<tr>
<td>2022</td>
<td>88</td>
<td>30.49</td>
<td>1.11</td>
</tr>
</tbody>
</table>

The data showed that the rates of drug overdose mortality in Ohio from 2016 to 2022 significantly increased from 19.09% to 35.63% in 2022 (RQ2c), \((t = -11.09, p < .001)\) (Table 4).

Paired t-test

Table 4. Percentage of deaths due to drug overdose in Ohio

<table>
<thead>
<tr>
<th>Year</th>
<th>n</th>
<th>Mean (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>88</td>
<td>19.09</td>
<td>0.89</td>
</tr>
<tr>
<td>2022</td>
<td>88</td>
<td>35.63</td>
<td>1.82</td>
</tr>
</tbody>
</table>

The data showed that the percent of smokers in Ohio from 2016 to 2022 significantly increased from 19.72% to 23.84% in 2022 (RQ2d), \((t = -19.96, p < .001)\) (Table 5). Paired t-test

Table 5. Percentage of Adults who smoke cigarettes in Ohio

<table>
<thead>
<tr>
<th>Year</th>
<th>n</th>
<th>Mean (%)</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>88</td>
<td>19.72</td>
<td>0.20</td>
</tr>
<tr>
<td>2022</td>
<td>88</td>
<td>23.84</td>
<td>0.32</td>
</tr>
</tbody>
</table>

When doing a Pearson correlation to see how the percent of people getting insufficient sleep correlates with the percent of people who excessively drink alcohol in Ohio counties in 2022 (RQ3a), we found a significant, moderate relationship \((r = -.53, p < 0.001)\). As the percent
of people who get insufficient sleep increase, the percentage of excessive alcohol drinkers decreases (Figure 1).

We did not find a significant relationship when doing a Pearson correlation to find the correlation between people getting insufficient sleep and percent of driving deaths related to alcohol in Ohio counties in 2022 (r = -0.04, p = 0.77) (RQ3b).

We did a Pearson correlation to see how the percent of people getting insufficient sleep correlates with the percent of smokers in Ohio counties in 2022 (RQ3c), we found a significant, strong relationship (r = 0.74, p < 0.001). As the percent of people who get insufficient sleep increase, the percentage of smokers increases (Figure 2).
When doing a Spearman correlation (RQ3d), we found a moderate, significant correlation between the percent of people who get insufficient sleep and the percent of drug overdose mortality in Ohio counties in 2022 ($r = 0.517, p < 0.001$). As the percent of people who get insufficient sleep increase, the percent of drug overdose mortality increases (Figure 3).
The percent of people getting insufficient sleep was not significantly different in urban versus rural counties in Ohio in 2022 ($t = -0.757$, $p = 0.451$).

Table 6. Percent of insufficient sleep between urban and rural counties in Ohio in 2022

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>21</td>
<td>40.157</td>
<td>2.088</td>
</tr>
<tr>
<td>Urban</td>
<td>67</td>
<td>40.543</td>
<td>2.023</td>
</tr>
</tbody>
</table>

Excessive drinking of alcohol was not significantly different in urban versus rural counties in Ohio in 2022 ($t = -0.578$, $p = 0.565$).

Table 7. Percent of excessive drinking between urban and rural counties in Ohio in 2022

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>21</td>
<td>18.876</td>
<td>1.196</td>
</tr>
<tr>
<td>Urban</td>
<td>67</td>
<td>19.049</td>
<td>1.198</td>
</tr>
</tbody>
</table>
The difference in the percent of driving deaths due to alcohol was not significant in urban versus rural counties in Ohio in 2022 ($t = -0.476$, $p = 0.636$).

**Table 8.** Percent of driving death with alcohol involvement between urban and rural counties in Ohio in 2022

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>21</td>
<td>29.538</td>
<td>8.732</td>
</tr>
<tr>
<td>Urban</td>
<td>67</td>
<td>30.785</td>
<td>10.958</td>
</tr>
</tbody>
</table>

The drug overdose mortality was not significantly different in urban versus rural counties in Ohio in 2022 ($t = -0.581$, $p = 0.563$).

**Table 9.** Percent of drug overdose mortality rate between urban and rural counties in Ohio in 2022

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>21</td>
<td>32.871</td>
<td>11.547</td>
</tr>
<tr>
<td>Urban</td>
<td>67</td>
<td>35.141</td>
<td>16.543</td>
</tr>
</tbody>
</table>

The percent of smokers was not significantly different in urban versus rural counties in Ohio in 2022 ($t = -1.495$, $p = 0.139$).

**Table 10.** Percent of smokers between urban and rural counties in Ohio in 2022

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>mean</th>
<th>Standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>21</td>
<td>22.986</td>
<td>2.659</td>
</tr>
<tr>
<td>Urban</td>
<td>67</td>
<td>24.103</td>
<td>3.082</td>
</tr>
</tbody>
</table>
We investigated how insufficient sleep, unemployment rate, and frequent physical distress predicted the variance in the percent of excessive alcohol use in Ohio in 2022. A stepwise linear regression found that 30.9% of the variance in excessive drinking could be predicted by our model ($F= 38.53, p = <0.001$). Percent of frequent physical distress accounted for 30.9 percent of the variance in our model ($B = -0.427, t= -6.207$). Insufficient sleep and unemployment rate did not significantly contribute to our model.

**Discussion**

To sum, the data analysis showed several key findings regarding insufficient sleep and risky behaviors in Ohio. There was a significant increase in the percentage of people experiencing insufficient sleep from 2016 to 2022 in Ohio, accompanied with increase in rates of excessive alcohol use, drug overdose mortality, and smoking during the same period. Correlation analyses demonstrated significant, positive relationships between insufficient sleep and smoking, and drug overdose mortality, suggesting a potential relationship between insufficient sleep and these risky behaviors. However, there was a negative correlation between insufficient sleep and excessive alcohol use. Interestingly, there were no significant differences in insufficient sleep or risky behaviors between urban and rural counties in Ohio. Finally, the multiple linear regression analysis highlighted the significant predictive value of frequent physical distress on excessive alcohol use, while insufficient sleep and unemployment rate did not significantly contribute to the model. Overall, the findings illustrated the importance of addressing insufficient sleep as a potential risk factor for various adverse health outcomes and demonstrated the need for further research and interventions targeting sleep health to mitigate risky behaviors in Ohio's population. Insufficient sleep may be associated with risky behaviors such as smoking and drug overdose.
mortality, this suggests that screening and counseling patients on insufficient sleep may help lower the rates of risky behaviors.

The percent of people getting insufficient sleep has significantly increased in Ohio from 2016 to 2022 by almost 5%. This rise in insufficient sleep is especially concerning since lack of sleep may diminish our decision making and increase risk-taking behaviors. Our finding of 40.45% of people getting insufficient sleep in 2022 in Ohio is even greater than the CDC national estimate of 34.4% and 34.8% for kids and adults, respectively. We also found significant, positive correlations between insufficient sleep and cigarette smoking, and insufficient sleep and drug overdose mortality. This suggests there may be a direct link between not getting adequate sleep and participating in risky behaviors, which aligns with previous studies showing that insufficient sleep may be an independent risk factor for taking part in risky behaviors. Overall, the high numbers of insufficient sleep in Ohio, even compared to national averages, indicates that the Ohio population may be at greater risk for partaking in risky behaviors than the national average. Surprisingly, we found a negative relationship between excessive alcohol use and insufficient sleep. This finding most likely points to the multitude of factors that may influence someone to indulge in a risky behavior.

One of the unexpected findings was that none of our parameters (ex: insufficient sleep, drug overdose mortality, excessive alcohol use) were significantly different between urban and rural counties in Ohio, contrasting with the previous literatures that showed rural counties have more insufficient sleep and alcohol uses. This disparity demonstrated a need to look further into the difference between urban and rural areas in Ohio.

The findings of elevated rates of insufficient sleep and risky behaviors in Ohio raised concern from a public health standpoint, as previous literature showed multifaceted effects of
insufficient sleep on the population and considered as a public health epidemic.\textsuperscript{12} Interventions should be implemented such as Health Education Campaigns for adequate sleep hygiene, especially for adolescents and young adults who showed vulnerability to insufficient sleep and develop risky behaviors.

Our findings could also be beneficial in the clinical setting, given the correlation between insufficient sleep and risky behaviors, sleep disorder screening would be helpful for patients with high risk of substance use disorder as improving sleep quality could be a possible factor for reducing addiction, which is demonstrated in the study which saw reduce substance abuse problems with improving sleep insomnia.\textsuperscript{13} Another possible application would in smoking cessation, cognitive behavioral therapy or other sleep interventions could combine with traditional treatments such as nicotine replacement to improve quit rates given the strong sleep-smoking correlation, which is proven by a pilot study integrating behavioral sleep intervention in smoking cessation.\textsuperscript{14}

One limitation of our study is that our findings rely on self-reported data. When relying on subjects to report data themselves, there may be bias in the data individuals report. Individuals may inherently under or over report their behaviors to align more with what is expected of them. Especially concerning topics such as substance abuse, individuals may be hesitant to report at all, or under-report, accurate data. Future studies should collect objective sleep and risky behavior data longitudinally to eliminate this bias.

Another limitation we have is our cross-sectional research design. The current method only allowed us to do correlation not causation. Thus, there is a possibility for reverse causation, i.e. risky behaviors cause insufficient sleep. To address this limitation, future studies should
involve direct interventional study with patients to improve sleep and see if it does improve or prevent risky behaviors, which proves the causation relationship.

Conclusion

This study looks at the role of insufficient sleep in participating in risk taking behaviors. These findings are important in trying to decrease risky behaviors such as drug overdose, which is one of the top issues in Ohio currently. Implications for medical practitioners and patients revolve around implementing screenings and programs to identify and improve sleep in individuals, in order to potentially decrease chances of participating in risky behaviors.
References


