Final_Report_2AA

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```
knitr::opts_chunk$set(echo = TRUE, message = FALSE, warning = FALSE)
library(readxl)
library(knitr)
library(tidyverse)
```

Final Report - Trends and Disparities in Cirrhosis Mortality and Alcohol Use Prevalence in the United States [2002 - 2012]

Abstract

- Our project analyzed trends and disparities in cirrhosis mortality rates and alcohol use prevalence in the United States from 2002 to 2012. Cirrhosis mortality rate estimates were generated using population and death data from the National Center of Health Statistics. Alcohol use prevalence estimates was produced by applying small area models to data from Behavioral Risk Factor Surveillance System from 2002 - 2012. Our analysis used data from the Institute of Health Metrics and Evaluation [IHME] Global Health Data Exchange [GHDx]. Our analysis revealed significant differences in mortality rates by race/ethnicity, alcohol use and geographic location.

Introduction

- Cirrhosis is a serious condition where scar tissue replaces healthy liver tissue often caused by chronic alcohol abuse, viral hepatitis [i.e - hepatitis B and C] or other liver diseases (Cirrhosis - Symptoms and Causes, n.d.).Cirrhosis leads to liver failure and is a significant contributor to mortality globally.Studies have shown that In the US, cirrhosis mortality rates vary by different demographic factors such as race/ethnicity, age and geographic location (Nassereldine et al., 2024). Understanding the disparities in cirrhosis mortality rates is crucial for effective public health interventions. Cirrhosis is a major public health issue in the United States with increasing mortality rates over the past two decades. The target audience for this project is public health analysts / researchers who are interested in understanding cirrhosis mortality trends and disparities in the US. The audience would be concerned with public health outcomes, healthcare planning and policy development related to liver disease.
- The questions we wanted to answer in our project were:
    1. How has cirrhosis mortality rates changed from 2002 to 2012 in the United States overall?
    2. What are the trends in cirrhosis rates by race and ethnicity and how do these trends differ across states?
    3. Are there notable differences in cirrhosis mortality rates between rural and urban counties?

4. How does age affect cirrhosis mortality rates and has there been a shift in age distribution among cirrhosis related deaths over time?
5. What regional patterns emerge in cirrhosis mortality rates and what factors might contribute to these variations?

Data Explanation

- Our first dataset is: **IHME United States Cirrhosis Mortality by County, Race and Ethnicity 2000-2019**.Cirrhosis mortality rate estimates were produced at the county level in the US, by racial and ethnic populations for each year between 2000-2019.Estimates were generated using population and deaths data from the National Center for Health Statistics and extracted by Institute of Health Metrics and Evaluation. https://ghdx.healthdata.org/record/ihme-data/us-cirrhosis-county-race-ethnicity-2000-2019. The data can be accessed by the public on IHME website using their Global Health Data Exchange database [GHDx].
  - The data set includes:
    - CSV file of county, state and national level estimates of cirrhosis mortality rates for each age group, sex, year and racial and ethnic populations.
- Our second data set is: **IHME United States Alcohol Use Prevalence by County 2002-2012**. IHME research produced alcohol use prevalence estimates for any drinking, heavy drinking, binge drinking and the proportion for heavy drinkers and binge drinkers by county, year and sex for 2002-2012. Estimates were produced by applying small area models to data from the Behavioral Risk Factor Surveillance System [BRFSS]. https://ghdx.healthdata.org/record/ihme-data/united-states-alcohol-use-prevalence-county-2002-2012
  - We decided to focus on binge drinking because binge drinking is associated with acute liver damage, and repeated episodes can lead to chronic liver diseases, including cirrhosis. We initially wanted to use heavy drinking but the data is only available from 2005 - 2012 and binge drinking has data from 2002 - 2012. Finally, any drinking is a broader category that may dilute the effect seen in heavy drinking or binge drinking as it includes all levels of alcohol consumption.
    - The data set includes:
      - CSV file of estimates for all states and counties for any drinking, heavy drinking, binge drinking, propotion heavy and prop binge for both sexes, females and males from 2002 - 2012.
- We had some issues merging the two data sets because the years and location and location_name was not consistent between the two data sets. Also, because the cirrhosis mortality data was so large we decided to cut down the cirrhosis mortality estimates from 2000 - 2019 to 2002 - 2012 so that it matched the time period that the alcohol prevalence data was collected.
- We used these data sets because IHME provides extensive global health data including mortality rates, disease prevalence and risk factors which are collected and processed using rigorous methodologies. IHME is a trusted source for researchers and policymakers. IHME is also a respected institution in global health and its data is widely cited in academic research, policy reports and global health initiatives.

Data Description

- There were Rows: 2482326 Columns: 19 in the cirrhosis mortality cleaned data set and Rows: 3179 Columns: 41 in the alcohol prevalence cleaned data set. When merged the two data sets included, Rows: 3107 Columns: 4. Each row in the data set represents either cirrhosis mortality data for a specific location or alcohol use prevalence data for a specific location from the years 2002 - 2012. The relevant variables in the data sets we used were:

Table 1: Relevant Variables

Variable	Variable Label	Description
location_name	Location Name	The location for the estimate
race_name	Race and ethnicity name	The race and ethnicity for the estimate. All groups besides Latino ar
year	Year	The time period for the estimate
val	Value	Mean estimate
State	Name	The state for the estimate
Location	Location Name	The county for the estimate
2002 - 2012 Both Sexes	2002 - 2012 Both Sexes	Alcohol prevalence for binge drinking in 2002 for both sexes

```
data <- read_excel("data_var.xlsx")

kable(data, format = "latex",,, caption = "Relevant Variables")
```

- There were 5897430 missing values in the Cirrhosis Mortality Data set and 0 missing values in Alcohol Prevalence Binge data set. Some quality issues we ran into was that the location's were not consistent between the two data sets as well as cirrhosis mortality having more demographic variables than alcohol prevalence.

Methods

- We chose to include the variables of location_name, race_name, year, val, State, Location and 2002 - 2012 Both Sexes because those variables were relevant to answering our questions on how alcohol prevalence and cirrhosis mortality rates were affected by different factors. Because of the way that each data set was structured we had to tweak and change questions as we went. For example, because the cirrhosis mortality estimates included other demographic data such as race groups and age groups when merging with the alcohol data set we chose to not include those variables in the merged data set because it was not relevant to merging with the alcohol data set. In addition, although the alcohol data set included prevalence estimates for both sexes, males and females we chose to only use both sexes for estimation because our cirrhosis mortality data set included data on both sexes and not on males and females separately.

Data Processing

```
# Define the path where all the Cirrhosis mortality data sets are stored.
path <- "Data/IHME_USA_CIRRHOSIS_COUNTY_RACE_ETHN_2000_2019_BOTH/"
```

```
# Initialize an empty list to store each year's data set
data_list <- list()

# Loop through each year, read the corresponding data set, add a 'year' column, and store in the list
for (year in 2002:2012) {
  file_name <- paste0("IHME_USA_CIRRHOSIS_COUNTY_RACE_ETHN_2000_2019_MX_", year, "_BOTH_Y2024M06D20.CSV
  file_path <- file.path(path, file_name)

  data <- read_delim(file_path, delim = ",", show_col_types = FALSE)
  data <- data %>% mutate(year = year)

  data_list[[as.character(year)]] <- data
}
```

```r
# Combine all the datasets from 2000 to 2019 into a single dataset
Cirrhosis_mortality_2002_2012_merged <- bind_rows(data_list)

# Save the merged Cirrhosis mortality dataset as a CSV file
write_csv(Cirrhosis_mortality_2002_2012_merged, "Cirrhosis_mortality_2002_2012_merged.csv")
```

```r
#Clean Cirrhosis Mortality Data
# Count NA values
sum(is.na(Cirrhosis_mortality_2002_2012_merged))
```

```
## [1] 5897430
```

```r
# Step 1: Clean NA values and filter columns for `cirrhosis_mortality_2000_2019_merged`
cirrhosis_mortality_2002_2012_merged_CLEANED <- Cirrhosis_mortality_2002_2012_merged %>%
  drop_na()
  #select(year, val, race_name, location_name, fips, age_name, sex_name)

# Save the cleaned dataset
write_csv(cirrhosis_mortality_2002_2012_merged_CLEANED, "cirrhosis_mortality_2002_2012_merged_CLEANED.c
```

```r
## Dataset 2
alcohol_prevalence_binge <- read_excel("Data/IHME_USA_COUNTY_ALCOHOL_USE_PREVALENCE_2002_2012_NATIONAL/I
```

```r
# Count NA values
sum(is.na(alcohol_prevalence_binge))
```

```
## [1] 0
```

```r
# Step 1: Clean NA values and filter columns for `alcohol prevalence binge CLEANED`
alcohol_prevalence_binge_CLEANED <- alcohol_prevalence_binge %>%
  drop_na()
```

```r
# Save the cleaned data set
write_csv(alcohol_prevalence_binge_CLEANED, "alcohol_prevalence_binge_CLEANED.csv")
```

```r
# Merging

# Cirrhosis dataset
# Calculate average 'val' by 'location_name'
average_val_by_location <- cirrhosis_mortality_2002_2012_merged_CLEANED %>%
  group_by(location_name) %>%
  summarize(average_val = mean(val, na.rm = TRUE))

cirrhosis_split <- average_val_by_location %>%
  mutate(State = gsub(".*\\((.*)\\).*", "\\1", location_name),  # Extract state
         Location = gsub("(.+)\\s\\(.*\\)", "\\1", location_name)) %>%  # Extract location
  select(-location_name)  # Drop the old location_name column
```

```r
# Alcohol dataset
# Calculate the average alcohol prevalence by state for each demographic group
average_alcohol_prevalence <- alcohol_prevalence_binge_CLEANED %>%
  group_by(State, Location) %>%
  summarise(
    Avg_Both_Sexes = mean(c_across(contains("Both Sexes")), na.rm = TRUE)
  )
# View the result
head(average_alcohol_prevalence, 3)
```

```
## # A tibble: 3 x 3
## # Groups:   State [1]
##   State   Location       Avg_Both_Sexes
##   <chr>   <chr>                   <dbl>
## 1 Alabama Alabama                  11.7
## 2 Alabama Autauga County           11.2
## 3 Alabama Baldwin County           14.2
```

```r
# Merge

merged_data <- merge(cirrhosis_split, average_alcohol_prevalence, by = c("State", "Location"))

write_csv(merged_data, "merged_data.csv")

test <- read_delim("merged_data.csv")
```

- We started by reading in our `CSV` file that included the IHME USA Cirrhosis County Race Ethnicity Estimates from 2000 - 2019. We looped through each year reading the corresponding data sets and chose to only include data from 2002 - 2019. This is because our alcohol prevalence data only included data from 2002 - 2012. We then combined all data sets from 2000 to 2012 into a single data set. When counted the NA values and decided to remove them because they were not relevant to our analysis. For our alcohol prevalence data set we read in the excel file and checked to see if there were any missing values and there were none. Finally we began the merging process which was a bit complicated.
- Our cirrhosis data set included multiple estimates for a location_name that was given as example: `Baldwin County (Alabama)` however our alcohol prevalence data set included two separate columns named for example `State: Alabama` and `Location: Baldwin County`. We knew this would be an issue for merging the data set so we decided to calculate the average value for cirrhosis mortality by its location name (includes state and county) and then split up the data set so that it included separate State and Location columns to match the alcohol prevalence data. We ended up having to forfeit some important columns such as `race_name` and `age_name` simply because the alcohol prevalence data wouldn't match those extra demographic factors and we wouldn't be able to include it in analysis.
- In addition, because our cirrhosis mortality data was only reported for both sexes we were unable to split by female and male like the alcohol prevalence data to include for analysis. For the alcohol data set we calculated the average alcohol prevalence by state and location and dropped the extra female and male columns so it was just for both sexes. This means the data is an average for all years from 2002 - 2012 as well as the cirrhosis mortality data also being an average from 2002 - 2012.
- To merge the data we merged our new cirrhosis split data and average alcohol prevalence.
- For a new categorical variable creation we created a new categorical variable called `Binge_Drinking_Category` as `Low`, `Medium` and `High` to see which states had high, low or medium prevalence of alcohol drinking. For our continuous variable we wanted to summarize the average cirrhosis mortality and average alcohol prevalence by State instead of having it for each county.
- We also wanted to use a linear regression model to check if there was a correlation between alcohol use and cirrhosis mortality. We used the average cirrhosis mortality and average alcohol prevalence that we calculated from our new continuous variable and fit a linear regression model to the data. We also calculated a Pearson's correlation coefficient and plotted a summarization.

Results

- As we worked with the data more and got to understand what questions we could and couldn't answer given time restrictions and data availability our questions changed a bit. Our new questions are now:
  1. How have cirrhosis mortality rates changed from 2002 to 2012 in the United States overall?

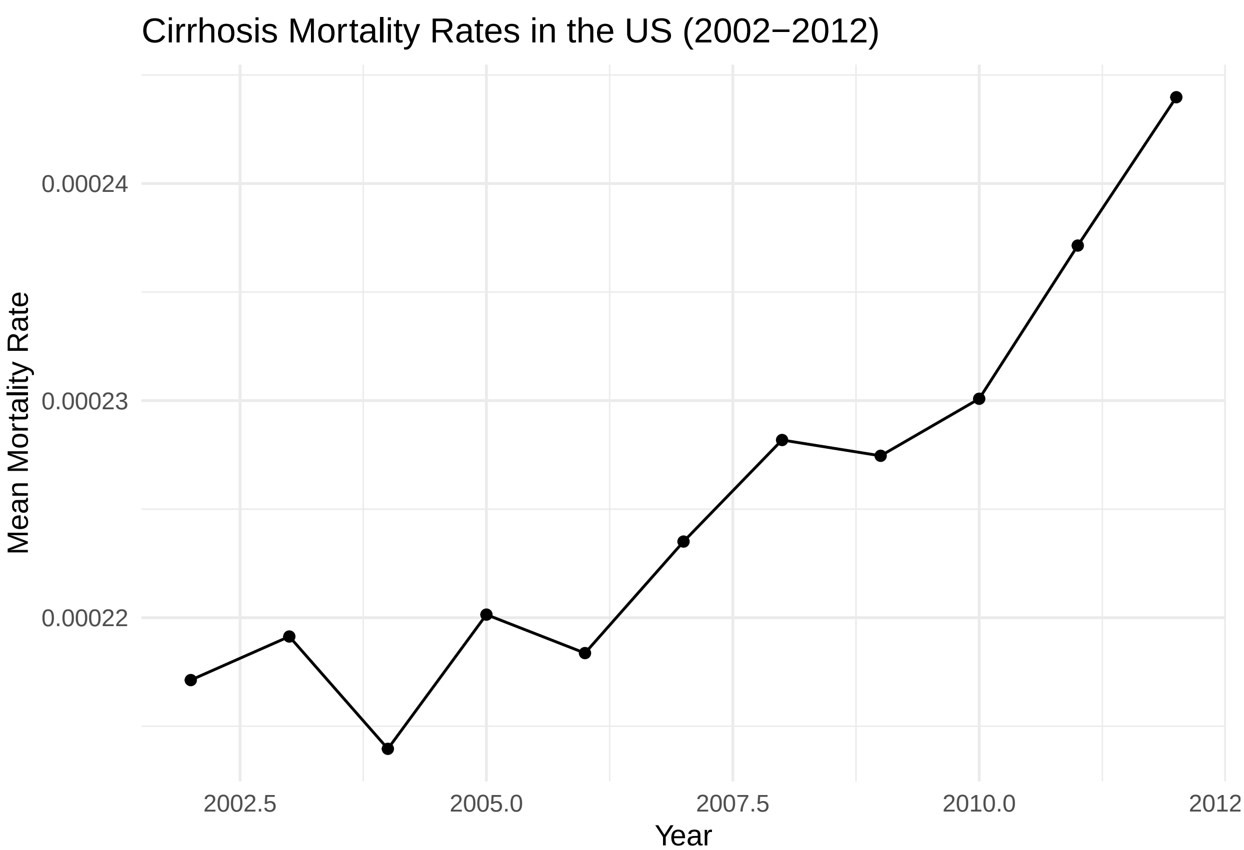
2. What are the trends in cirrhosis rates by race and ethnicity from 2002 - 2012?
3. Which states have the highest, medium and lowest alcohol binge drinking?
4. What is the average cirrhosis mortality rate and alcohol prevalence by state?
5. Is there a correlation between average cirrhosis mortality rates and average alcohol prevalence by state?

Question 1: How have cirrhosis mortality rates changed from 2002 to 2012 in the United States overall?

```
cirrhosis_mortality_2002_2012_merged_CLEANED <- read_delim("cirrhosis_mortality_2002_2012_merged_CLEANEI

# Calculate mean mortality rate per year
annual_mortality <- cirrhosis_mortality_2002_2012_merged_CLEANED %>%
  group_by(year) %>%
  summarize(mean_mortality_rate = mean(val, na.rm = TRUE))

# Plot the change in mortality rates over time
ggplot(annual_mortality, aes(x = year, y = mean_mortality_rate)) +
  geom_line() +
  geom_point() +
  labs(title = "Cirrhosis Mortality Rates in the US (2002-2012)",
       x = "Year", y = "Mean Mortality Rate") +
  theme_minimal()
```

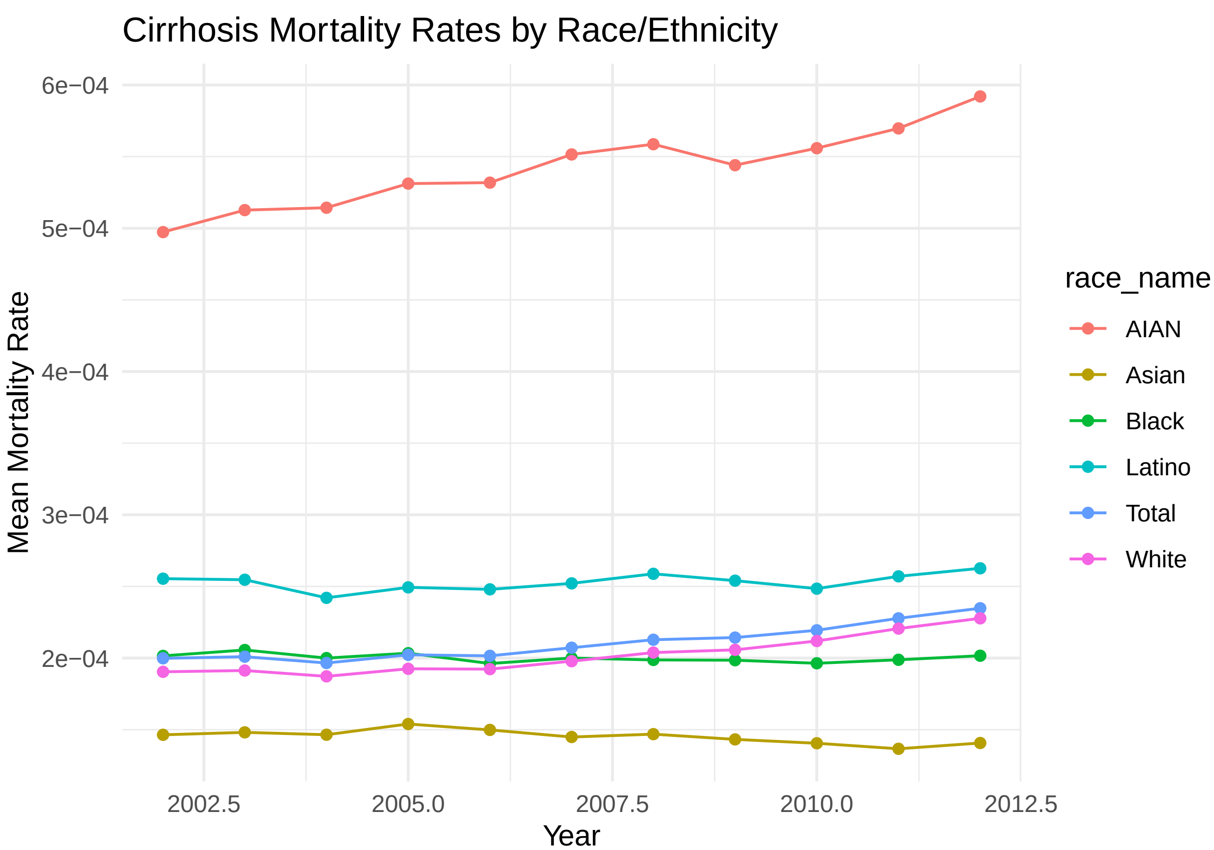


- This graph shows cirrhosis mortality rates in the US from 2002 - 2012. As we can see from this graph there has been quite an increase of cirrhosis mortality from 2010 onward. This suggests potential trends or factors that have contributed to increased mortality. Possible explanations could range from increased risk factors such as heavy alcohol use or hepatitis infections or socioeconomic changes such as increased poverty or reduced healthcare funding which may influence cirrhosis mortality rates.

Question 2: What are the trends in cirrhosis rates by race and ethnicity from 2002 - 2012?

```r
# Calculate mean mortality rate by race/ethnicity and year
racial_trends <- cirrhosis_mortality_2002_2012_merged_CLEANED %>%
  group_by(year, race_name) %>%
  summarize(mean_mortality_rate = mean(val, na.rm = TRUE))

# Plot the trends by race/ethnicity
ggplot(racial_trends, aes(x = year, y = mean_mortality_rate, color = race_name)) +
  geom_line() +
  geom_point() +
  labs(title = "Cirrhosis Mortality Rates by Race/Ethnicity",
       x = "Year", y = "Mean Mortality Rate") +
  theme_minimal()
```



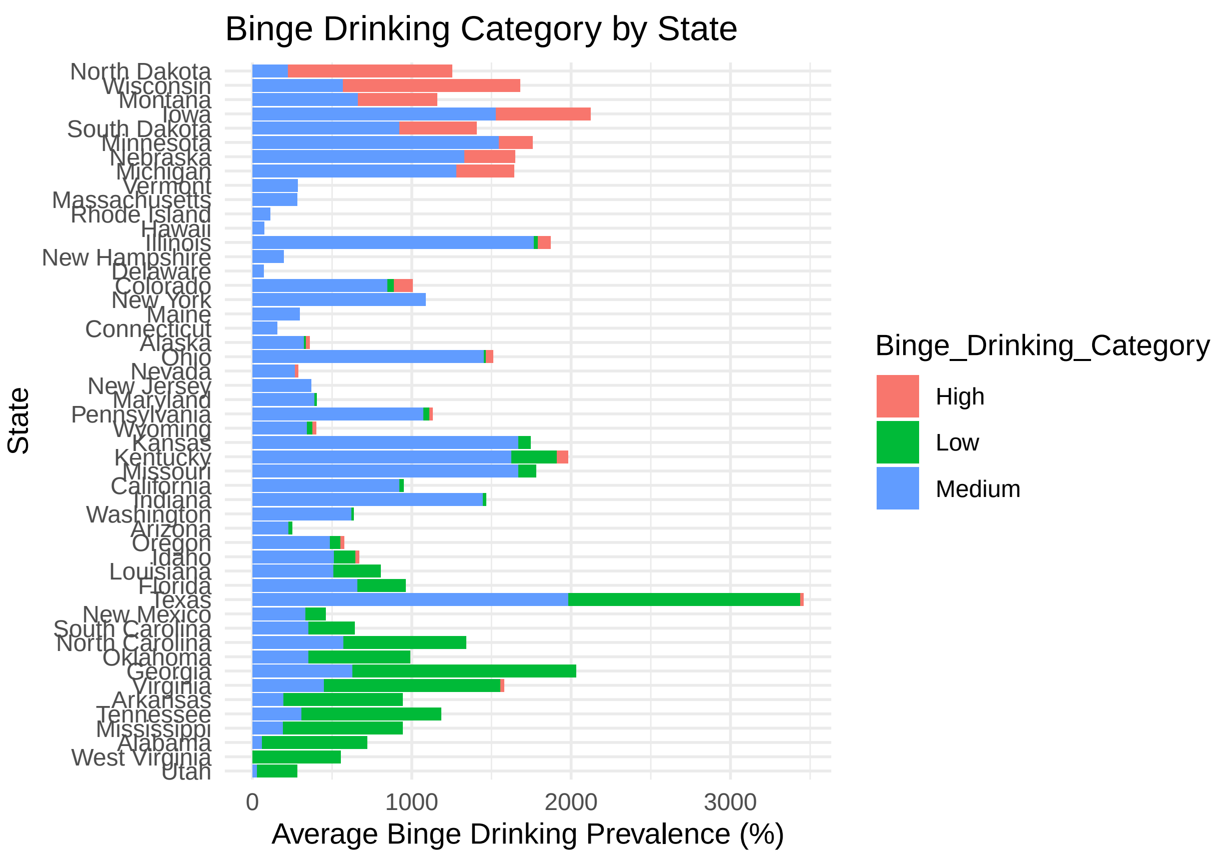
This graph clearly shows significant racial and ethnic disparities in cirrhosis mortality rates. As we can see from the graph, those categorized as AIAN have the highest cirrhosis mortality rates with Latino populations coming in second and Black, Total and White being fairly similar and Asian has the lowest amount of cirrhosis mortality rates. The highest cirrhosis mortality rates could reflect factors such as higher prevalence of risk factors, socioeconomic challenges or disparities in healthcare access and quality.

Question 3: Which states have the highest, medium and lowest alcohol binge drinking?

```
merged_data <- read_delim("merged_data.csv")

# Create new categorical variable for binge drinking
merged_data <- merged_data %>%
  mutate(Binge_Drinking_Category = case_when(
    Avg_Both_Sexes < 13.6 ~ "Low",
    Avg_Both_Sexes >= 13.6 & Avg_Both_Sexes < 22.3 ~ "Medium",
    TRUE ~ "High"
  ))

# Plotting
ggplot(merged_data, aes(x = reorder(State, Avg_Both_Sexes), y = Avg_Both_Sexes, fill = Binge_Drinking_Ca
  geom_bar(stat = "identity") +
  coord_flip() +
  labs(title = "Binge Drinking Category by State",
       x = "State",
       y = "Average Binge Drinking Prevalence (%)") +
  theme_minimal()
```



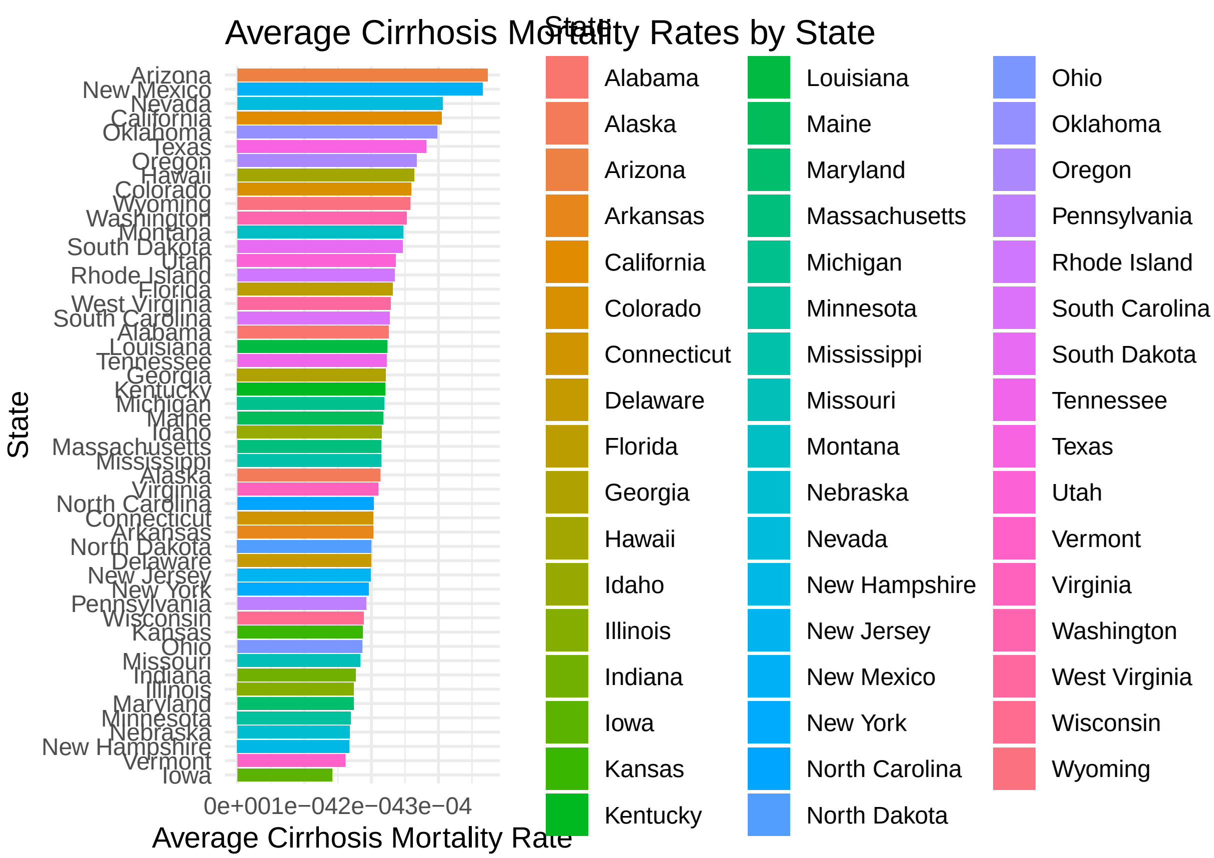
- This graph shows which states have the highest prevalence of binge drinking and which states has the lowest. As we can see from the graph North Dakota has the largest percentage of high average binge drinking prevalence while Utah has the lowest. There are many factors that contribute to high binge drinking rates such as cultural norms, availability of alcohol, socioeconomic conditions and other regional factors. Understanding these regional differences are important to help tailor public health interventions and policies. Exploring underlying causes of these disparities is important to inform broader approaches to address binge drinking at a national level and its implications.

Question 4: What is the average cirrhosis mortality rate and alcohol prevalence by state?

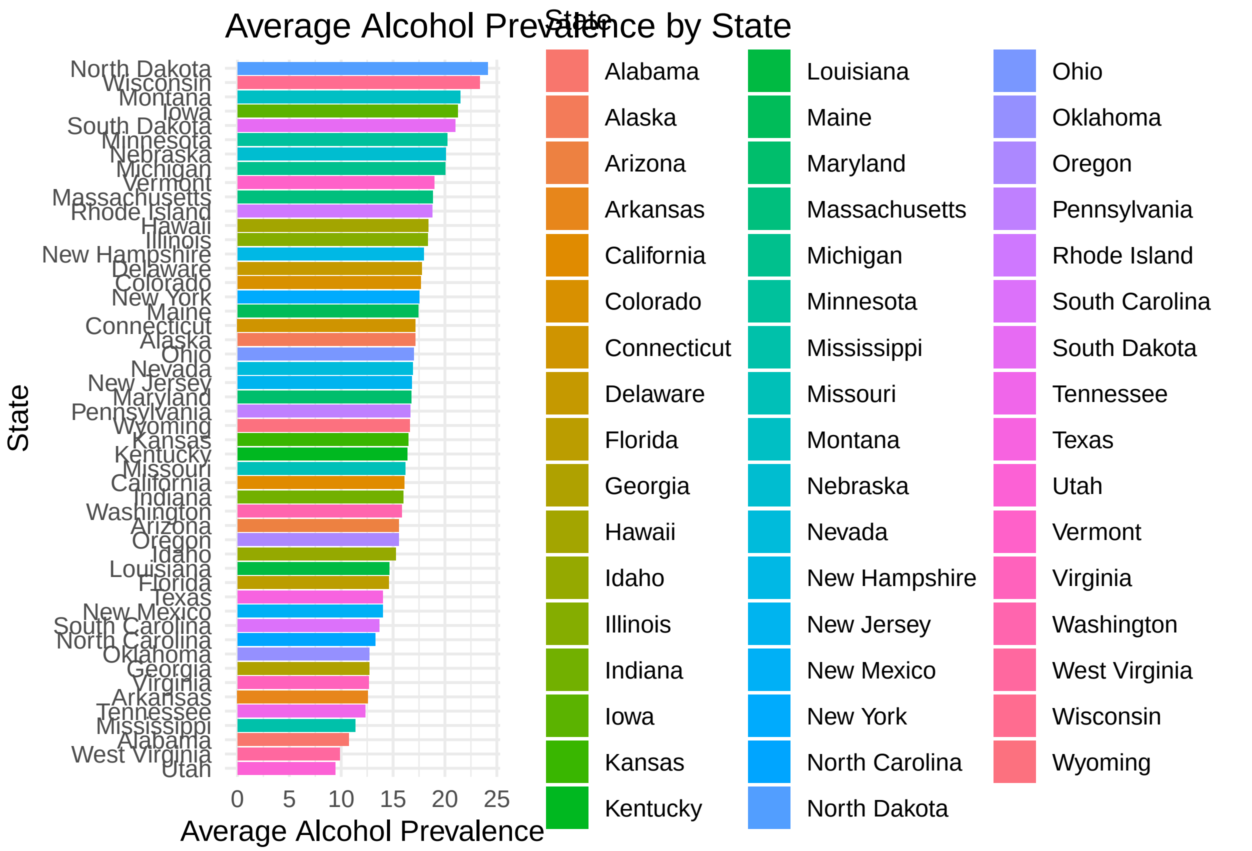
```r
# new continous variable and summarize the data by state
summarization_df <- merged_data %>%
  group_by(State) %>%
  summarise(
    Avg_Cirrhosis_Mortality = mean(average_val, na.rm = TRUE),
    Avg_Alcohol_Prevalence = mean(Avg_Both_Sexes, na.rm = TRUE)
  )

# View the summarization table
#print(summarization_df)

# average cirrhosis mortality rate by state
ggplot(summarization_df, aes(x = reorder(State, Avg_Cirrhosis_Mortality), y = Avg_Cirrhosis_Mortality,
  geom_bar(stat = "identity") +
  coord_flip() +
  labs(title = "Average Cirrhosis Mortality Rates by State",
       x = "State",
       y = "Average Cirrhosis Mortality Rate") +
  theme_minimal()
```



```
# average alcohol prevalence by state
ggplot(summarization_df, aes(x = reorder(State, Avg_Alcohol_Prevalence), y = Avg_Alcohol_Prevalence, fi
  geom_bar(stat = "identity") +
  coord_flip() +
  labs(title = "Average Alcohol Prevalence by State",
       x = "State",
       y = "Average Alcohol Prevalence") +
  theme_minimal()
```

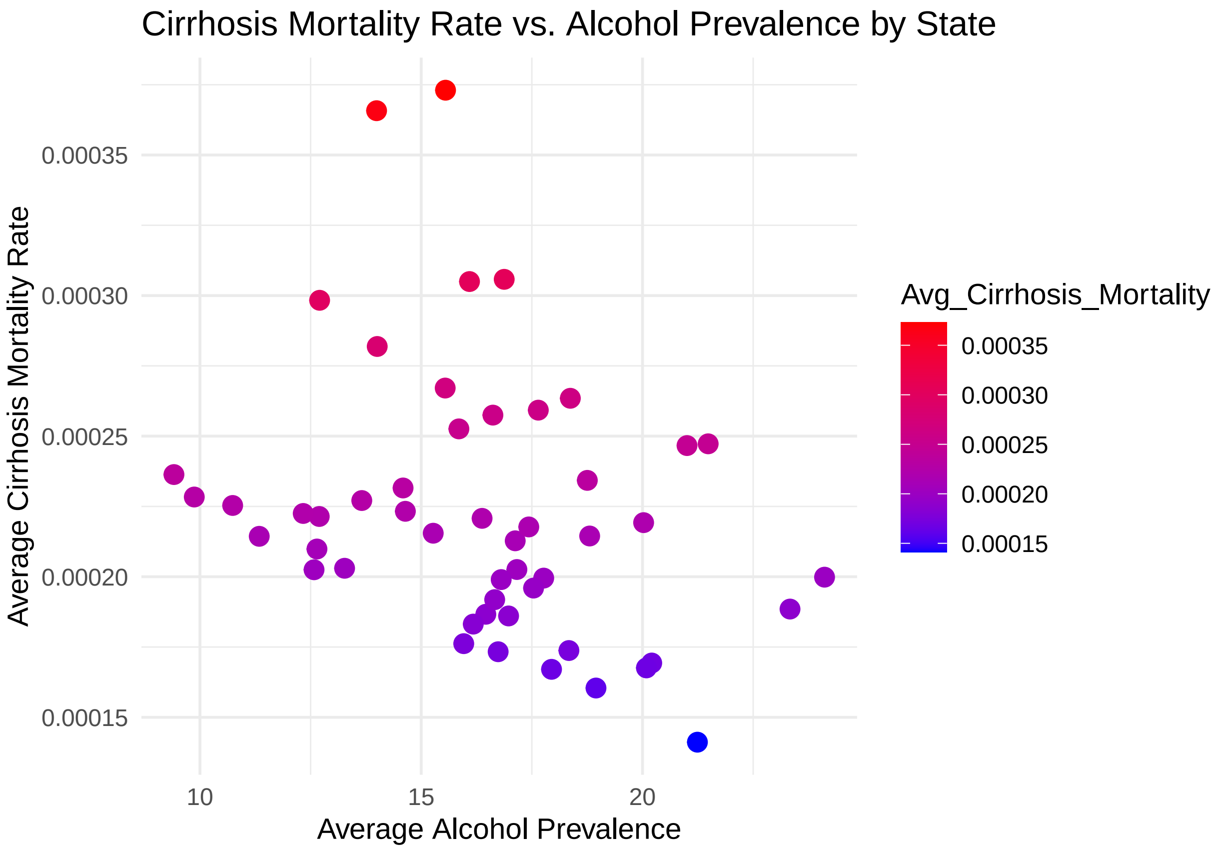


- For this question we wanted to see what the average prevalence of cirrhosis mortality and alcohol prevalence of binge drinking was by State. Since our data is given at multiple counties we want to aggregate it to see a larger picture by state. As we can see from the data, the states with the largest average cirrhosis mortality rates are Arizona, New Mexico and Nevada while the states with the largest alcohol prevalence are North Dakota, Wisconsin and Montana. The results of these graphs help answer some of our questions and we can start to learn that maybe alcohol consumption doesn't have as much to do with cirrhosis mortality rates and we orignally thought.

Question 5: Is there a correlation between average cirrhosis mortality rates and average alcohol prevalence by state?

```
# Scatter plot of average cirrhosis mortality rate vs. average alcohol prevalence
ggplot(summarization_df, aes(x = Avg_Alcohol_Prevalence, y = Avg_Cirrhosis_Mortality)) +
  geom_point(aes(color = Avg_Cirrhosis_Mortality), size = 3) +
  scale_color_gradient(low = "blue", high = "red") +
  labs(title = "Cirrhosis Mortality Rate vs. Alcohol Prevalence by State",
       x = "Average Alcohol Prevalence",
```

```r
    y = "Average Cirrhosis Mortality Rate") +
  theme_minimal()
```



- Finally we wanted to see if there was a correlation between cirrhosis mortality rates and alcohol prevalence when grouped by State. We created a scatter plot that shows average cirrhosis mortality rate with average alcohol prevalence. As you can see from the scatter plot, there actually seems to be a negative association where lower average cirrhosis mortality rates correlate with higher average alcohol prevalence.

```r
# Fit the linear regression model
model <- lm(Avg_Cirrhosis_Mortality ~ Avg_Alcohol_Prevalence, data = summarization_df)

# Summary of the model
summary(model)
```

```
##
## Call:
## lm(formula = Avg_Cirrhosis_Mortality ~ Avg_Alcohol_Prevalence,
##     data = summarization_df)
##
## Residuals:
##        Min         1Q     Median          3Q         Max
## -6.170e-05 -3.272e-05 -1.452e-05  2.546e-05  1.462e-04
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)             2.926e-04  3.398e-05   8.609 2.69e-11 ***
## Avg_Alcohol_Prevalence -4.224e-06  2.034e-06  -2.076   0.0432 *
```

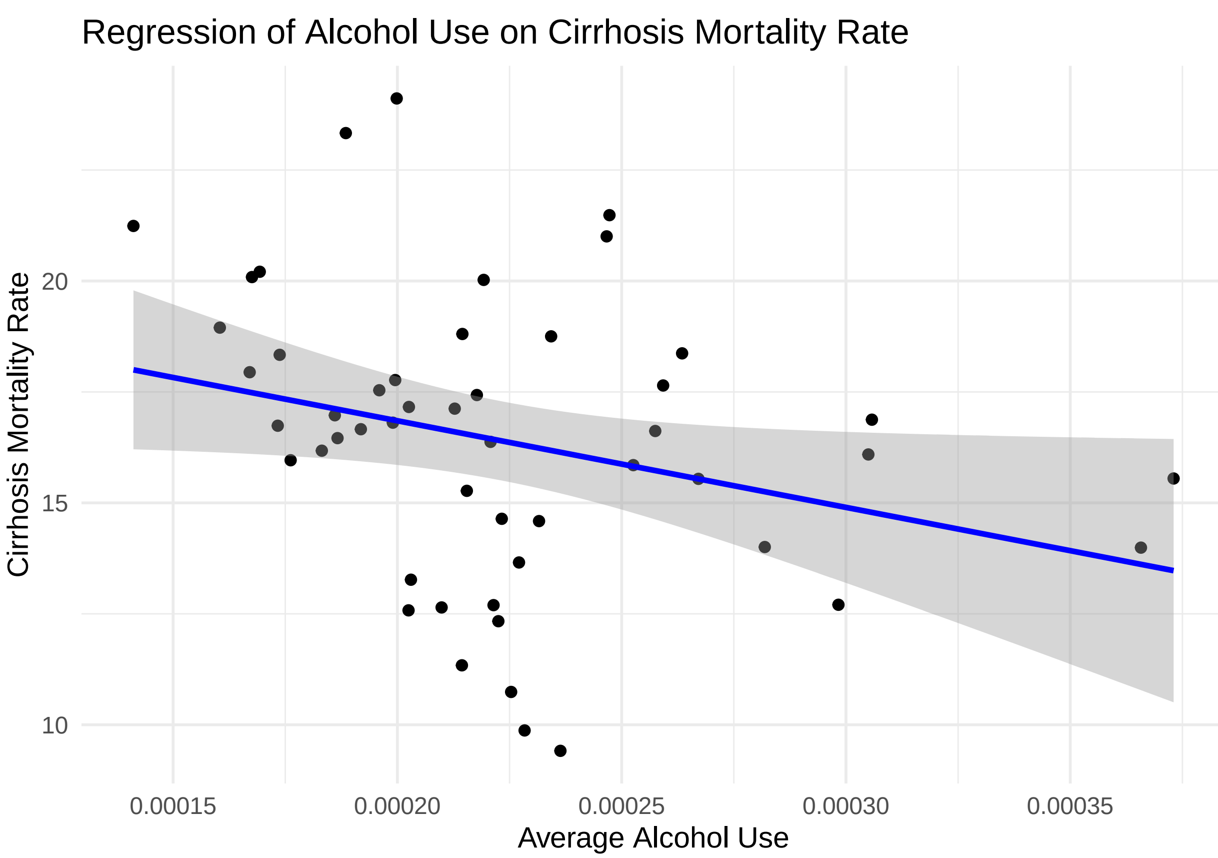
```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4.617e-05 on 48 degrees of freedom
## Multiple R-squared:  0.08241,    Adjusted R-squared:  0.0633
## F-statistic: 4.311 on 1 and 48 DF,  p-value: 0.04324
```

```
# Calculate Pearson correlation coefficient
correlation <- cor(summarization_df$Avg_Cirrhosis_Mortality, summarization_df$Avg_Alcohol_Prevalence)
correlation
```

```
## [1] -0.2870777
```

- We fit a linear regression model to get a better look at the data and our linear model actually shows that there is a statistically significant relationship between average alcohol prevalence and average cirrhosis mortality although the effect size is relatively small. The p-value is 0.04324 which indicates that the model is statistically significant overall. While the result implies there is a significant relationship between alcohol prevalence and cirrhosis mortality, the model explains only a small proportion of variance in cirrhosis mortality rates. It is important to explore other variables or interactions and look at potential confounding variabels that could improve the models explanatory power.

```
ggplot(summarization_df, aes(x = Avg_Cirrhosis_Mortality, y = Avg_Alcohol_Prevalence)) +
  geom_point() +
  geom_smooth(method = "lm", col = "blue") +
  labs(title = "Regression of Alcohol Use on Cirrhosis Mortality Rate",
       x = "Average Alcohol Use",
       y = "Cirrhosis Mortality Rate") +
  theme_minimal()
```



- Our Pearson's correlation coefficient of -0.2870777 suggests a moderate negative linear relationship between the two variables being compared. Therefore as one variable increases the other tends to decrease but the relationship is not extremely strong. Pearson's correlation coefficient explains that there is a bit of an inverse relationship between the two variables but there could be many other factors at play that affect the relationship between the two variables.

Findings

- The results of our analysis provide significant insights into the patterns and trends of cirrhosis mortality rates and alcohol prevalence in the US from 2002 - 2012. Overall, the trend of cirrhosis mortality rates indicate that there has been an increase of cirrhosis mortality after 2010 is concerning and suggests that there is increasing alcohol consumption, higher rates of hepatitis infections or socioeconomic changes that may contribute to higher mortality rates. The data reveals stark disparities in cirrhosis mortality rates among different racial and ethnic groups. AIAN populations experience the highest mortality rates followed by Latino populations, Black, White and Asian groups having the lowest rates. These disparities most likely reflect underlying socioeconomic disparities. The variation in binge drinking prevalence across the states also indicates that cultural, economic and other factors play a role in shaping alcohol consumption patterns.
- The observation that states with high average cirrhosis mortality rates do not necessarily coincide with states having high alcohol prevalence suggests that other factors beyond alcohol consumption contributes to cirrhosis mortality. The negative correlation between average cirrhosis mortality rates and alcohol prevalence also suggests a complex relationship. The scatter plot and regression analysis show that higher alcohol prevalence does not directly correlate with higher cirrhosis mortality rates. This finding points to the possibility of potential confounding factors that are influencing cirrhosis mortality and that alcohol consumption alone is not enough to explain the variations we have seen in our data.

Limitations

- The analysis is limited by state level data as well as not being able to account for race / ethnicity, age groups and sex for the combined data set. While associations are identified, causality cannot be established soley from the data sets we used. The analysis also does not account for other potential confounders such as healthcare access, socioeconomic status, age, and sex. The study also covers a small time period from 2002 - 2012 and may not capture recent trends or look into data during and after COVID-19.

Future work

- For the future more complex and in depth analysis can be conducted using county level data, sex data, age data and additional variables such as healthcare access and socioeconomic conditions. Qualitative analysis can also complement the quantitative analysis to explore different contextual factors and gain deeper insights into the relationship between cirrhosis mortality rates, alcohol consumption and other contributing factors.

Summary

- Overall this analysis highlights important trends in cirrhosis mortality and alcohol consumption. While alcohol consumption is a significant risk factor, it alone does not account for all the variation in cirrhosis mortality. Cirrhosis mortality is a complex issue that requires additional insights and data. Future research should focuses on a detailed and complex analysis to understand what causes cirrhosis mortality rates and inform more effective public health strategies.

Sources

Cirrhosis—Symptoms and causes. (n.d.). Mayo Clinic. Retrieved August 7, 2024, from https://www.mayoclinic.org/diseases-conditions/cirrhosis/symptoms-causes/syc-20351487

Nassereldine, H., Compton, K., Li, Z., Baumann, M. M., Kelly, Y. O., Motte-Kerr, W. L., Daoud, F., Rodriquez, E. J., Mensah, G. A., Nápoles, A. M., Pérez-Stable, E. J., Murray, C. J. L., Mokdad, A. H., & Dwyer-Lindgren, L. (2024). The burden of cirrhosis mortality by county, race, and ethnicity in the USA, 2000–19: A systematic analysis of health disparities. The Lancet Public Health, 9(8), e551–e563. https://doi.org/10.1016/S2468-2667(24)00131-2

United States Alcohol Use Prevalence by County 2002-2012 | GHDx. (n.d.). Retrieved August 7, 2024, from https://ghdx.healthdata.org/record/ihme-data/united-states-alcohol-use-prevalence-county-2002-2012

United States Cirrhosis Mortality by County, Race, and Ethnicity 2000-2019 | GHDx. (n.d.). Retrieved August 7, 2024, from https://ghdx.healthdata.org/record/ihme-data/us-cirrhosis-county-race-ethnicity-2000-2019