

Mental Health

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Introduction

Mental health disorders are complex and can take many forms. The underlying sources of the data presented in this entry apply specific definitions, typically in accordance with WHO's *International Classification of Diseases* (ICD-10). This broad definition incorporates many forms, including depression, anxiety, bipolar, eating disorders and schizophrenia.

A mental disorder is characterized by a clinically significant disturbance in an individual's cognition, emotional regulation, or behavior. It is usually associated with distress or impairment in important areas of functioning. There are many different types of mental disorders. Mental disorders may also be referred to as mental health conditions. The latter is a broader term covering mental disorders, psychosocial disabilities and (other) mental states associated with significant distress, impairment in functioning, or risk of self-harm. The data shown in this entry demonstrate that mental health disorders are common everywhere. Improving awareness, recognition, support and treatment for this range of disorders should therefore be an essential focus for global health.

Depression is a common illness worldwide, with an estimated 3.8% of the population affected, including 5.0% among adults and 5.7% among adults older than 60 years. Approximately 280 million people in the world have depression. Depression is different from usual mood fluctuations and short-lived emotional responses to challenges in everyday life. During a depressive episode, the person experiences a depressed mood (feeling sad, irritable, empty) or a loss of pleasure or interest in activities, for most of the day, nearly every day, for at least two weeks. Several other symptoms are also present, which may include poor concentration, feelings of excessive guilt or low self-worth, hopelessness about the future, thoughts about death or suicide, disrupted sleep, changes in appetite or weight, and feeling especially tired or low in energy.

Statement of goals

To dive deep further into the aspects of depression the main research questions that we've tried to address through the analysis done in this project are the following:

- How depression varies by Gender?
- How does depression vary by Age?
- Does depression vary with changes in economic factors?
- Does substance disorder explain depression?
- Explore the correlation of Age, Sex, and Substance disorders w.r.t depression to analyze the model explainability.

Data description & Graphs

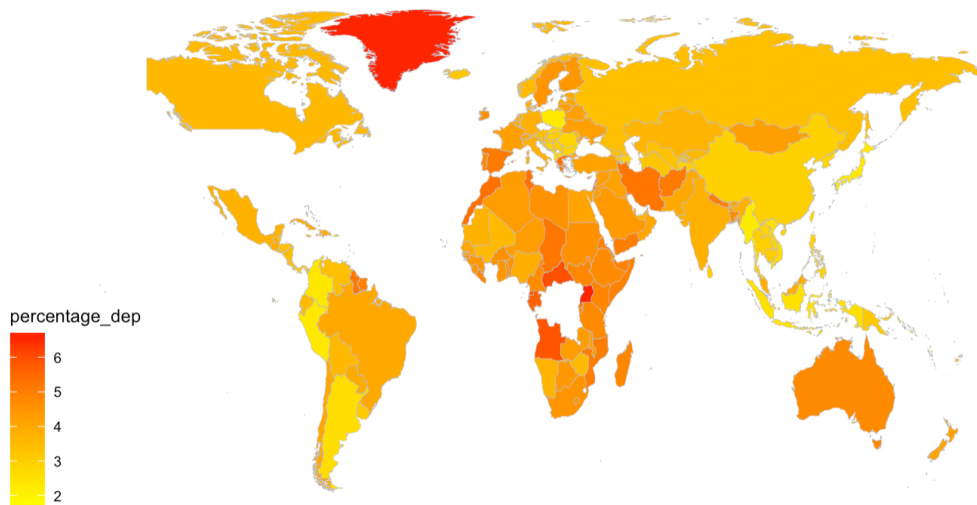
The Global Burden of Disease (GBD) is a tool that estimates mortality and disability across countries, time, age, and gender. It quantifies health loss caused by hundreds of diseases, injuries, and risk factors in order to improve health systems and eliminate disparities. The Global Burden of Disease is collected and analyzed by a consortium of more than 7,000 researchers in more than 156 countries and territories. The data capture premature death and disability from more than 350 diseases and injuries in 195 countries, by age and sex, from 1990 to the present. The GBD's flexible design allows it to be used at the global, national, and local levels to understand health trends over time.

In terms of the analysis done the main data sources used were:

- Depression-age-gender-disorders - Contains trivariate data to identify the age, sex and gender to determine depression
- Depression-by-age-gender - Contains bivariate data to identify the age and gender to determine depression
- Depression-by-age - Contains univariate data to identify age to determine depression
- Depression-by-gender - Contains univariate data to identify gender to determine depression
- Depression-disorders - Contains data to get insight into depression % by varied disease causes
- Continents - Maps every country to the continent it belongs to

Percentage of Depression by Country

Red represents high depression and Yellow is low depression



Data downloaded from <https://ourworldindata.org/mental-health#citation>

Fig 0.1 Depression percentage by Country

According to the figure above, in 2017, an estimated 264 million people in the world experienced depression. The share of the population with depression ranges mostly between 2% and 6% around the world today. The continuous world map for the year 2017 suggests that Uganda and Greenland have had the highest depression rating according to all age groups which have been normalized according to the

population in each of those age groups and coming to happiest countries the lowest depression rates were for Brunei, Myanmar and Japan.

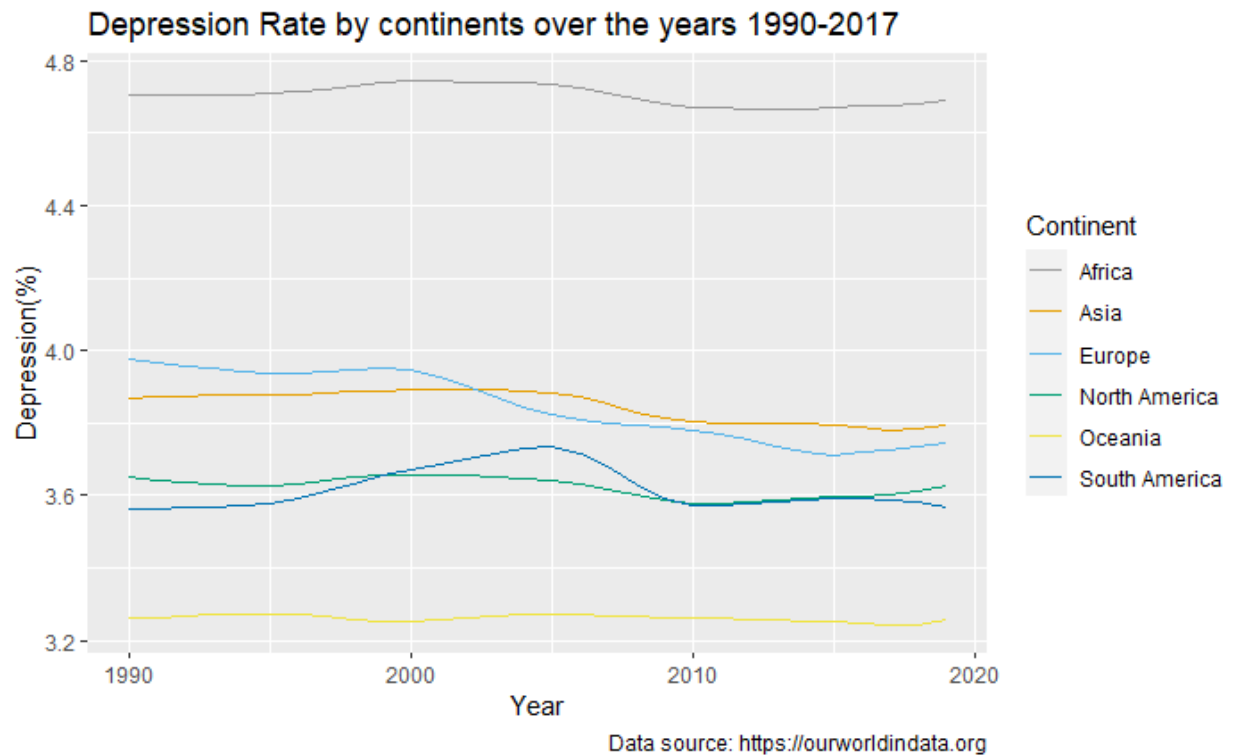


Fig 0.2 Depression percentage by continents over the years

According to the figure above, just to get a view of how the data looks on a high level, one could observe that the percentage of depressed people has always remained high in Africa and the least depressed population is basically Oceania. In accordance with Europe, the trend clearly showcases that there has been a decrease in the population of depressed people.

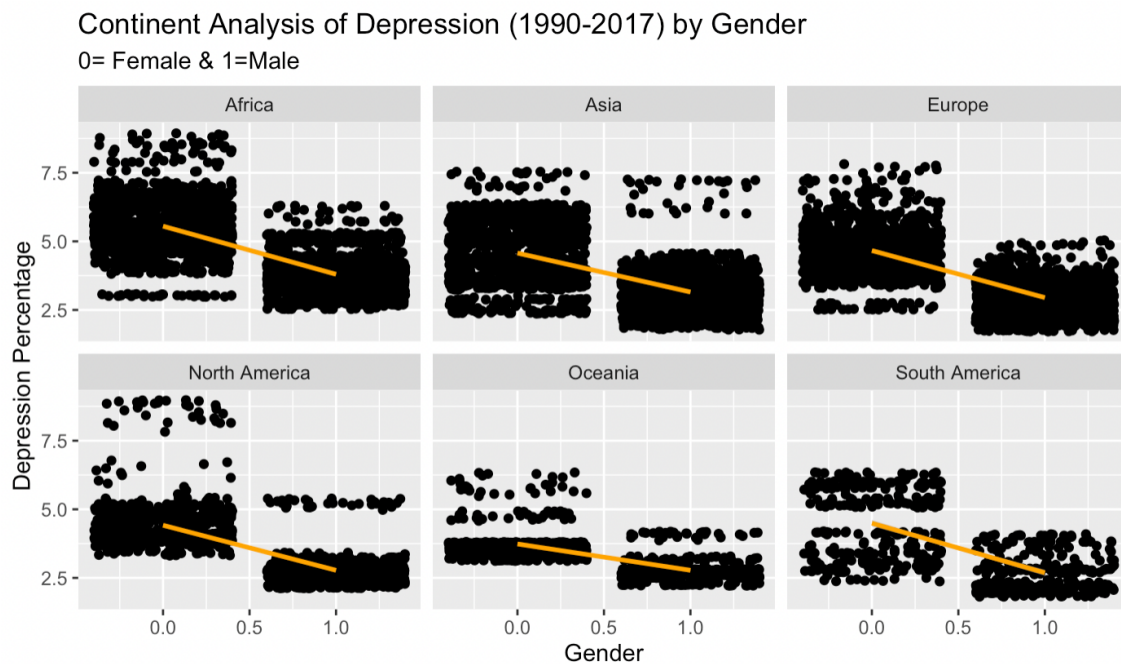
Model/Results/Answers

Research Question 1: How depression varies by Gender?

The plot below clearly shows the relationship between the dichotomous variables, i.e. Gender differences in depression prevalence across the continents. It is clear that the female population appears to be more depressed than the male population for the majority of the data. There is a significant difference in depression levels between the continents of Africa and North America when the averages in each plot are compared. Oceania, on the other hand, appears to have the lowest number of depressed people, both males and females.

Based on data-independent research, we discovered the following medical reasons for this trend of higher depression in females:

- Premenstrual problems
- Pregnancy
- Postpartum depression
- Perimenopause and menopause
- Life circumstances and culture



Data downloaded from <https://ourworldindata.org/mental-health#citation>

Fig 1.1 Continent Analysis of Depression by Gender

Research Question 2: How does depression vary by Age?

Figure 2.1 shows the relationship between depression and age groups across continents in our data. It looks like the depression on average tends to increase when moving up the age bracket across continents. The trend is most evident in African countries with exceptions to the trend in North America and Oceania. In some countries in North America and Oceania, teens and adults are more depressed compared to seniors. These exceptions in trends in North America and Oceania seem to be driven majorly by Canada, Greenland, Australia, and New Zealand as seen in Figure 2.2. Depression in Greenland seems particularly high compared to the other three countries across age groups.

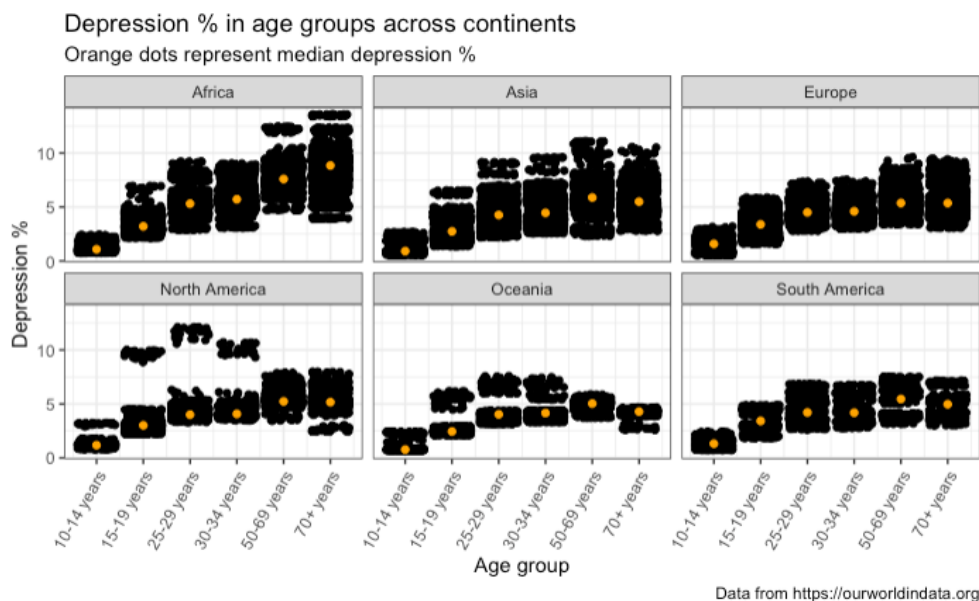


Fig 2.1 Depression among age groups across continents

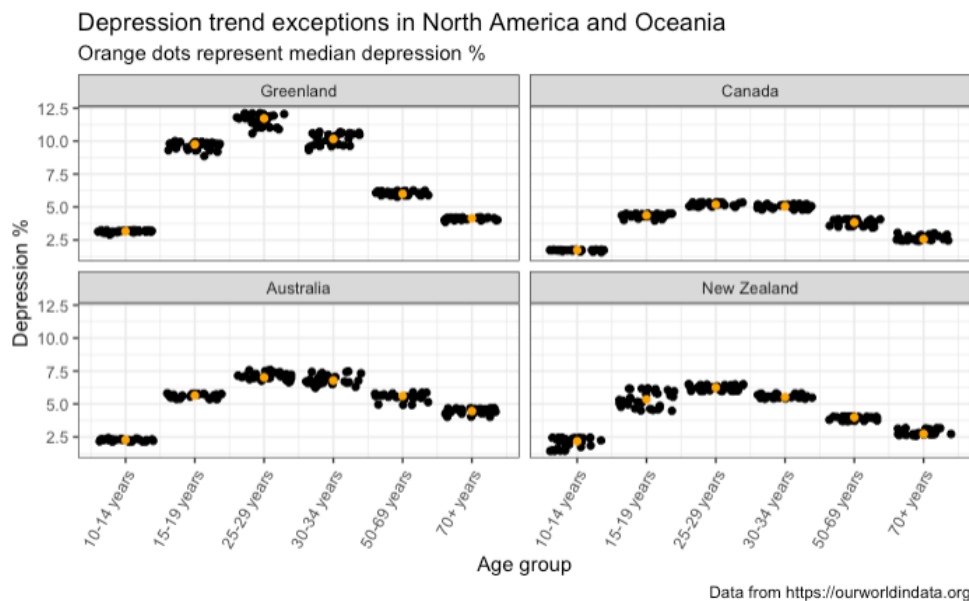


Fig 2.2 Countries in North America and Oceania with higher teen and adult depression compared to seniors

Research Question 3: Does depression vary with changes in economic factors?

We investigated the association between depression and numerous economic factors such as GDP per capita, GDP, and the GINI index. The association between GDP per capita and the countries' Depression rates piqued our interest the most. We can see in Figure 3.1 that there is a U-shaped relationship between Depression and GDP per capita. Depression is most prevalent in nations with low GDP per capita and begins to decline in countries with medium GDP per capita. Then, the interesting tendency that we see here is that when countries' GDP per capita increases, depression begins to rise slightly.

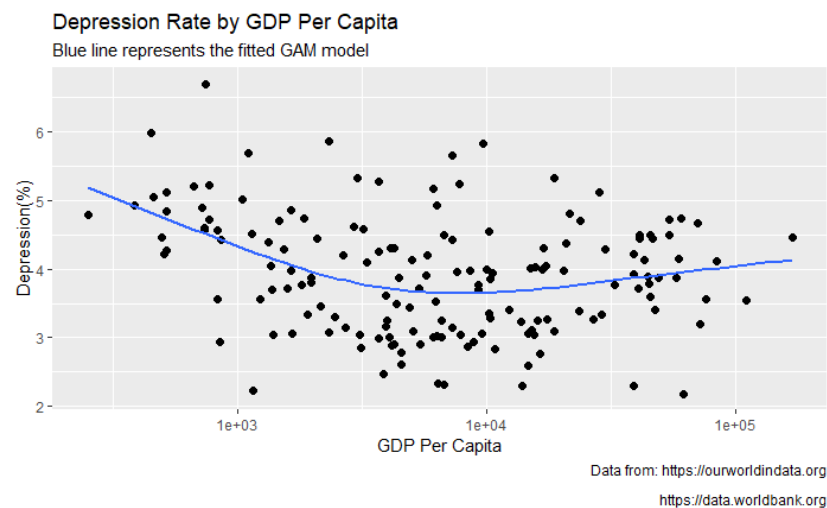


Fig 3.1 Depression percentage by GDP per Capita

The purpose of the plot in Figure 3.2 is to explore the U-shaped trend that we analyzed in the plot above in more detail.

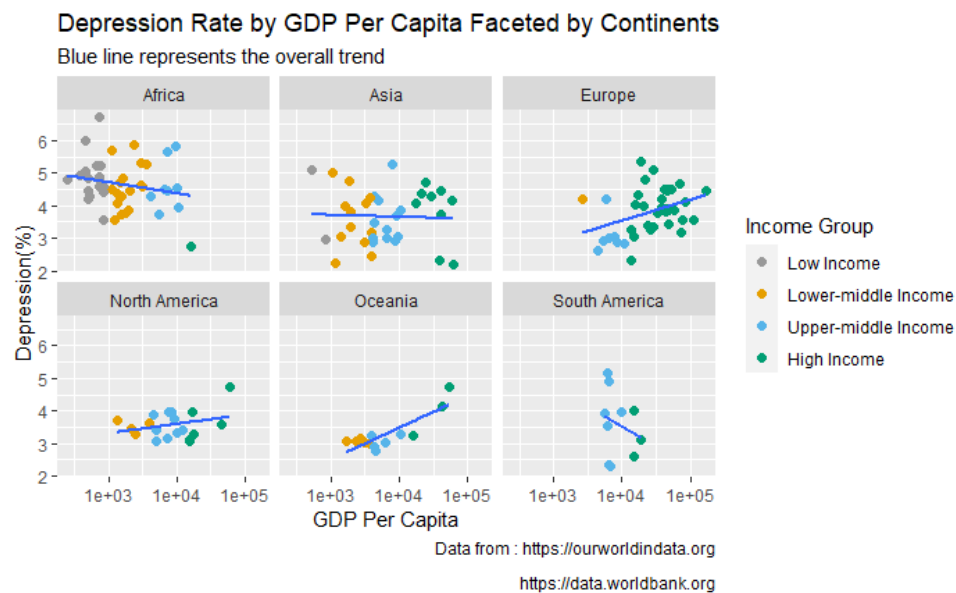


Fig 3.2 Depression percentage by GDP per Capita faceted by Continents and separated by income groups

We can see that in impoverished continents like Africa and Asia, depression rates do not rise in tandem with GDP per capita. On the contrary, depression rates climb when GDP per capita rises in continents such as Europe, Oceania, and North America. We can see that the tendency of rising depression with rising GDP per capita may be traced to Europe, a few Oceanian countries such as Australia and New Zealand, and the United States of America.

We attempted to fit the GAM model by using GDP per capita as an explanatory variable and depression rates as a response variable. Our model could only explain 17.4% of the deviation, so we felt that while it was intriguing to investigate why some nations have higher rates of depression, we needed more granular data to draw any significant conclusions. The prediction made by the model can be seen in Appendix 2.

Research Question 4: Does substance disorder explain depression?

We are looking at two categories of chemicals in our analysis: alcohol and drugs. We show the trend of each predictor with the target variables, such as alcohol/depression use disorder population percent vs depression population percent.

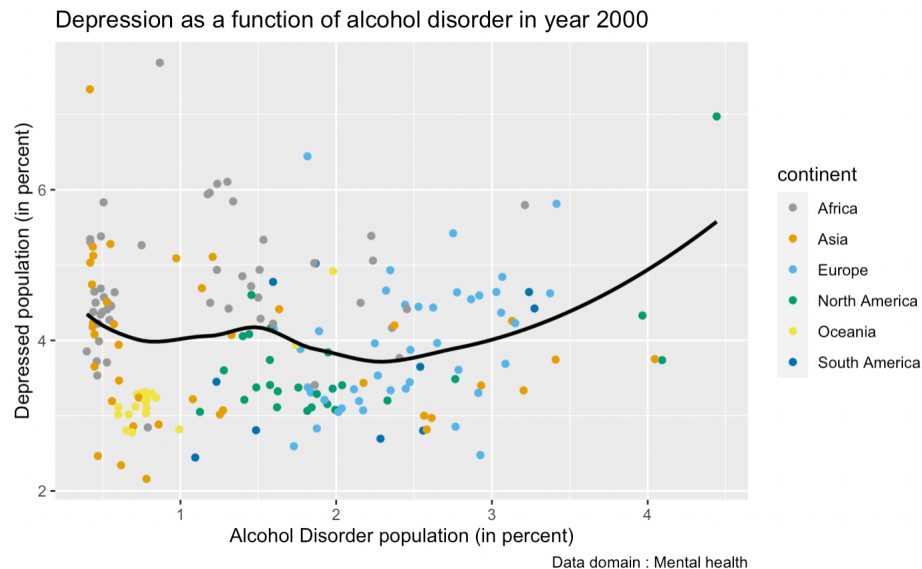


Fig 4.1 Depression as a function of Alcohol disorders in the year 2000

Figure 4.1 depicts a nearly U-shaped relationship between the drinking disorder population and the sad population. However, there is a little departure in trend around 1.4%-1.7% for alcohol use disorder percent. A cluster of data points from Africa (gray in color) and North America can explain this divergence (green in color). According to the deviation, Africa has a higher depression rate but a lower alcohol use disorder rate than North America, and vice versa. Figure 4.2 shows a similar difference in trend when comparing drug use disorder percent to depression percent. Based on this variation, the initial guess is that other factors other than the substance condition may be involved in explaining the depression percentage.

Using the alcohol use disorder and drug use disorder percent variables, a linear model is fitted to predict depression percent. Based on the R-squared value, drug use disorder explains 2% of the variability in depression percent, whereas alcohol use disorder explains 0% of the variability in depression percent. However, considering the interaction between drug use disorder and alcohol use disorder explains 22% of the variability in depression percent, indicating that substance disorders interact.

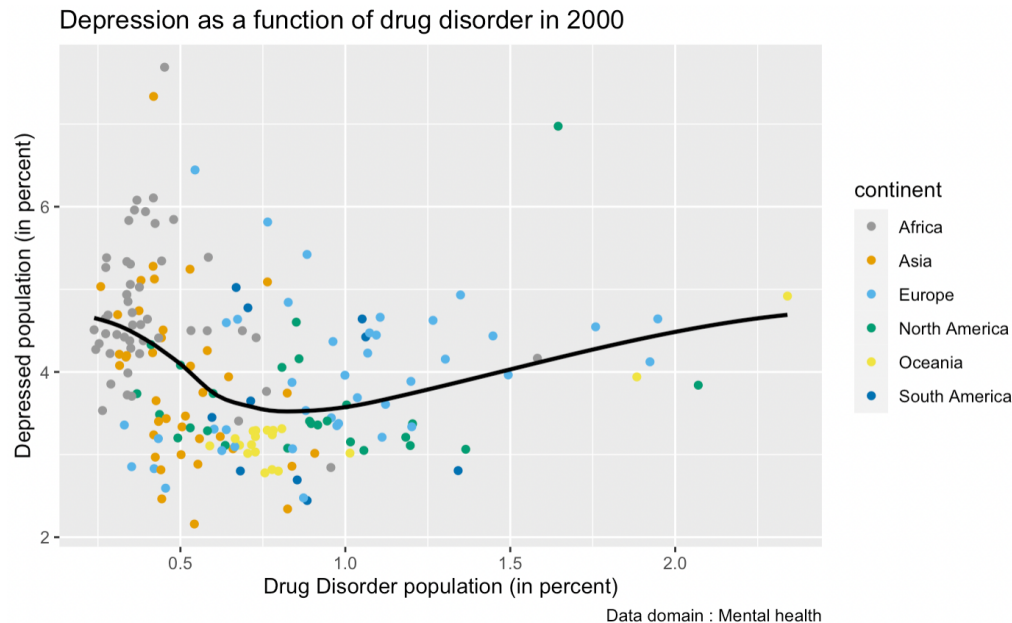


Fig 4.2 Depression as a function of drug disorder in 2000

Research Question 5: Explore the correlation of Age, Sex, and Substance disorders w.r.t depression to analyze the model explainability

To further understand how these variables explain the depression % using linear models, we employed a unified dataset that included age, gender, and drug use disorders into a single dataset for this analysis. The model below provided the greatest fit in our scenario after numerous modeling rounds, altering the parameters and interaction to compare AIC scores, residuals, and heteroskedasticity.

```

{r}
model = lm(dep ~ age + sex + alcohol + drug + sex:drug + age:drug + age:alcohol + sex:alcohol + age:sex, data = depbyAgeGenDis)

```

The above is a fitted linear model to get the variation in depression percentage with the following aspects:

- Age
- Sex
- Alcohol %
- Drug %
- Interaction between sex and drug
- Interaction between sex and alcohol
- Interaction between age and drug
- Interaction between age and alcohol
- Interaction between age and sex

Figure Appendix 1 shows the derived model parameters for the same, we can clearly see that the R-Squared comes to be 61%. We can reasonably say that the variables Age, Sex, and Substance usage explain about 61% of the depression percentage in individuals and that there is some interaction between variables of interest.

Figures 5.1 and 5.2 show that there appears to be a linear link between depression and substance use disorders (alcohol and drug). Figure 5.1 shows that females are generally more depressed than males across all age categories. We may also see that depression increases with increasing alcohol usage in adolescent and adult guys, but decreases in senior males. Depression among females increases with alcohol usage across all age groups, however, the slope becomes less steep as we age (teens start out less depressed, and seniors start out more depressed).

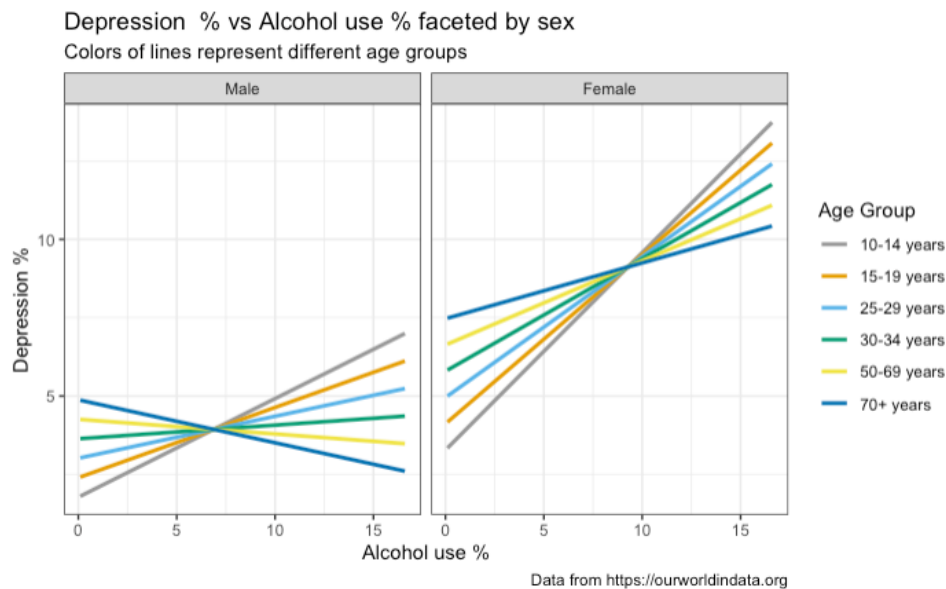


Figure 5.1 Depression percentage vs Alcohol use percentage across age groups and genders

According to Figure 5.2, depression in females is generally higher than in males across all age categories. We can also see that depression among teen guys increases with increased drug use, whereas it decreases among senior males. With increasing drug usage in adult males, depression either increases (25-29 years) or reduces (30-34 years). Female depression increases with drug usage across all age categories except 70+, however, the slope becomes less steep as we advance up the age group (teens start out less depressed, and seniors start out more depressed). Senior females over the age of 70 experienced a small decrease in depression as their drug use increased.

The tendency of decreasing depression with increased drug use may appear counterintuitive, but we would like to investigate more bifurcated data regarding the impact of many types of drugs on depression. There have been controlled studies that show the anti-depressant benefits of caffeine, which may explain some of the decreasing trends in depression among seniors with increased drug usage, but we can't say for sure without more significant bifurcation about the types of medications used for the data at hand.

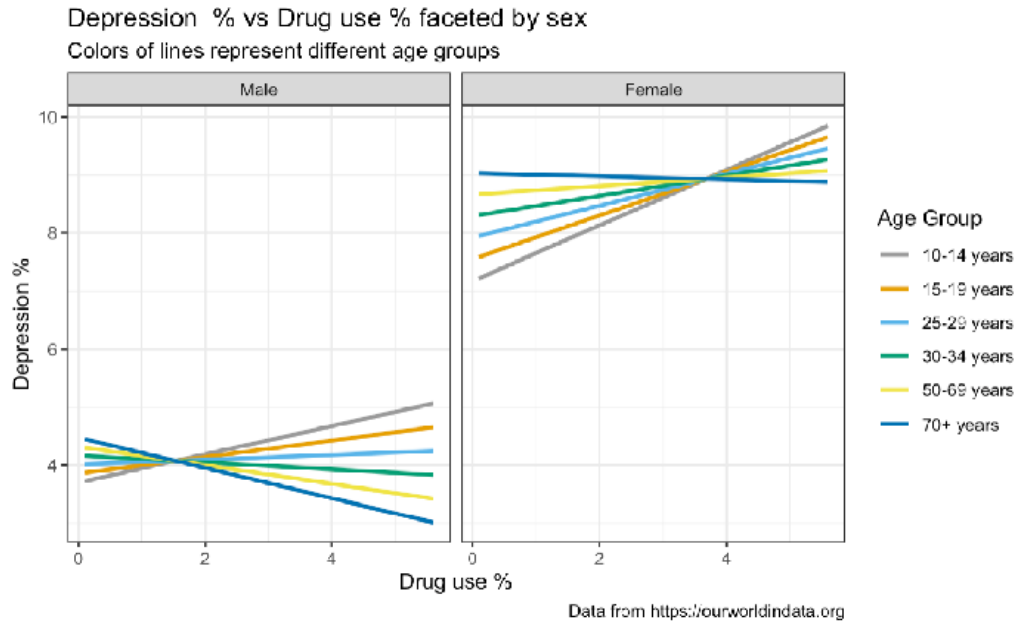


Figure 5.2 Depression percentage vs Drug use percentage across age groups and genders

Conclusions

Age, gender, drug usage, alcohol consumption, and depression rates all have a substantial association. When it comes to evaluating the relationship between economic conditions and depression rates, there is still much to be discovered. The model that we fit yielded an R-square of 0.61, indicating that the model still has some variance to explain. We observed depression in females was generally higher in males regardless of age and substance use. The depression rates of females generally increased with an increase in alcohol use but seemed to decrease with an increase in drug use for some age groups. For males, the depression rates seem to increase with alcohol and drug use in teens, while adults and senior males showed variation in this trend.

Future work

There are many factors that we haven't examined yet, therefore we'd like to investigate them further in the future. We also intend to understand more about the issues we encountered while fitting the GAM model. Finding a dataset with age and gender-based income for countries would help us learn about the interplay between age and gender, income, and depression.

Limitations

The limitations faced during the implementation of the project are as follows:

- While trying to fit a model on the dataset, after conversion of the categorical fields into numerical categorical values when trying to fit a GAM model it was throwing an error which suggested that we couldn't use GAM as the number of categories was quite less than the degrees of freedom required to fit a spline onto the variables which limited us to stick to simpler linear models for our analysis. Usually using method = "REML" would avoid the issue and helps reduce the amount of overfitting in smaller datasets but this wasn't working on our end.

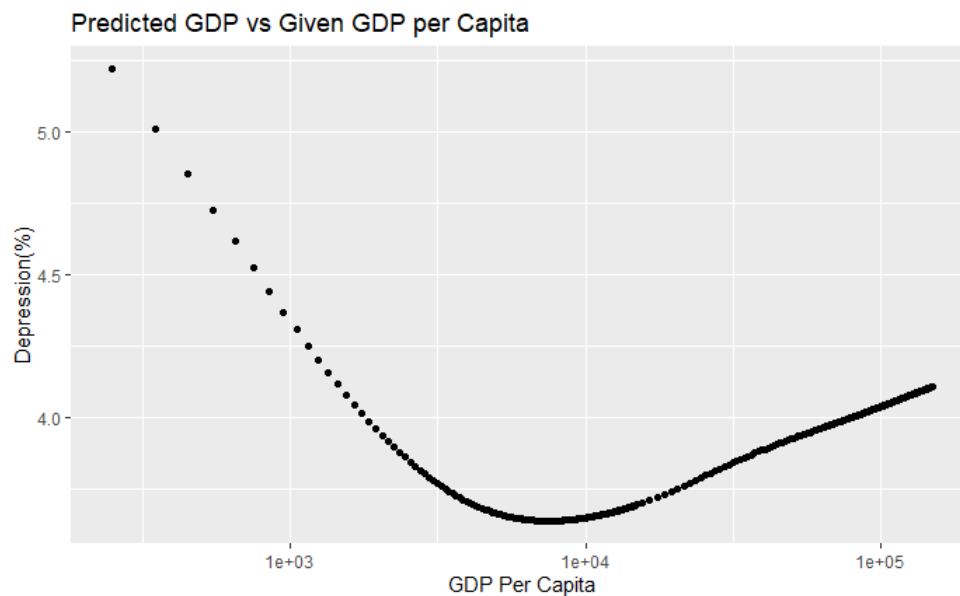
- Limitation of data available to make significant conclusions about the relationship between economic factors and depression.

Appendix

Appendix 1

```
lm(formula = dep ~ age + sex + alcohol + drug + sex:drug + age:drug +
    age:alcohol + sex:alcohol + age:sex, data = depbyAgeGenDis)
      coef.est coef.se
(Intercept) -0.46    0.05
age           0.69    0.01
sex           0.62    0.03
alcohol       0.09    0.02
drug          0.11    0.03
sex:drug      0.23    0.02
age:drug     -0.10    0.01
age:alcohol  -0.09    0.00
sex:alcohol   0.32    0.01
age:sex       0.22    0.01
---
n = 73440, k = 10
residual sd = 1.50, R-Squared = 0.61
```

Appendix 2



Citations:

Alcohol vs depression :[

https://onlinelibrary.wiley.com/doi/abs/10.1111/add.14935?casa_token=NcVGjUpdPgYAAAAA:9CfxE-7Dp7bC_Yj1xPBrtN3NCme7nk3sSRJxvlOXPNWj9bB9_zT66mHEU5_O8CylYg_jtfc4A4uTww]

Caffeine vs depression:

[<https://bnrc.springeropen.com/articles/10.1186/s42269-018-0034-1#:~:text=Conclusion,serotonin%2C%20norepinephrine%2C%20and%20dopamine>]