

Evaluating Screening Tools for Identifying Mental Health Risk

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Abstract

This project investigates the mental health risks faced by patients transitioning from emergency care to hospital discharge with a focus on the intersection of medical recovery and mental health outcomes. Recognizing the vulnerability of these patients, especially those who have experienced injuries or acute illnesses – the study explores how socioeconomic factors like race, income, work status, and gender influence mental health screening results. Our project aims to identify disparities in healthcare access and outcomes. The goal being to highlight the role of social determinants in shaping the effectiveness of current mental health risk assessments. By analyzing these factors, the goal is to uncover patterns that inform more personalized and equitable healthcare practices in order to potentially improve early identification and intervention for those at risk of mental health issues such as depression, anxiety and post-traumatic stress disorder (PTSD).

Introduction

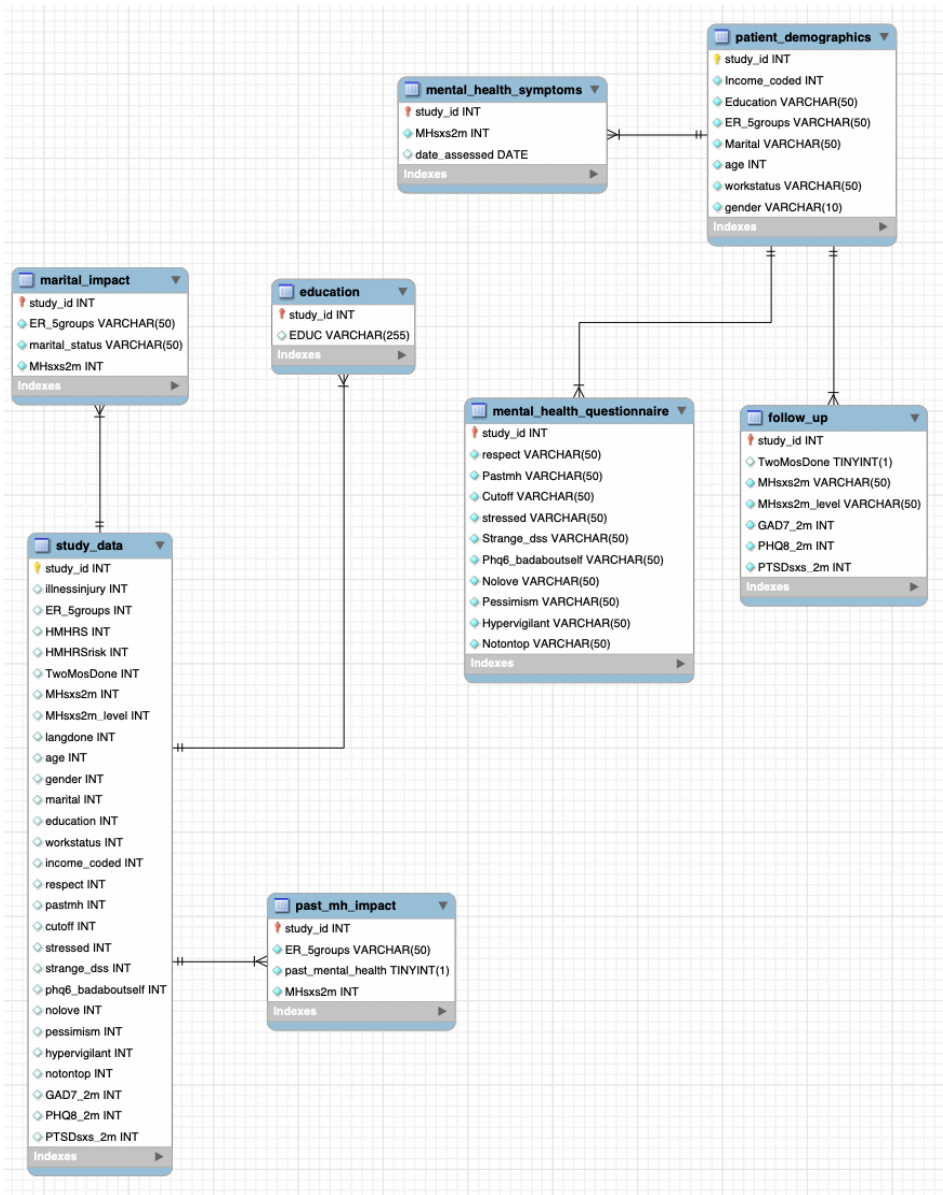
The goal of this project is to explore how socioeconomic factors – such as race, income, gender, language, and other demographic characteristics affect mental health risk assessment outcomes for patients transitioning from emergency care to hospital discharge. Patients in this group are extremely vulnerable to developing serious mental health conditions during the critical recovery period, yet existing screen tools often fail to adequately address the culture and socioeconomic diversity of the patient population. This research project seeks to address this gap by examining the prevalence of mental health conditions like depression, anxiety, and PTSD in different demographic groups with the aim of uncovering disparities in mental health outcomes.

Our motivation stems from growing recognition of persistent healthcare disparities, particularly those that affect marginalized and underserved populations. By investigating how factors like socioeconomic status and cultural background influence the results of mental health screening, we hope to contribute valuable data-driven insights that can improve early identification of at-risk individuals.

The significance of this study lies in its potential to inform the development of personalized healthcare practices, ultimately reducing health disparities and improving mental health outcomes across diverse populations. This work aims to raise awareness about mental health risks in different demographics, break down barriers to mental healthcare, and advocate for more inclusive healthcare practices with respect to gender, culture, socioeconomic status, and education.

Database Design

Our primary key, `study_id`, is used to connect entities like `patient_demographic`, `mental_health_symptoms`, `mental_health_questionnaire`, and `follow_up`. Each of the entities have a many-to-one relationship with `patient_demographic` as it holds information about each patient's responses and data to the entity. This ensures all entities lead to one unique identifier, making it convenient and easy to access specific data.



Data Sources and Methods

The data used in this project was sourced from the replication study of the Hospital Mental Health Risk Screen, which involved 631 U.S. patients admitted through emergency care between 2021 and 2023 [1]. This dataset explored mental health risk factors and outcomes of patients admitted to emergency mental health facilities over a two-year period. Data was accessed through OpenICPSR repository and upon downloading the data was given three excel sheets. One titled “ HMHRS replication paper data “ which is the csv file with all necessary data, “HMHRS replication data dictionary” which is a xlsx with an explanation for the numbers such as how ethnicity, income, and education were documented, and “README for Carlson 2024 HMHRS Replication paper” which is a txt file explaining the background of the study. We also read the publisher's research paper published in PLOS One by Carlson et al. (2024) [2] to help us gain a better understanding behind the questions asked.

The data was initially imported into an SQL database for analysis. During the import process, null constraints were implemented to prevent the entry of blank or missing values to ensure the integrity of the dataset. Several categorical variables were transformed into numerical values to standardize the data for analysis. For example, the data column for ER_5groups (renamed to Ethnicity) used numerical values (0-5) to represent specific ethnic groups. Similarly the income_code data column (renamed to Income) used numerical values of -1, 9, 10, 11, 12, 13 which represented different incomes. In the income_code field, invalid or missing data was replaced with a value of -1 which represents unknown or unspecified income information. Another example is the education data column where 0-5 represents different levels of education. These numericals values were retained in relevant columns such as “cutoff: as “stressed” to maintain consistency in the dataset.

All steps taken to obtain, clean, and analyze the data can be fully reproduced in the future. Additionally, visualizations of the data were generated using Excel, Google Sheets, and Google Colab with the relevant information obtained from our analyzed data (query outputs).

Analysis

List of questions being answered throughout this project:

1. Is there a relationship between income and educational attainment in influencing the severity of 2-month mental health symptoms, with a breakdown by ethnicity?
2. How do language preferences and race interact to influence mental health symptoms, and what roles does education play in this relationship?
3. How does marital status and past mental health history impact mental health symptoms across different ethnoracial groups?
4. What is the relationship between PTSD symptoms and feelings of being cut off by others, and how does this vary across different marital statuses?

Question 1

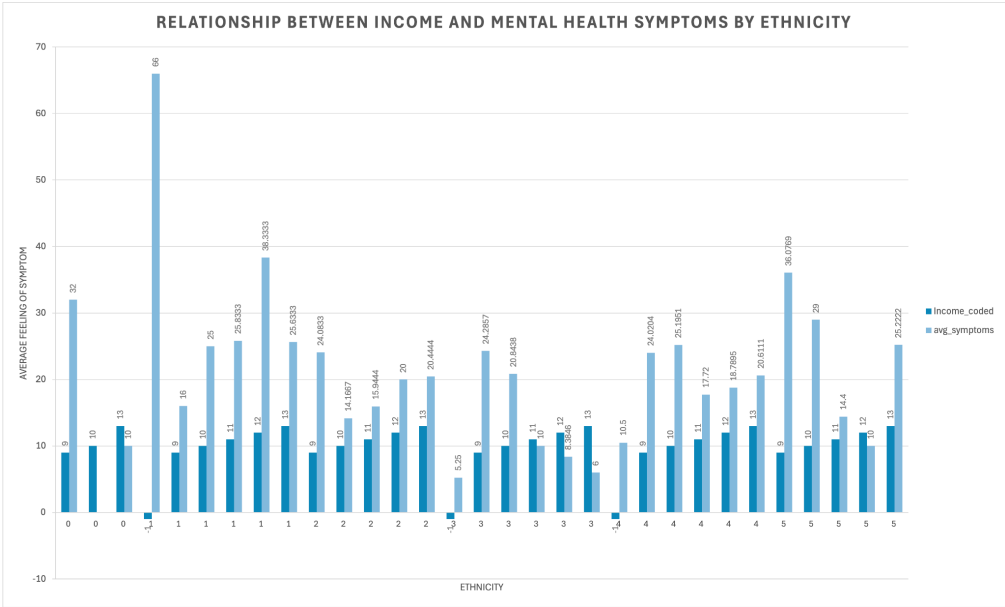
“Is there a relationship between income and educational attainment in influencing the severity of 2-month mental health symptoms, with a breakdown by ethnicity?”

Query 1 and Output 1:

```
-- Query 1: Relationship Between Income, Education,
-- and Mental Health Symptoms by Ethnicity
SELECT
  pd.ER_5groups AS Ethnicity,
  pd.Income_coded AS Income,
  AVG(mh.MHxs2m) AS Avg_Symptoms
FROM
  patient_demographics pd
JOIN
  mental_health_symptoms mh ON pd.study_id = mh.study_id
GROUP BY
  pd.ER_5groups,
  pd.Income_coded
ORDER BY
  pd.ER_5groups,
  pd.Income_coded;
```

Ethnicity	Income	Avg_Symptoms
0	9	32.0000
0	10	0.0000
0	13	10.0000
1	-1	66.0000
1	9	16.0000
1	10	25.0000
1	11	25.8333
1	12	38.3333
1	13	25.6333
2	9	24.0833
2	10	14.1667
2	11	15.9444
2	12	20.0000
2	13	20.4444
3	-1	5.2500
3	9	24.2857
3	10	20.8438
3	11	10.0000
3	12	8.3846
3	13	6.0000
4	-1	10.5000
4	9	24.0204
4	10	25.1951
4	11	17.7200
4	12	18.7895
4	13	20.6111
5	9	36.0769
5	10	29.0000
5	11	14.4000
5	12	10.0000
5	13	25.2222

Visualization 1:



Ethnicity	Income Code	Education
0 = Unanswered	-1 = Unanswered	0 = Did not disclose
1 = AAPI	9 = Less than \$25,000	1 = Primary/Grade school
2 = Latinx	10 = \$25,000 - \$49,999	2 = High School or GED
3 = Black	11 = \$50,000 - \$74,999	3 = Some College
4 = White	12 = \$75,000 - \$99,999	4 = College Degree
5 = Multirace/A	13 = \$100,000 or more	5 = Graduate Degree
		9 = No School

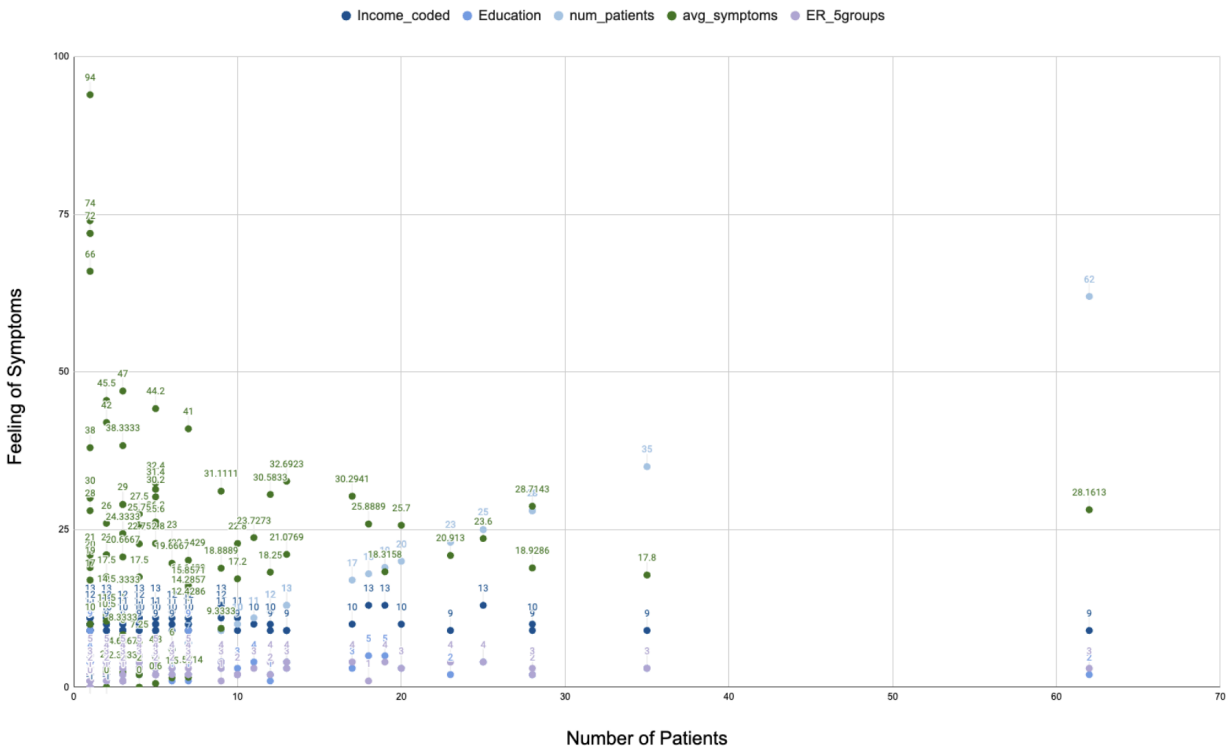
This visualization shows the relationship between income and mental health symptoms by ethnicity. Specifically showing how lower income individuals tend to have higher mental health symptoms.

Query 2 and Output 2:

```
-- Query 2: Comparing Mental Health Symptoms by Income and
-- Education Within Ethnicity
SELECT
  pd.ER_Sgroups AS Ethnicity,
  pd.Income_coded AS Income,
  pd.Education AS Education,
  COUNT(*) AS num_patients,
  AVG(mh.MHxs2m) AS Avg_Symptoms
FROM
  patient_demographics pd
JOIN
  mental_health_symptoms mh ON pd.study_id = mh.study_id
GROUP BY
  pd.ER_Sgroups,
  pd.Income_coded,
  pd.Education
ORDER BY
  pd.ER_Sgroups,
  pd.Income_coded,
  pd.Education;
```

Ethnicity	Income	Education	num_patients	Avg_Symptoms
0	9	1	1	74.0000
0	9	3	1	17.0000
0	9	4	1	5.0000
0	10	2	1	0.0000
0	10	3	1	0.0000
0	13	4	1	20.0000
0	13	5	1	0.0000
1	-1	5	1	66.0000
1	9	1	1	0.0000
1	9	2	1	28.0000
1	9	3	3	14.3333
1	9	4	1	0.0000
1	9	5	3	24.3333
1	10	3	1	3.0000
1	10	4	1	0.0000
1	10	5	1	72.0000
1	11	2	1	72.0000
1	11	3	1	0.0000
1	11	4	1	10.0000
1	11	5	3	24.3333
1	12	4	3	38.3333
1	13	2	2	10.5000
1	13	3	1	2.0000
1	13	4	9	31.1111
1	13	5	18	25.8889
2	9	1	12	18.2500
2	9	2	28	28.7143
2	9	3	10	22.8000
2	9	4	2	0.0000
2	9	5	1	94.0000
2	9	9	7	14.2857
2	10	1	7	1.5714
2	10	2	6	6.0000
2	10	3	5	32.4000
2	10	4	5	26.2000
2	10	9	1	0.0000
2	11	1	2	14.5000
2	11	2	10	17.2000
2	11	3	3	8.0000
2	11	4	2	26.0000
2	11	5	1	10.0000
2	12	1	1	38.0000
2	12	3	2	21.0000
2	12	5	1	0.0000
2	13	2	2	17.5000
2	13	3	5	25.6000
2	13	4	1	19.0000
2	13	5	1	2.0000
3	-1	3	1	21.0000
3	-1	4	2	0.0000
3	-1	9	1	0.0000
3	9	1	6	1.5000
3	9	2	62	28.1613
3	9	3	35	17.8000
3	9	4	13	32.6923
3	9	5	3	29.0000
3	10	1	1	0.0000
3	10	2	28	18.9286
3	10	3	20	23.7000
3	10	4	11	23.7273
3	10	5	4	7.2500
3	11	2	4	0.0000
3	11	3	5	0.6000
3	11	4	7	12.4286
3	11	5	4	27.5000
3	12	3	1	0.0000
4	12	4	9	9.3333
4	12	5	3	8.3333
4	13	2	1	0.0000
4	13	3	4	2.0000
4	13	4	2	2.0000
4	13	5	2	21.0000
4	-1	3	2	10.5000
4	9	1	3	29.0000
4	9	2	23	20.9130
4	9	3	13	21.0769
4	9	4	5	44.2000
4	9	5	5	22.8000
4	10	1	3	5.0000
4	10	2	12	30.5833
4	10	3	17	30.2941
4	10	4	7	16.1429
4	10	5	2	11.5000
4	11	2	7	20.1429
4	11	3	9	18.8889
4	11	4	6	19.6667
4	11	5	3	4.6667
4	12	2	2	2.5000
4	12	3	6	23.0000
4	12	4	7	15.8571
4	12	5	4	25.7500
4	13	2	5	30.2000
4	13	3	5	4.8000
4	13	4	25	23.6000
4	13	5	19	18.3158
5	9	2	7	41.0000
5	9	3	4	22.5000
5	9	4	2	45.5000
5	10	2	3	2.3333
5	10	3	3	47.0000
5	10	4	2	42.0000
5	11	3	2	5.0000
5	11	4	3	20.6667
5	12	1	1	0.0000
5	12	3	1	30.0000
5	12	4	1	0.0000
5	13	3	4	17.5000
5	13	5	5	31.4000

Visualization 2:
Comparing Mental Health Symptoms by Income, Education, and Symptoms Within Ethnicity



Ethnicity	Income Code	Education
0 = Unanswered	-1 = Unanswered	0 = Did not disclose
1 = AAPI	9 = Less than \$25,000	1 = Primary/Grade school
2 = Latinx	10 = \$25,000 - \$49,999	2 = High School or GED
3 = Black	11 = \$50,000 - \$74,999	3 = Some College
4 = White	12 = \$75,000 - \$99,999	4 = College Degree
5 = Multirace/A	13 = \$100,000 or more	5 = Graduate Degree
		9 = No School

This visualization shows the comparison between mental health symptoms by income, education, and symptoms within ethnicity. Specifically showing how people of color had a higher average mental health score compared to the non-people of color population, how people with a low level of education had a higher average mental health score, and how people with lower income levels had higher average mental health scores. Summarizing how depending on a person's income, educational attainment, and ethnicity – it will determine their mental health score due to factors like stress, responsibilities, number of jobs, etc.

Question 2

“What is the relationship between PTSD symptoms and feelings of being cut off by others, and how does this vary across different marital statuses?”

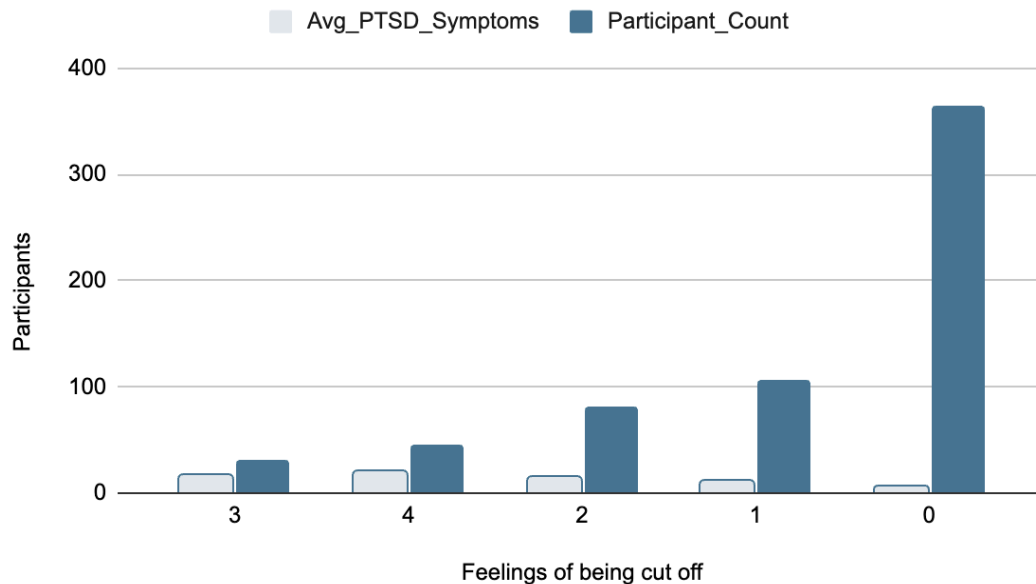
Query 1 and Output 1:

SELECT

```
Cutoff,  
AVG(PTSDsxs_2m) AS Avg_PTSD_Symptoms,  
COUNT(*) AS Participant_Count  
FROM mental_health_questionnaire mq  
JOIN follow_up f ON mq.study_id = f.study_id  
GROUP BY Cutoff;
```

Cutoff	Avg_PTSD_Symptoms	Participant_Count
0	6.3479	365
2	14.9268	82
4	20.1522	46
1	10.8505	107
3	16.7097	31

Relationship Between PTSD Symptoms and Cutoff Scores



The first graph shows the comparison between feelings of being cut off and average PTSD symptoms. Feelings of being cut off increases as the participant count lowers.

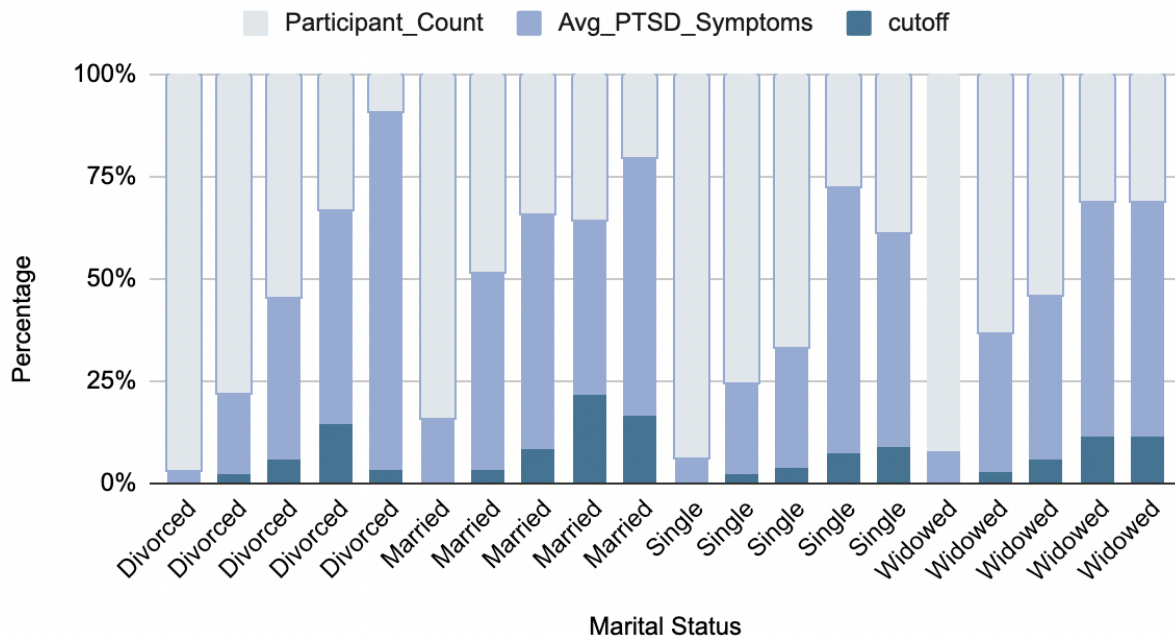
Query 2 and Output 2:

SELECT

```
p.marital,
mq.Cutoff,
AVG(f.PTSDsxs_2m) AS Avg_PTSD_Symptoms,
COUNT(*) AS Participant_Count
FROM patient_demographics p
JOIN mental_health_questionnaire mq ON p.study_id = mq.study_id
JOIN follow_up f ON p.study_id = f.study_id
GROUP BY p.marital, mq.Cutoff;
ORDER BY p.marital, mq.Cutoff;
```

marital	Cutoff	Avg_PTSD_Symptoms	Participant_Count
Divorced	0	4.8370	135
Married	0	8.8511	47
Single	0	7.0093	108
Widowed	0	6.5467	75
Divorced	1	8.8000	35
Married	1	13.9286	14
Single	1	10.0882	34
Widowed	1	13.1250	24
Divorced	2	14.0526	19
Married	2	13.6250	8
Single	2	16.0833	36
Widowed	2	14.1579	19
Divorced	3	11.1429	7
Married	3	6.0000	5
Single	3	26.3636	11
Widowed	3	15.0000	8
Divorced	4	15.0833	12
Married	4	15.6000	5
Single	4	24.5556	18
Widowed	4	20.5455	11

Average PTSD Symptoms by Marital Status and Cutoff Scores



The second graph shows marital statuses with varying feelings of being cut off in comparison to the average PTSD symptoms. The purpose is to see how feelings of being cut off and average PTSD symptoms are affected by marital status.

Question 3

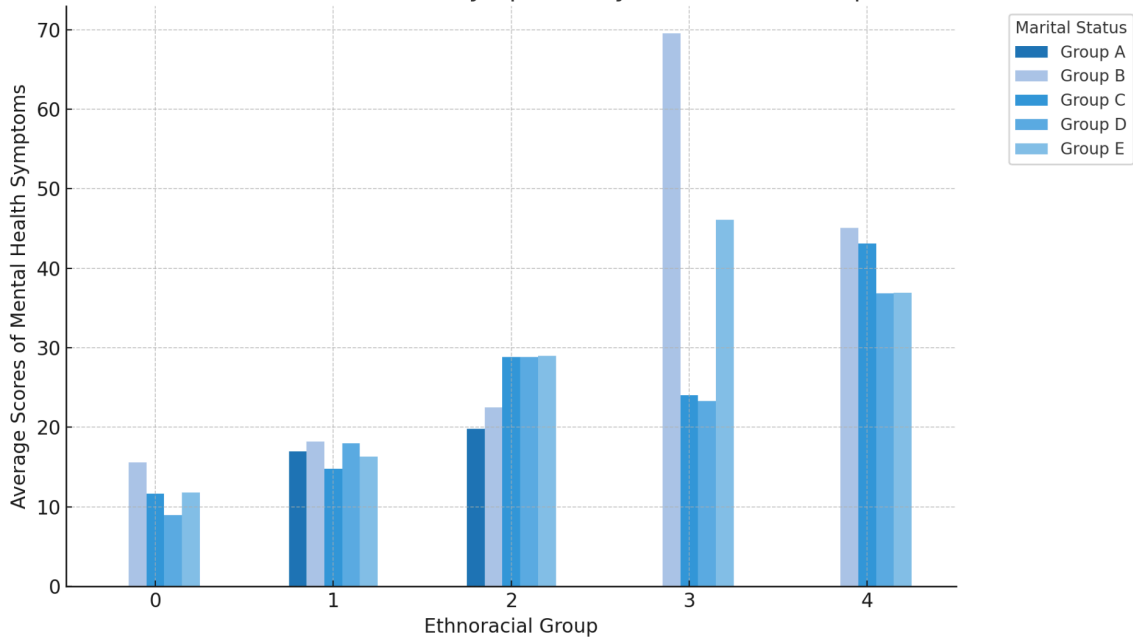
How does marital status and past mental health history impact mental health symptoms across different ethnoracial groups?

Query 1 and Output 1:

```
SELECT
  ER_5groups AS Ethnoracial_Group,
  marital_status AS Marital_Status,
  AVG(MHxs2m) AS Avg_MHxs2m
FROM
  marital_impact
GROUP BY
  ER_5groups,
  marital_status
ORDER BY
  ER_5groups,
  marital_status;
```

ethnoracial_group	marital_status	avg_MHxs2m
Group A	Divorced	47.0000
Group A	Married	0.0000
Group A	Other	11.0000
Group A	Single	0.0000
Group B	Divorced	19.5833
Group B	Married	25.5000
Group B	Other	50.0909
Group B	Single	25.5484
Group C	Divorced	16.6000
Group C	Married	14.9412
Group C	Other	20.6316
Group C	Single	26.3077
Group D	Divorced	9.9535
Group D	Married	21.7778
Group D	Other	19.7037
Group D	Single	24.0762
Group E	Divorced	20.7356
Group E	Married	24.5455
Group E	Other	20.4314
Group E	Single	25.2667

Average Scores of 2-Month Mental Health Symptoms by Ethnoracial Group and Marital Status



The first plot examines the relationship between past mental health history and current symptom severity across different ethnoracial groups, highlighting variations in symptom scores.

Query 2 and Output 2:

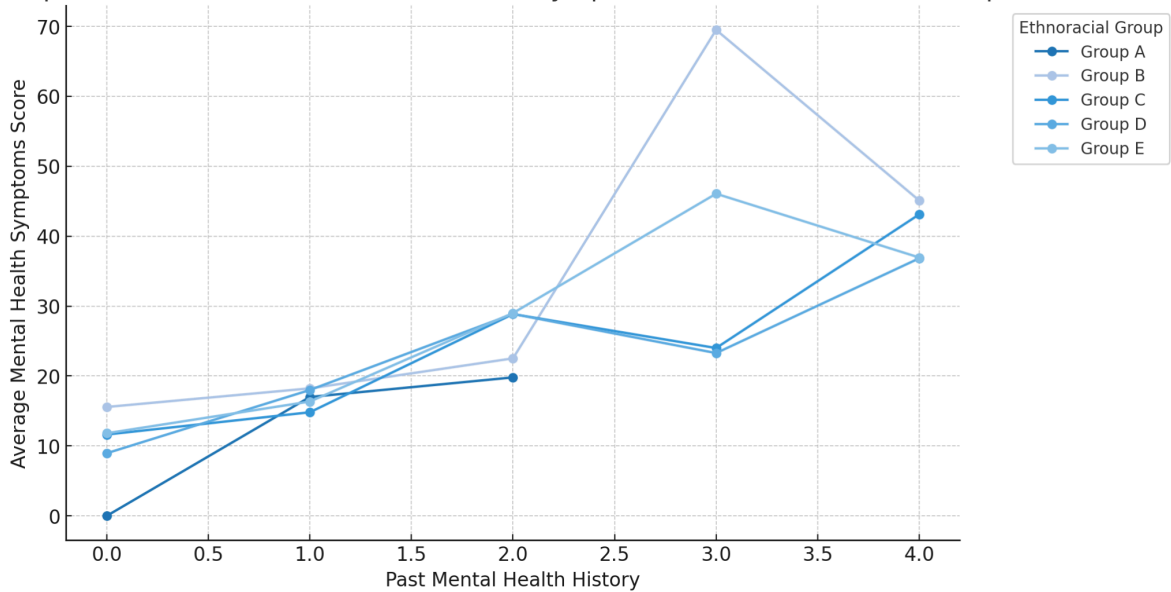
```

SELECT
  ER_5groups AS Ethnoracial_Group,
  past_mental_health AS Past_Mental_Health,
  AVG(MHxsxs2m) AS Avg_MHxsxs2m
FROM
  past_mh_impact
GROUP BY
  ER_5groups,
  past_mental_health
ORDER BY
  ER_5groups,
  past_mental_health;

```

ethnoracial_group	past_mental_health	avg_MHxsxs2m
Group A	0	0.0000
Group A	1	17.0000
Group A	2	19.8000
Group B	0	15.5714
Group B	1	18.2333
Group B	2	22.5238
Group B	3	69.5000
Group B	4	45.1000
Group C	0	11.6304
Group C	1	14.8148
Group C	2	28.8571
Group C	3	24.0000
Group C	4	43.1176
Group D	0	8.9571
Group D	1	18.0000
Group D	2	28.8730
Group D	3	23.2778
Group D	4	36.8333
Group E	0	11.8103
Group E	1	16.3500
Group E	2	29.0000
Group E	3	46.0714
Group E	4	36.9474

Impact of Past Mental Health on Current Symptoms Across Ethnoracial Groups



The second plot compares average mental health symptom scores based on marital status and ethnoracial group, illustrating how these factors interact to influence mental health outcomes.

Question 4

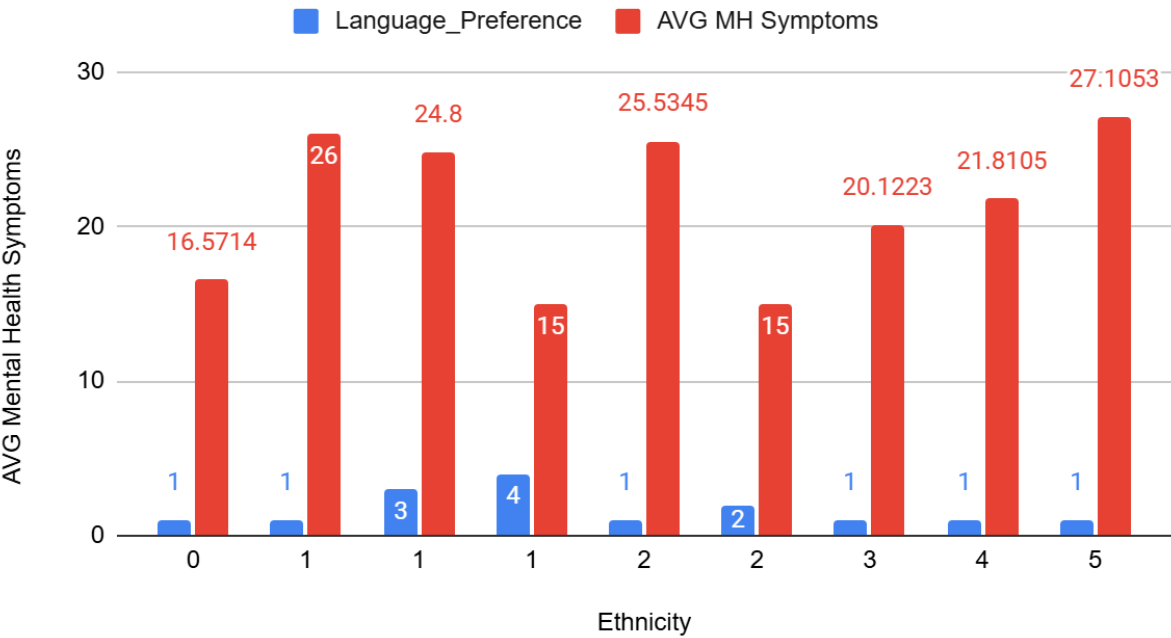
How do language preferences and race interact to influence mental health symptoms, and what role does education play in this relationship?

Query 1 and Output 1:

```
SELECT
  pd.ER_5groups AS Ethnicity,
  sd.langdone AS Language_Preference,
  AVG(mh.MHsxs2m) AS Avg_MH_Symptoms,
  COUNT(*) AS Participant_Count
FROM study_data sd
JOIN patient_demographics pd ON sd.study_id = pd.study_id
JOIN mental_health_symptoms mh ON sd.study_id = mh.study_id
GROUP BY pd.ER_5groups, sd.langdone
ORDER BY pd.ER_5groups, sd.langdone;
```

Ethnicity	Language_Preference	Avg_MH_Symptoms	Participant_Count
0	1	16.5714	7
1	1	26.0000	45
1	3	24.8000	5
1	4	15.0000	2
2	1	25.5345	58
2	2	15.0000	57
3	1	20.1223	229
4	1	21.8105	190
5	1	27.1053	38

Ethnicity and Language in Respect to Mental Health



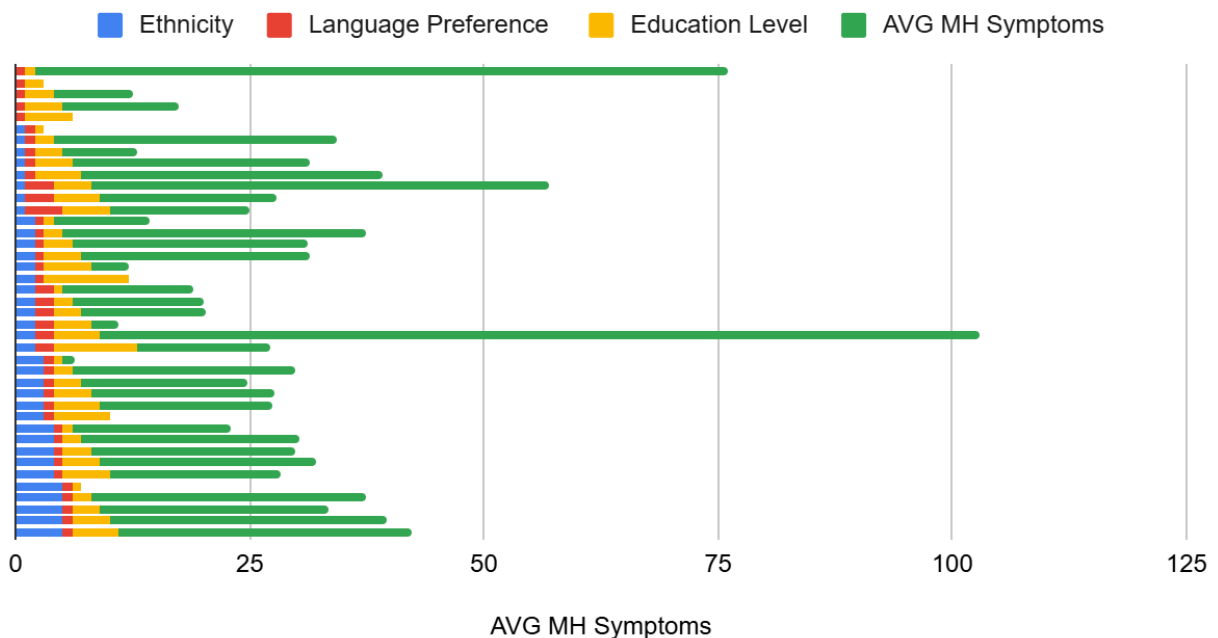
The graph shows combinations of ethnicity and language spoken in reference to the average mental health symptoms. The purpose is see if people from varying ethnicities and languages that are spoken are more likely to have mental health symptoms

Query 2 and Output 2:

```
SELECT
  pd.ER_5groups AS Ethnicity,
  sd.langdone AS Language_Preference,
  pd.education AS Education_Level,
  AVG(mh.MHxs2m) AS Avg_MH_Symptoms,
  COUNT(*) AS Participant_Count
FROM study_data sd
JOIN patient_demographics pd ON sd.study_id = pd.study_id
JOIN mental_health_symptoms mh ON sd.study_id = mh.study_id
GROUP BY pd.ER_5groups, sd.langdone, pd.education
ORDER BY pd.ER_5groups, sd.langdone, pd.education;
```

Ethnicity	Language_Preference	Education_Level	Avg_MH_Symptoms	Participant_Count
0	1	1	74.0000	1
0	1	2	0.0000	1
0	1	3	8.5000	2
0	1	4	12.5000	2
0	1	5	0.0000	1
1	1	1	0.0000	1
1	1	2	30.2500	4
1	1	3	8.0000	6
1	1	4	25.4286	14
1	1	5	32.2500	20
1	3	4	49.0000	1
1	3	5	18.7500	4
1	4	5	15.0000	2
2	1	1	10.3333	3
2	1	2	32.3182	22
2	1	3	25.2857	21
2	1	4	24.5000	8
2	1	5	4.0000	3
2	1	9	0.0000	1
2	2	1	14.0000	19
2	2	2	14.0000	24
2	2	3	13.2500	4
2	2	4	3.0000	2
2	2	5	94.0000	1
2	2	9	14.2857	7
3	1	1	1.2857	7
3	1	2	23.9579	95
3	1	3	17.7121	66
3	1	4	19.5682	44
3	1	5	18.3125	16
3	1	9	0.0000	1
4	1	1	17.0000	6
4	1	2	23.3673	49
4	1	3	21.9615	52
4	1	4	23.0600	50
4	1	5	18.2424	33
5	1	1	0.0000	1
5	1	2	29.4000	10
5	1	3	24.4286	14
5	1	4	29.6250	8
5	1	5	31.4000	5

Ethnicity Education and Language in Mental Health



Different combinations of ethnicity, language spoken and education level to see that changes the results.
The goal is to see how education affects these factors.

Conclusions

Through our analysis, we found out a variety of factors that may play a role in a person's mental health score. Specifically, when comparing mental health symptom scores across different ethnic groups, it shows that people of color generally reported a higher mental health score compared to non-people of color. It also reveals that individuals with a lower level of education also tend to have higher average mental health scores, as do those who come from a lower socio-economic status.

When analyzing how education, ethnicity and language spoken collectively affects someone's mental health we found that the groups with the highest mental health symptoms were POCs in higher education. In this part of the analysis language spoken had little impact on mental health symptoms as most of the patients in this analysis were english speakers

The findings of the relationship between PTSD symptoms and feelings of being cut off by others in relation to marital status reveal that the average PTSD symptoms for divorced participants have an extreme cutoff compared to other married/single participants. Married, Single, and Widowed individuals with high average PTSD symptoms report high cutoff scores. The number of participants decreases as cutoff scores increase except for the Single group. The Single group maintains high participant counts even at higher cutoff scores, which indicates prevalent feelings of being cut off.

The past mental health history and marital status have a significant impact on mental health symptoms, and there is a noticeable ethnoracial variation. In Group B (Latinx), this group exhibits the most severe symptoms with a peak at around 70, and it has a score of 3.0 for past mental health evaluation. Among all groups, Group B (AAPI) experiences the sharpest spikes. Contradictorily, the higher score for mental health represents more severe mental health conditions. For people who are single, represented by 0, they have the lowest mental health scores regardless of ethnicity, which means single people have the best mental health.

Of the 631 patients enrolled in the study, the overall follow-up rate at two months was 72.4% [1]. This relatively high dropout rate raises concerns about potential response bias, as those who dropped out may have differed significantly from those who remained, possibly affecting the generalizability of the findings. Data was collected through various self-report methods, including mail and on-site questionnaires and paper-and-pencil interviews. However the use of self-report measures introduced the risk of social desirability bias. Additionally, cultural factors play a significant role in how individuals interpret and respond to survey questions.

It is important to acknowledge these limitations. Identifying the shortcomings and ensuring transparency helps prevent extrapolation of our results and guide future researchers to address unanswered questions about mental healthcare. Despite these challenges, the findings contribute to a deeper understanding of the disparities in mental health screening and care. Our analysis highlights the need for more inclusive and culturally sensitive screening tools and provides a foundation for addressing the barriers related to stigma and access to mental

healthcare. Through exploration of this issue, we hope to spread awareness and encourage development of plans of action to improve mental healthcare for all individuals.

Author Contributions

Dalia Zizumbo → Cleaning Data, Writing Report, Slide Presentation, Created 2 Tables and 2 Query's, ER diagram

Maryam Abdus Salaam → Created 2 Tables and 2 Query's, ER diagram

Xiqiao Liu → Created 2 Tables and 2 Query's, ER diagram

Yumiko Chow → Writing report, Slide Presentation, Created 2 Tables and 2 Queries, ER diagram

References

1. 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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