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Disparities in Mental Health Across Counties in North Carolina

Sophia Wang[1] and Kayvan Lavassani[#]

[1]Chapel Hill High School, USA
[#]Advisor

ABSTRACT

The purpose of this paper is to determine whether there is a significant causal relationship between economic factors and mental health conditions. In recent years, mental health conditions have increased in the population, and people of all ages have reported symptoms of anxiety or depression. In this paper, using data available from all 100 counties in North Carolina, I analyze the relationship between economic factors and mental health conditions. I run simple linear regression to determine the direction of the relationships and then run multiple linear regression to find the factors that are significantly correlated with anxiety/depression ER visits. I find that there is a statistically significant relationship between median income as well as high school graduation rate with anxiety and depression ER visits. Both factors are potentially contributing to the mental health conditions present in people living in North Carolina.

Introduction

Mental health is an important topic that affects all aspects of our lives. According to the National Institute of Mental Health, it is estimated that over one in five U.S. adults have a mental illness (NIMH, 2023). The term mental illness includes many mental health conditions, the most common being anxiety and depression (NAMI, n.d.). Mental health conditions can have a very strong impact on our daily lives. They can affect the way you think and feel, disrupt normal functioning, and increase your risk for self-harm (WHO, 2022). In addition, mental health conditions can be harmful to your physical health. They can put you at a higher risk for diabetes, heart disease, and stroke (CDC, n.d.). There are many factors that can potentially increase your risk for developing a mental health condition such as genetics, environment, lifestyle, poverty, violence, and inequality (NAMI, n.d.; WHO, 2022).

In North Carolina, it is estimated that two million people live with a mental illness (Parker, 2018). Mental health conditions have been increasing steadily for the past eight years, which is a problem that is potentially being exacerbated by income inequality (Colarossi, 2022). Income inequality has been rising in the U.S. for decades, but especially in North Carolina (deBruyn, 2018). For my research, I collected data from all 100 North Carolina counties and analyzed the correlation between economic factors and mental health conditions across North Carolina counties.

Various studies have attempted to establish an association between household income and mental health. One study by Sareen et al. (2011) attempted to find the relationship between household income and mental disorders for U.S. adults. They interviewed over 34,000 adults two times three years apart, to gather data on the change (or lack of change) in income as well as the presence of mental disorders. The study found that low levels of household income are associated with mental disorders and suicide attempts, while high levels of household income are associated with happiness and decreased risk for mental health problems.

Another study by Thomson et al. (2022) aimed to explore the extent to which lower income causes poorer mental health. They found that income changes probably affect mental health, however, the effects are

low. They reported that increased income is associated with improved mental health while decreased income is associated with declining mental health, but they note that their findings have low certainty. A paper by Parra-Mujica et al. (2023) involving UK adults aged 16-24 examined the relationship between average household income and mental health, as well as changes in household income and mental health. They found that higher household income is associated with a smaller risk for depressive symptoms. In addition, they found that increased household income (over childhood and adolescence) has a significant relationship with reduced symptoms of anxiety and depression.

One study (Kaplan et al., 1994) researched the effects of not graduating high school on mental health. They found that there were significant effects on mental health in early adulthood due to not graduating high school. Additionally, not graduating high school increases the likelihood for psychological dysfunction.

Using these previous studies, I hypothesized that economic factors in North Carolina would have a statistically significant correlation to the number of anxiety and depression ER visits, and in finding a correlation, can find an explanation for the disparities in mental health across counties in North Carolina.

Method

The mental health data were collected from ncdetect.org. I used the most recent data, which were from 2021. The data for children in poverty were from countyhealthrankings.org and the data median income were from hdpulse.nimhd.nih.gov. All other economic data were from ncbudget.org, which has data from 2016 - 2022.

The six economic factors I used are median income, percentage of children in poverty, percentage of residents without health insurance, life expectancy, high school graduation rate, and percentage of residents receiving SNAP (Table 1). The mental health conditions I used are anxiety and depression. In order to quantify those variables, I used the number of ER (Emergency Room) visits from 2021 for anxiety and for depression (Table 1).

Using all of my data for North Carolina counties, I ran simple linear regression for each economic factor and anxiety/depression ER visits. Then, I ran multiple linear regression with all economic factors and anxiety/depression ER visits.

The models for multiple regression model are as follows:

$$\begin{aligned}\text{Anxiety ER Visits} &= \beta_0 + \beta_1 \text{Median Income} + \beta_2 \text{Percentage of Children in Poverty} \\ &+ \beta_3 \text{Percentage of Residents without Health Insurance} + \beta_4 \text{Life Expectancy} \\ &+ \beta_5 \text{High School Graduation Rate} + \beta_6 \text{Percentage of Residents Receiving SNAP}\end{aligned}$$

$$\begin{aligned}\text{Depression ER Visits} &= \beta_0 + \beta_1 \text{Median Income} + \beta_2 \text{Percentage of Children in Poverty} \\ &+ \beta_3 \text{Percentage of Residents without Health Insurance} + \beta_4 \text{Life Expectancy} \\ &+ \beta_5 \text{High School Graduation Rate} + \beta_6 \text{Percentage of Residents Receiving SNAP}\end{aligned}$$

Table 1.

Variables	Description
Anxiety ER Visits	The data for anxiety ER (Emergency Room) visits are from 2021.
Depression ER Visits	The data for depression ER (Emergency Room) visits are from 2021.
Median Income	The data for median income are from 2017 - 2021. I predict that it will have a negative correlation with anxiety-depression ER visits.
Percentage of Children in Poverty	The data for the percentage of children in poverty are from 2021. I predict that it will have a positive correlation with anxiety/depression ER visits.

Percentage of Residents without Health Insurance	The data for the percentage of residents without health insurance are from 2016 - 2020. I predict that it will have a positive correlation with anxiety/depression ER visits.
Life Expectancy	The data for life expectancy are from 2018 - 2020. I predict that it will have a negative correlation with anxiety/depression ER visits.
High School Graduation Rate	The data for high school graduation rate are from 2021. I predict that it will have a negative correlation with anxiety/depression ER visits.
Percentage of Residents Receiving SNAP	The data for the percentage of residents receiving SNAP are from 2022. I predict that it will have a positive correlation with anxiety/depression ER visits.

Results

Simple Linear Regression

After running simple linear regression for each of the economic factors and anxiety ER visits, I found that median income had the highest correlation with the number of anxiety ER visits with $R^2 = 0.117$. These two variables have a negative correlation, so the direction is as predicted (Figure 2).

The next highest correlation was with life expectancy, with $R^2 = 0.063$. Life expectancy and anxiety ER visits have a negative correlation, which is as predicted (Figure 4). The coefficient of determination for high school graduation rate was 0.05. High school graduation rate and anxiety ER visits have a negative correlation, which is as predicted (Figure 5). For the percentage of residents without health insurance, $R^2 = 0.04$. Percentage of residents without health insurance and anxiety ER visits have a positive correlation, which is as predicted (Figure 3).

The coefficient of determination for percentage of children in poverty and percentage of residents receiving SNAP were 0.034 and 0.033 respectively, which are relatively low. They both have positive correlations, which is as predicted (Figure 1 and Figure 6). This indicates that crossing the threshold into poverty or needing food assistance does not significantly affect the risk of developing anxiety.

After running simple linear regression for each of the economic factors and depression ER visits, I found that median income had the highest correlation with the number of depression ER visits with $R^2 = 0.094$. The coefficient of determination for high school graduation rate, life expectancy, percentage of residents receiving SNAP, percentage of children in poverty, and percentage of residents without health insurance were 0.064, 0.048, 0.035, 0.03, and 0.021 respectively.

Overall, the results were fairly similar with anxiety and depression ER visits. Each economic factor had the same direction for the correlation when graphed against anxiety and depression ER visits.

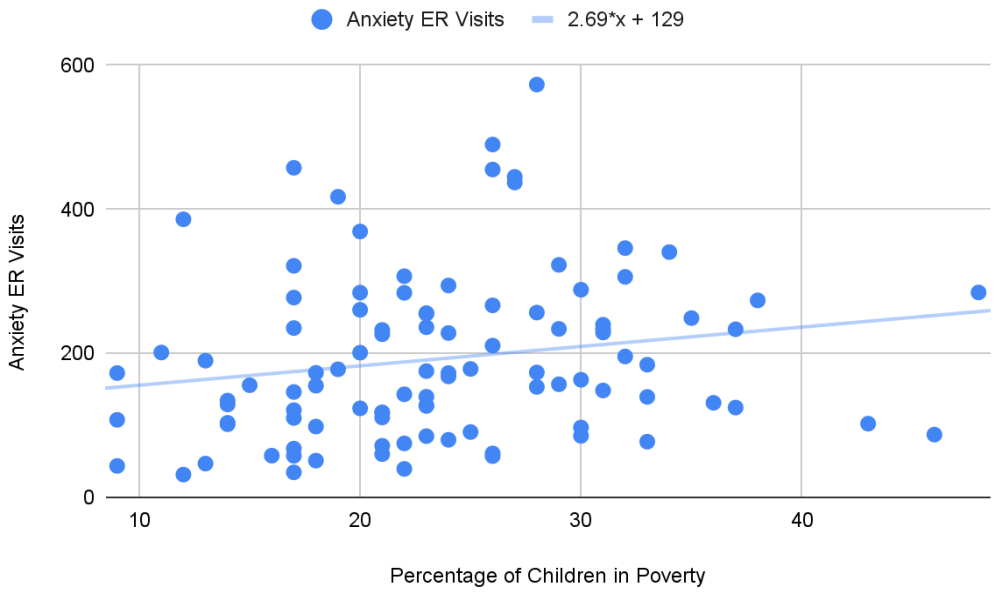

Figure 1. Graph of Percentage of Children in Poverty vs. Anxiety ER Visits

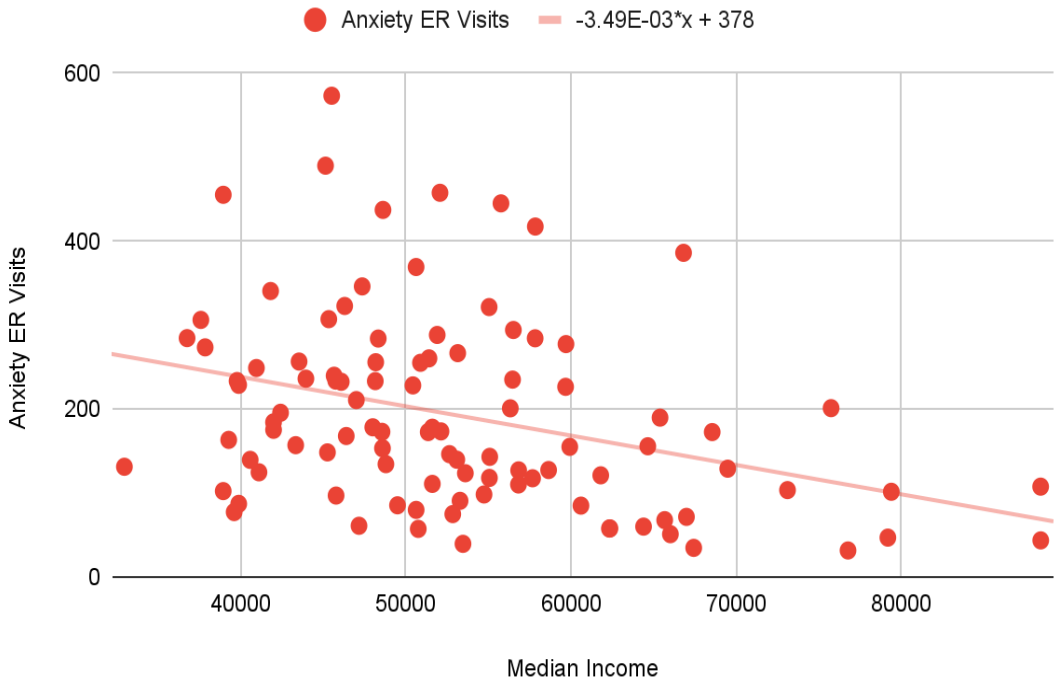

Figure 2. Graph of Median Income vs. Anxiety ER Visits

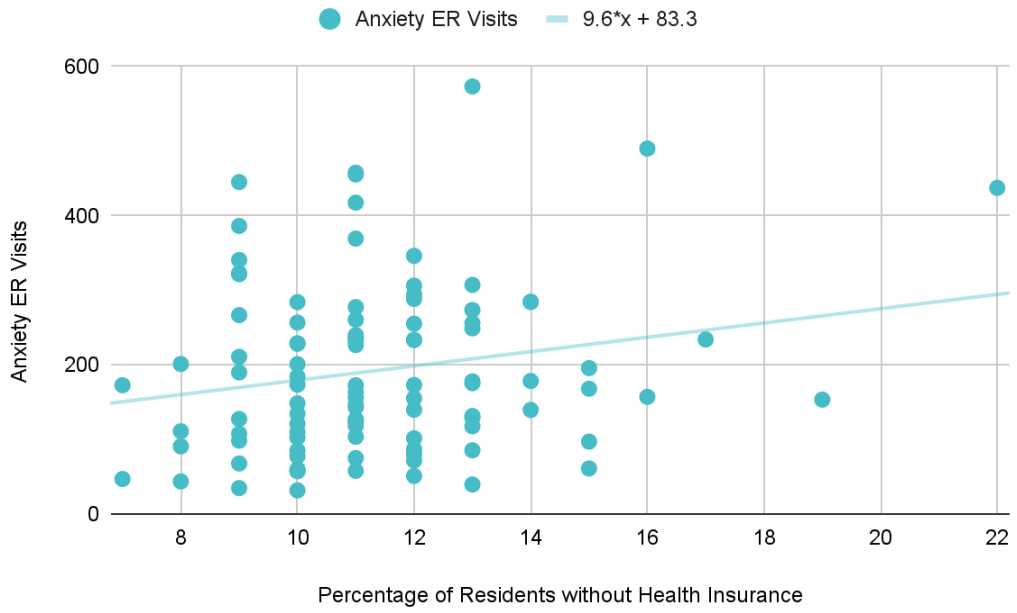

Figure 3. Graph of Percentage of Residents without Health Insurance vs. Anxiety ER Visits

Figure 4. Graph of Life Expectancy vs. Anxiety ER Visits

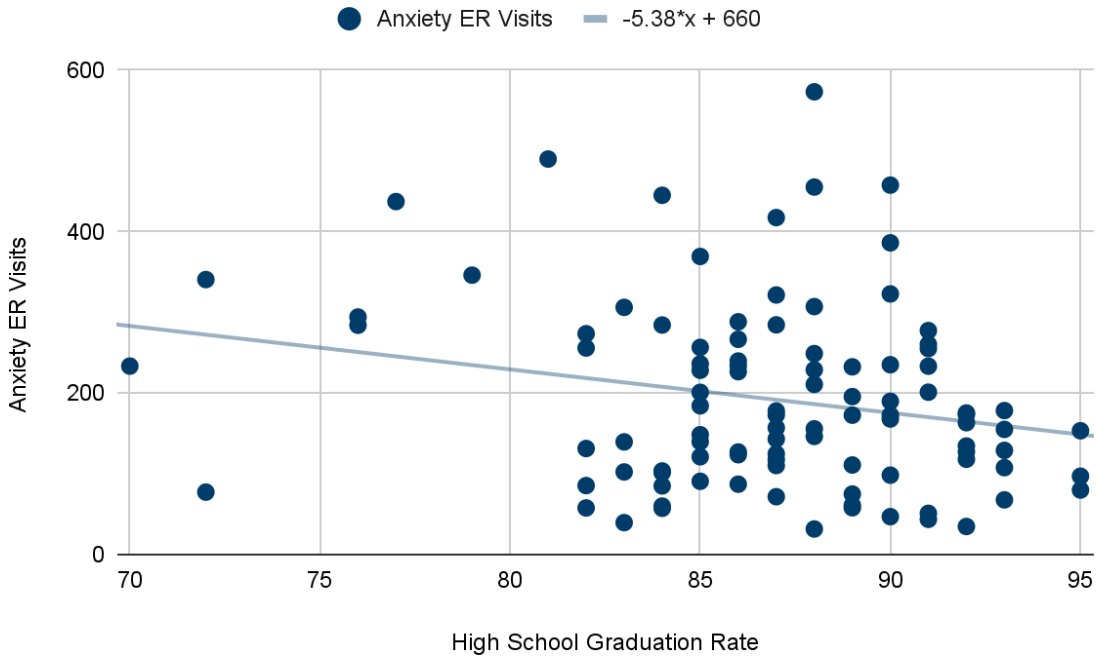

Figure 5. Graph of High School Graduation Rate vs. Anxiety ER Visits

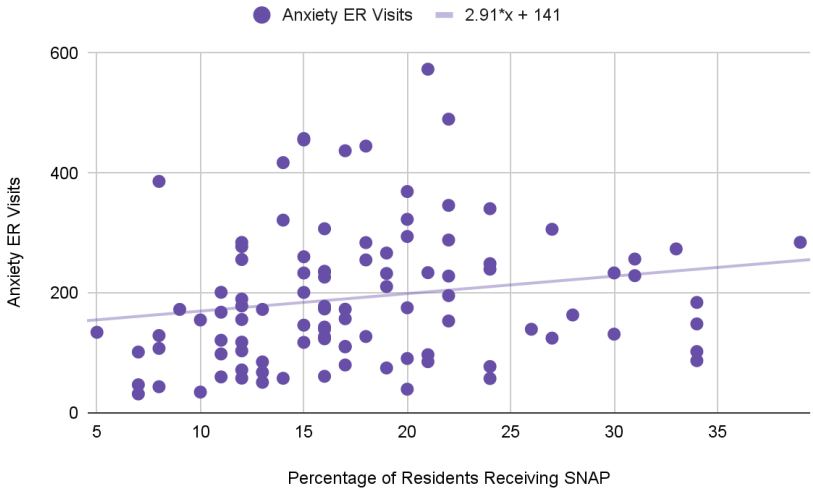

Figure 6. Graph of Percentage of Residents Receiving SNAP vs. Anxiety ER Visits

Multiple Linear Regression Models

For the analysis of economic factors and anxiety ER visits, I run the following multiple linear regression model:

$$\begin{aligned} Anxiety\ ER\ Visits \\ &= \beta_0 + \beta_1 Median\ Income + \beta_2 Percentage\ of\ Children\ in\ Poverty \\ &+ \beta_3 Percentage\ of\ Residents\ without\ Health\ Insurance + \beta_4 Life\ Expectancy \\ &+ \beta_5 High\ School\ Graduation\ Rate \\ &+ \beta_6 Percentage\ of\ Residents\ Receiving\ SNAP \end{aligned}$$

After running multiple linear regression with all the economic factors and anxiety ER visits, I found that median income, with a p-value of 0.0033, was the economic factor with the strongest statistically significant result when $\alpha = 0.05$ (Table 2). If I was using a higher significance level, $\alpha = 0.10$, high school graduation rate would also have a statistically significant result with a p-value of 0.074. Although the other economic factors are statistically insignificant, they can still be used to help predict anxiety ER visits.

Table 2. Multiple Linear Regression Results for Anxiety ER Visits

Predictor	**Coefficient**	**Estimate**	**Standard Error**	***t*-statistic**	***p*-value**
Constant	β_0	1394.2492	652.4835	2.1368	0.0352
Median Income	β_1	-0.0054	0.0018	-3.0174	0.0033**
Percentage of Children in Poverty	β_2	-5.0998	3.4379	-1.4834	0.1413
Percentage of Children without Health Insurance	β_3	4.4003	5.1415	0.8558	0.3943
Life Expectancy	β_4	-5.6932	7.9623	-0.715	0.4764
High School Graduation Rate	β_5	-4.4241	2.4484	-1.807	0.074*
Percentage of Residents Receiving SNAP	β_6	-1.3663	3.7655	-0.3628	0.7175

**p <0.05, *p<0.10

Overall $R^2 = 0.1874$

For the next multiple regression model, the model is as follows:

$$\begin{aligned} \text{Depression ER Visits} \\ &= \beta_0 + \beta_1 \text{Median Income} + \beta_2 \text{Percentage of Children in Poverty} \\ &+ \beta_3 \text{Percentage of Residents without Health Insurance} + \beta_4 \text{Life Expectancy} \\ &+ \beta_5 \text{High School Graduation Rate} + \beta_6 \text{Percentage of Residents Receiving SNAP} \end{aligned}$$

After running multiple linear regression with all the economic factors and depression ER visits, I found that median income, with a p-value of 0.0091, was the economic factor with the strongest statistically significant result when $\alpha = 0.05$ (Table 3). High school graduation rate also had a statistically significant result with a p-value of 0.0358. Although the other economic factors are statistically insignificant, they can still be used to help predict depression ER visits.

Table 3. Multiple Linear Regression Results for Depression ER Visits

Predictor	Coefficient	Estimate	Standard Error	*t*-statistic	*p*-value
Constant	β_0	802.8523	457.1921	1.7561	0.0824
Median Income	β_1	-0.0033	0.0013	-2.6623	0.0091**
Percentage of Children in Poverty	β_2	-3.4981	2.4089	-1.4521	0.1498
Percentage of Children without Health Insurance	β_3	1.7849	3.6026	0.4954	0.6215
Life Expectancy	β_4	-1.4708	5.5792	-0.2636	0.7926
High School Graduation Rate	β_5	-3.6536	1.7156	-2.1297	0.0358**
Percentage of Residents Receiving SNAP	β_6	0.0449	2.6385	0.017	0.9865

**p <0.05

Overall $R^2 = 0.1042$

Discussion

In this study, I found that median income is a statistically significant variable in predicting mental health conditions. This suggests that economic factors are potentially causing the disparity in mental health across counties in North Carolina.

The results from my research are consistent with the results found in the study conducted by Sareen et al. (2011). Both my research and this study found that low levels of household income are significantly associated with mental health problems, while high levels of household income are associated with fewer mental health problems.

My research results are also similar to the results found in the study by Thomson et al. (2022), which reported that increased income is associated with improved mental health while decreased income is associated with declining mental health. These results indicate that income likely has an effect on mental health.

In my research, I also found that high school graduation rate has a significant effect on mental health. This was found in a study by Kaplan et al. (1994), which reported that not graduating high school increases the likelihood of negative mental health effects.

I did not find any significance in life expectancy, high school graduation rate, percentage of residents without health insurance, percentage of children in poverty, or percentage of residents receiving SNAP. However, in the graphs with these insignificant predictive variables, although they have a weak correlation, the direction is as predicted.

One limitation with this study is that it is difficult to establish a causal relationship between economic factors and mental health conditions. Although these have a correlation, that correlation could be caused by confounding variables or reverse causation. More research is needed to explore this relationship to account for confounding and reverse causation. Another potential issue when running multiple linear regression is how the predictive variables relate to each other, and it would be helpful to further examine these relationships in order

to minimize multicollinearity. This would help determine the most significant economic factors that have a direct impact on mental health.

An important consideration when studying mental health is seeing how socio-demographic factors like gender, age, and race affect mental health conditions. For future studies, it would be helpful to consider socio-demographic factors and to add more economic factors and mental health conditions. Additionally, running multiple linear regression with many different combinations of economic data and mental health conditions would help to find the best equation for predicting mental health conditions.

Conclusion

This study has important implications in that it provides evidence of economic factors that influence mental health conditions in our population. Given the large number of people with mental health conditions, it is important to analyze the potential causes and find ways to improve mental health. Although my study is focused on North Carolina, the results can be used to help provide evidence of specific factors that influence the prevalence of mental health conditions across the population.

Since numerous studies have come to the conclusion that economic factors have a significant relationship to mental health, future studies should look into what can be done to help improve the mental health of low-income families. For example, they could study the effect of low-cost or no-cost mental health services. Another possible way to improve mental health is to find ways to help people gain access to education and complete a high school education.

In summary, since median income and high school graduation rate have a significant correlation to anxiety/depression ER visits, it can be concluded that economic factors probably have an effect on mental health conditions. Additionally, it is possibly this relationship that creates a disparity in mental health across North Carolina counties.

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