

Assessing the Effectiveness of Screening Tools in Detecting At-Risk Mental Health Patients

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Problem Statement and Background

Patients transitioning from emergency care for injuries or acute illnesses to hospital discharge are particularly vulnerable to developing significant mental health challenges during this critical recovery phase. The emotional and psychological impact of patients' medical experiences increases the risk of developing mental health conditions such as depression, anxiety, and post-traumatic stress disorder (PTSD). Despite the urgent need for early identification and intervention for at-risk individuals, many existing screening tools often fall short in effectively addressing the diverse needs of the population, particularly those from various multicultural backgrounds. These shortcomings can result in missed opportunities for timely support, leaving patients at risk for poor recovery and outcomes.

The goal of our analysis is to measure and visualize the effectiveness of these screening tools in identifying at-risk patients based on their survey responses. The trends observed in the visualizations, whether upward or downward, will help us evaluate the effectiveness of the screening process in recognizing these issues. By comparing and contrasting these visualizations and data, we aim to draw conclusions about the screening's efficacy and consider whether a different approach might be more effective in identifying at-risk factors for mental health. We

also aim to investigate how factors such as race, language spoken, gender, and socioeconomic status influence screening results, and whether these factors contribute to disparities in mental health care.

Our motivation stems from the growing recognition of persistent healthcare disparities, specifically those affecting marginalized and underserved populations. By investigating how factors like socioeconomic status and cultural background influence the results of mental health screening, we aim to provide valuable data-driven insights that can improve early identification and support for at-risk individuals. We hope to reduce healthcare disparities and improve patient outcomes through more effective, culturally sensitive screening practices.

Introduction to Our Data

For this research project we used The Hospital Mental Health Risk Screen dataset (HMHRS) from 2021-2023, available on the openICPSR website (<https://www.openicpsr.org/>). They used their own personalized screening process, where they took a different approach at identifying at-risk patients across multiple multicultural background groups. Most of this data was collected using many different self-reported methods, including mail and on-site questionnaires and paper-and-pencil interviews. This dataset includes three different files: “HMHRS replication paper data”, “HMHRS replication data dictionary”, and a “README for Carlson 2023 HMHRS Replication paper”. When looking over the csv we noticed there was some missing information, this could stem from the cultural factors that play a significant role in how individuals interpret and respond to survey questions. Through language differences, misunderstanding of question, and unsure of the weight each question carries. The HMHRS tool was designed to help with early identification of mental health risks, providing a culturally

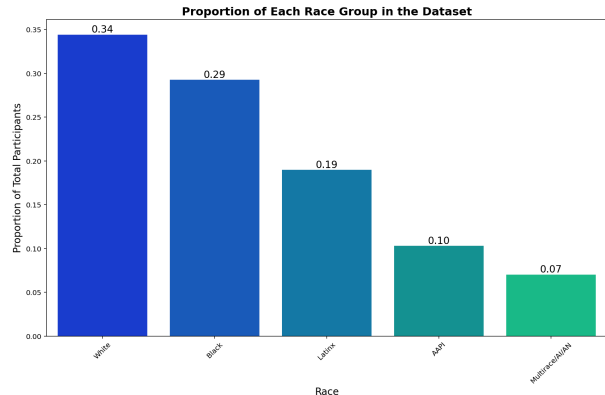
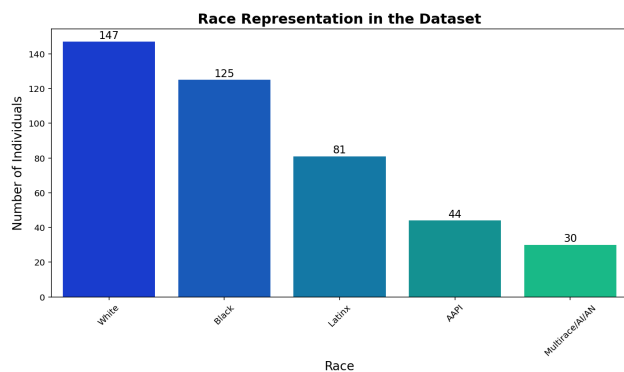
sensitive framework that can lead to more effective interventions tailored to the unique experiences and challenges faced by patients.

Data Science Approaches

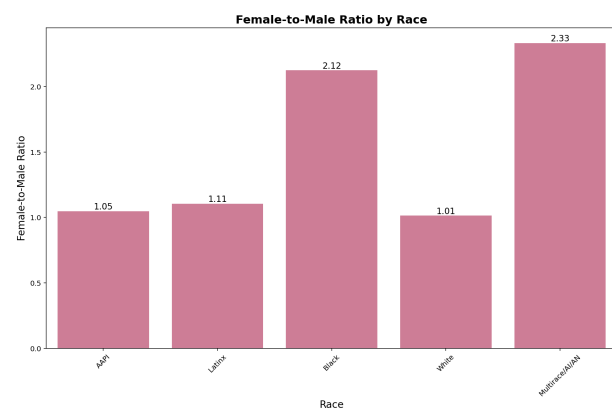
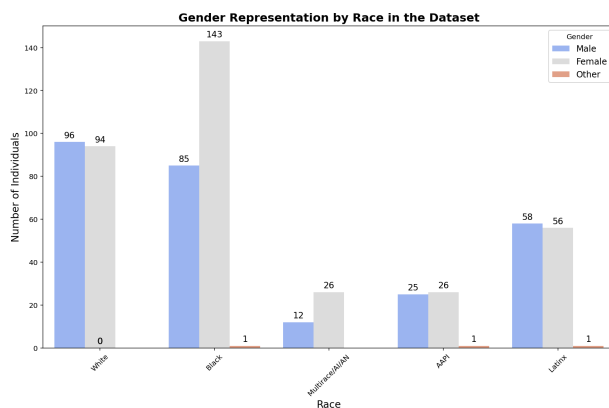
Throughout the analysis of our data, we started by using a bar chart to compare the racial representation in the dataset, which helped us identify which ethnic groups were most and least represented. This was achieved by performing a calculation where the total amount of each race was added then taking the total amount for each race and dividing it by the total number of participants. To compare how male and female representation within each racial group we made a second bar chart, which allowed us to identify gender disparities when comparing each race's ratio female:male. A calculation was also performed to obtain this finding, by adding the number of females and males by race, then dividing the total count of females by males to obtain the ratio. To compare how income influences mental health we decided to make a line chart, which shows the mental health differences across various socio-economic groups. Lastly, in order to analyze our data we decided to make three linear regression graphs to best compare how socioeconomic status affects mental health, specially comparing feelings of being "Not On Top of Things", "Stressed", and "Bad About Self" based on income levels. These linear regressions help us analyze the impact of socioeconomic status on various mental health outcomes.

Results and Conclusions

Throughout the course of this project we've learned that socioeconomic status, race, and gender all play significant roles in shaping mental health outcomes.

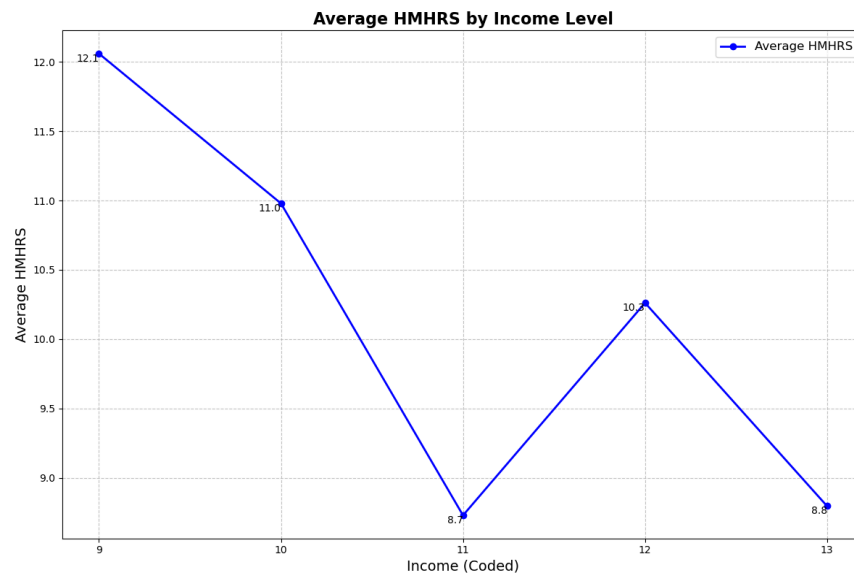


When answering the question “Which race was the most and least represented in the dataset?”, the visualizations showed the racial distribution across the data. Our findings indicated that the “White” group had the highest representation, making up 34% of the survey responses. While the “Multirace/BI/AN” group had the lowest representation, making up 7% of the responses within the data. These findings show the need for more inclusive representation across racial groups when trying to identify the mental health risks of a certain population.

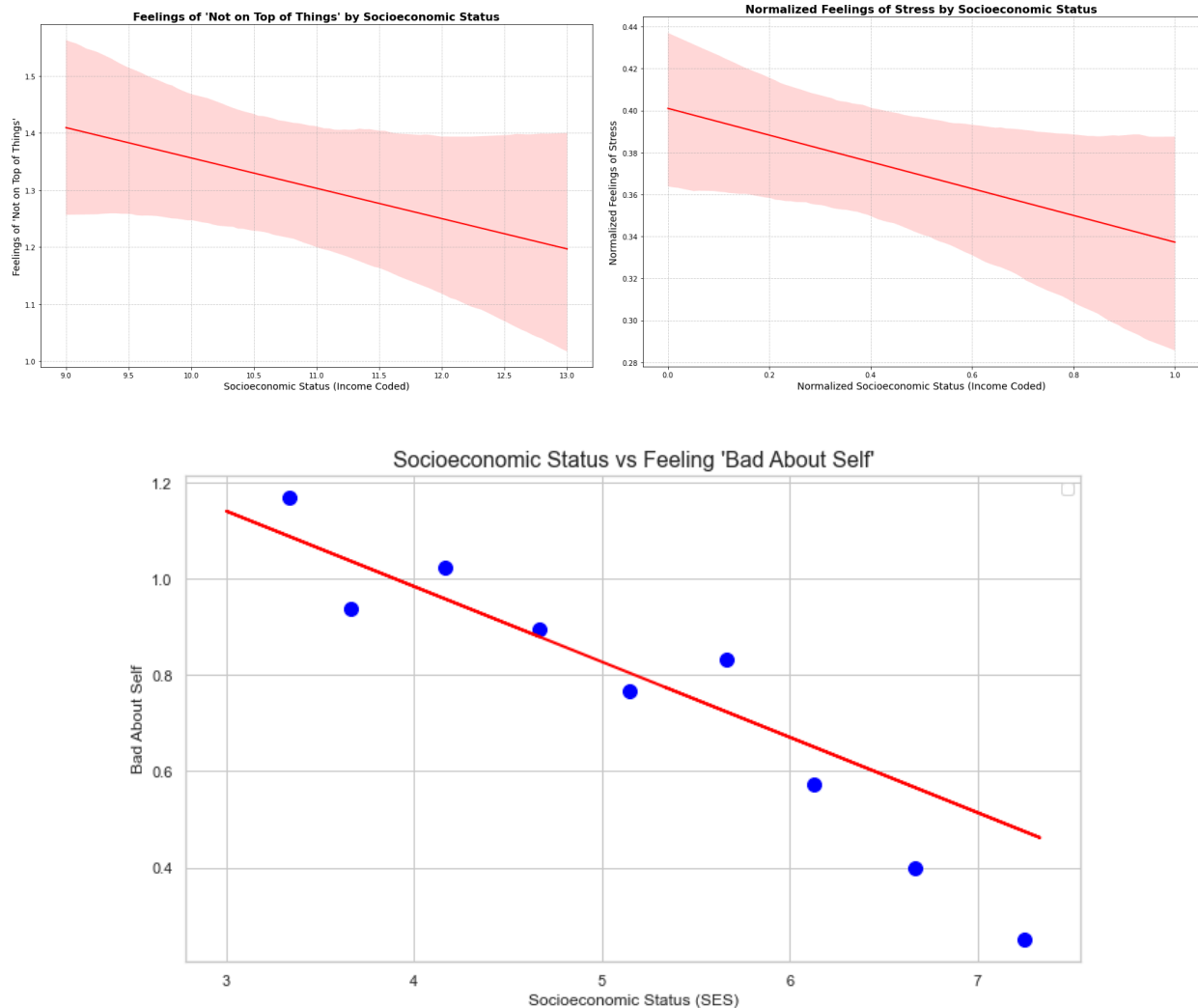


When answering the question “Which race had the most and least male/representation in the exam?”, these visualizations showed the gender distribution by race and the female-to-male ratio for each race group. The largest gender disparity was among those who identify as “Multirace/BI/AN”, with a 2.33:1 ratio, showing a higher representation of females compared to males. The lowest gender difference was seen within those who identified as “White” with a

1.01:1 ratio, showing a more balanced gender representation within this group. These findings show the importance of gender representation within different racial groups and the need to address gender disparities when examining mental health outcomes.



When discussing the correlation between income levels and HMHRS results, the graph indicates a close inverse relationship between HMHRS scores and income at different levels. This means that people making less than \$25,000 are often not scoring well, while people who earn \$50,000-\$74,999 are also not scoring well. For those earning between \$75,000 and \$99,999, however, the opposite applies as their results improve, followed by another decline that is momentarily seen among those earning \$100,000 and above. The tendencies reflect complicated relations between economic status and mental well-being with mental health potentially having different risk levels that do not necessarily correlate directly with the changes in income.



The regression line slopes downward, indicating a negative relationship between Socioeconomic Status (SES) and the feeling of "Bad About Self". This suggests that individuals with higher SES characterized by greater income, better education, and more stable employment tend to feel less "Bad About Self". There is a clear trend in the relationship between socioeconomic status and how individuals feel about themselves. All the regression lines are sloping downwards, which means that the better the socioeconomic status is the less likely they are to feel stressed or have low self-esteem and mental well-being. The trend implies that socioeconomic advantages affect self-esteem and mental well-being. People with higher SES

might experience fewer stressors related to financial instability, education barriers, or job insecurity, which could contribute to a more positive sense of self. This finding highlights the potential role of SES as a mitigating factor against negative self-perception and supports the importance of addressing socioeconomic disparities to improve mental health outcomes.

We chose to explore the correlation between several other factors that we found interesting and would want to explore in the future. The results show us that there is a strong correlation between these factors. The negative correlation means that as one increases the other decreases. So for example as seen in our previous graphs as income gets higher the stress levels decrease and vice versa.

Correlation between income and stress: -33.011951448241746
Correlation between stress and age: -93.17949549993779
Correlation between mental health score and education level: -46.112400100617855
Correlation between mental health score and income: -63.930155537177455
Correlation between mental health score and education level: -106.3480837199253

In conclusion, the dataset used in this study was diverse and included individuals from various ethnic and socioeconomic backgrounds. Our analysis revealed a couple patterns within this dataset: individuals from higher socioeconomic backgrounds generally did not have high mental health scores, while those from lower socioeconomic backgrounds tended to report lower self-esteem, higher stress, and more mental health symptoms. Additionally, we also found that more gender representation is needed within racial groups, particularly for those identifying as Multirace/AI/AN and Black. A limitation of this data was the small sample size, along with a significant number of participants who completed the survey did not follow up.

This work is significant because it emphasizes the complex interplay between socioeconomic status, mental health, gender, and self-esteem across diverse ethnic groups. The

findings of this research challenge the common assumption that higher-income socioeconomic groups always have better mental conditions. Meanwhile, the disparities within ethnic groups and genders underscore the necessity of adopting effective mental health interventions and support in these communities. This is vital for policymakers, clinicians, and community leaders aiming to design effective, culturally competent mental health programs and interventions.

Future Work

Building on the findings of this study, we aim to explore the impact of factors like; investigating the impacts of a person's education, marital status, and the scoring of other mental health related questions on overall HMHRS scores. By analyzing other datasets that have a larger number of participants, equally diverse within ethnicity, economic status, and gender, we hope to uncover patterns that highlight at-risk populations.

Additionally, if there is no dataset that meets our need for analysis, we plan to create our own survey by collaborating with local mental health organizations. These collaborations will help us create well thought-out questions that cover diverse backgrounds, education levels, and cultural understanding. While also educating participants on the importance of thinking and answering each question.

Citations

Carlson EB. Performance replication of the Hospital Mental Health Risk Screen in 631 U.S. patients admitted through emergency care, 2021-2023. *Openicpsr.org*. Published online October 1, 2024. doi:<https://doi.org/10.3886/E208549V1>

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Mental Health Risk Screen in ethnoracially diverse U.S. patients admitted through emergency care. *PloS one*. 2024;19(10). doi:<https://doi.org/10.1371/journal.pone.0311256>