RISING RESEARCHERS by MOONPREP

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Introduction of Rising Researchers

This journal edition highlights students who participated in the eight-week virtual research intensive. The course was designed to provide students with an introduction to the use of statistical tools and machine learning techniques for health equity research.

Through lectures, hands-on experiments, public electronic health records databases, machine learning algorithms, statistical skills and tools, class and small group discussions, and oral presentations, students explored the computational world with emphasis on human diseases like cardiovascular disease and health equity issues.

The hands-on patient cohort selection and machine learning modeling emphasized the proper use of the scientific method to answer a research question, develop a hypothesis, carry out computational tasks, make observations, analyze, interpret and communicate results.

Learning Units

- Scientific method with emphasis on hypothesis testing and statistical tests.
- Statistical sampling and patient selection criteria.
- Introduction to social determinants of health (SDoH) and their importance in patient care and health outcomes.
- Introduction to machine learning modeling tools to detect and “explain” health equity gaps and their association with social determinants of health.

Course Goals

- Exploration of general machine learning for the healthcare research field and career opportunities in the field.
- Construction of a unique research question and hypothesis related to the health equity gaps in cardiovascular diseases.
- Development of a research strategy including the definition and justification of patient inclusion criteria, as well as study hypotheses.
- Understanding the data processing pipeline for machine learning models including exploration of computing tools and techniques to extract data from large electronic health record databases.
- Explanation of equity gaps in patient care using statistical tests and machine learning algorithms.
- Investigation of existing literature to build reference and resource lists.
- Final research poster presentation and publication in academic research journal.
- Creation of research report for publication submission.

Students Have Mastered The Following Skills And Tasks

- Describe and demonstrate the ability to use the scientific method.
- Demonstrate an understanding of research design, including patient selection criteria, generation and justification of hypotheses, and choosing appropriate hypothesis testing tools.
- Develop fundamental knowledge on health equity, machine learning, and career opportunities in the area.
- Understand what Social Determinants of Health (SDoH) are and their influence in patient care and outcomes.
- Develop data preprocessing, extraction and curation skills for application in public health records data.
- Use machine learning tools to model and interpret the association between the SDoH and health outcomes.
- Demonstrate ability to record and interpret data from experiments.
- Demonstrate ability to run multiple experiments to evaluate different hypotheses.
- Demonstrate the ability to communicate research and results.

Academic Credit And Grading

- Each student receives a grade and feedback throughout the course.
- Students will receive 2 college credits, an official transcript, and a certification of completion issued by the University of Massachusetts Amherst (UMass).

Academic Team

Meet the Professor: Purity Mugambi

- PURITY MUGAMBI IS A PH.D. CANDIDATE IN COMPUTER SCIENCE AT THE UNIVERSITY OF MASSACHUSETTS - AMHERST
- HER RESEARCH FOCUSES ON DEVELOPING MACHINE LEARNING TOOLS TO ENHANCE AND IMPROVE HEALTH EQUITY.
- PRIOR TO BEGINNING HER PH.D. PROGRAM AT UMASS, PURITY WORKED AS A RESEARCH SOFTWARE ENGINEER AT IBM RESEARCH AFRICA, NAIROBI'S OFFICE.

Meet the Program Director: Nicole Gress

- NICOLE IS A LICENSED PROFESSIONAL SCHOOL COUNSELOR WITH A MASTER'S DEGREE IN BOTH SCHOOL COUNSELING AND HIGHER EDUCATION LEADERSHIP AND POLICY STUDIES.
- NICOLE WILL WORK AS A SUPPLEMENTAL COACH DURING THE RISING RESEARCHERS PROGRAM INTRODUCING STUDENTS TO THE COLLEGE ADMISSIONS PROCESS AND ITS NECESSARY PREPARATIONS.
- WORKING WITH NICOLE, STUDENTS WILL LEARN HOW TO LEVERAGE THIS UNIQUE RESEARCH EXPERIENCE TO GIVE THEMSELVES AN EDGE IN THE COLLEGE ADMISSIONS PROCESS.

Rising Researchers Students

The following students participated in the 2023 Rising Researchers Course.

Abisola Asante

Examining Ethnic, Gender and Age Differences in the Prescribing Patterns of Beta Blockers for Patients in the MIMIC III Dataset.

ABSTRACT:

The aim of this study is to use statistical hypothesis tests to identify ethnic, gender and age differences in the prescribing patterns of beta blockers for patients in the MIMIC III dataset. This is an observational, retrospective study using quantitative and qualitative data from the MIMIC III demo dataset. In four of the five hypotheses tested, there were no ethnic, gender or age differences in the prescribing patterns of beta blockers for patients in the MIMIC III dataset.

INTRODUCTION:

Beta blockers are medications that block the effect of adrenaline on the heart leading to a slower heart rate and lower blood pressure. Adrenaline is a stress hormone that causes heart cells to pump faster and stronger which leads to a fast heart rate and high blood pressure. Beta blockers also help widen veins and arteries to improve blood flow (Mayo Clinic Staff, 2021). The United States Food and Drug Administration (FDA) has approved many beta blockers, including atenolol (Tenormin), carvedilol (Coreg), labetalol (Trandate) metoprolol (Lopressor, Toprol XL), propranolol (Inderal, InnoPran XL), and timolol (FDA, 2021). Beta blockers are essential medications and are FDA-approved to treat various diseases such as tachycardia, hypertension (high blood pressure), myocardial infarction (heart attack), congestive heart failure, cardiac arrhythmias, coronary artery disease, hyperthyroidism, essential tremor, aortic dissection, portal hypertension, glaucoma, and migraine prophylaxis (Farzam & Jan, 2022). There are three main ways that patients can take beta blockers- orally (by mouth), intravenously (through the veins) and ophthalmically (in the eye) (Farzam & Jan, 2022). Common side effects that patients may experience when taking beta blockers include feeling tired, upset stomach, headache, dizziness, constipation or diarrhea and feeling lightheaded (FDA, 2021).

As stated earlier, one of the diseases that beta blockers are used to treat is myocardial infarction, or heart attack. A heart attack happens when the heart muscles don't get enough oxygen. This happens when blood flow to the heart muscle is blocked due to a buildup of plaque in the arteries. When the plaque breaks, it quickly forms a blood clot. The blood clot is the actual cause of the heart attack (Johns Hopkins Medicine, n.d). Patients with myocardial infarction should be quickly treated with aspirin which thins the blood and prevents blood clots from forming (*Aspirin and heart disease* 2021). In addition, it is recommended that all patients who have had a myocardial infarction be prescribed 81 mg to 325 mg of aspirin indefinitely (Bonin, 2018). Furthermore, myocardial infarction usually causes severe chest pain, therefore, patients are typically given morphine, a strong pain medicine, to help relieve the chest pain (Bonin, 2018)

Historically, research studies have suggested that beta blockers are not as effective for black people with high blood pressure (Abson et al, 1981; Moser and Lunn, 1981; VA Coop Study Group, 1982; Nesbitt, 2009, Mayo Clinic Staff, 2021). Therefore, doctors tend not to prescribe beta blockers for black patients (Holt et al, 2022; Apeles, 2022; Nesbitt, 2009).

Research has also suggested that beta blockers are not as effective in elderly people, especially when taken without other blood pressure medications (Wink, 2003; Mayo Clinic Staff , 2023). A 1998 study by Messerli and colleagues concluded that "beta blockers, until proven otherwise, should no longer be considered appropriate first-line therapy of uncomplicated hypertension in the elderly hypertensive patient."

STUDY AIM/RESEARCH QUESTIONS:

The aim of this study is to identify ethnic, gender and age differences in the prescribing patterns of beta blockers for patients in the MIMIC III dataset.

Description of Dataset: MIMIC-III is a large, freely-available database comprising de-identified health-related data associated with over 40,000 patients who stayed in critical care units of the Beth Israel Deaconess Medical Center between 2001 and 2012 (Pollard & Mark, 2019). This study used a demo subset of the MIMIC III database. The subset included information for 129 patients.

The following research questions guided this study:

1. Does the time to discharge differ by ethnicity for patients who were prescribed beta blockers?
2. Does the prescription of beta blockers differ by ethnicity for females that were prescribed beta blockers?
3. Does the time to discharge differ by age for patients who were prescribed beta blockers?
4. Does the prescription of beta blockers differ by ethnicity for patients who were also prescribed morphine?
5. For patients who were prescribed both a beta blocker and aspirin, does the dose of aspirin prescribed differ by gender?

Hypotheses:

1. If a black person is prescribed beta blockers, then it will take more time for them to be discharged from the hospital compared to white people because studies have suggested that beta blockers may not be effective in black people.
2. If a female is prescribed a beta blocker, then it is more likely that she is a white female than a female of color because doctors avoid prescribing beta blockers to patients of color.
3. If a person over 75 years of age is prescribed a beta blocker, then they are more likely to have a longer duration in the hospital compared to people under the age of 75 because studies have shown that beta blockers are not as effective for older people.
4. If a person of color was treated with morphine, then they are less likely to have been prescribed a beta blocker compared to a white person who was also treated with morphine because studies have suggested that beta blockers may not be effective in black people.
5. If a patient was prescribed both a beta blocker and aspirin, then the dose of aspirin prescribed will not differ by gender because treatment guidelines for myocardial infarction recommend that all patients receive 81mg to 325mg of aspirin and doesn't consider the gender of the patient.

STUDY DESIGN/METHOD:

This is an observational, retrospective study using quantitative and qualitative data from the MIMIC III dataset. Statistical hypothesis tests were used to perform analyses to help answer the research questions. Anaconda, a local coding terminal, was used to prompt a Jupyter Notebook statistical testing tool to run a t-test to find the p-value of each experiment.

Inclusion Criteria: All patients in the MIMIC III demo dataset will be included in the analyses.

Below is the method to test each hypothesis.

1. If a black person is prescribed beta blockers, then it will take more time for them to be discharged from the hospital compared to white people because studies have suggested that beta blockers may not be effective in black people.

    a. Rule out people not prescribed beta blockers
    b. Filter for black people prescribed beta blockers
    c. Find the average admit duration for black people prescribed beta blockers
    d. Filter for white people prescribed beta blockers
    e. Find the average admit duration for white people prescribed beta blockers
    f. Compare the average admit duration between the two groups
    g. Run a t-test in Jupyter Notebook to find the p-value

A possible confounder is the possibility of patients that were discharged due to death and not due to recovery. The following is the study design to account for this confounder:

    a. Rule out people not prescribed beta blockers
    b. Rule out people discharged due to death
    c. Filter for black people prescribed beta blockers
    d. Find the average admit duration for black people prescribed beta blockers
    e. Filter for white people prescribed beta blockers

f. Find the average admit duration for white people prescribed beta blockers
g. Compare the average admit duration between the two groups
h. Run a t-test in Jupyter Notebook to find the p-value

2. If a female is prescribed a beta blocker, then it is more likely that she is a white female than a female of color because doctors avoid prescribing beta blockers to black patients.

    a. Rule out all males
    b. Determine the number of females of color
    c. Calculate the probability of females of color being prescribed beta blockers
    d. Determine the number of white females
    e. Calculate the probability of white females being prescribed beta blockers
    f. Compare probabilities of the two groups
    g. Run a t-test in Jupyter Notebook to find the p-value

A possible confounder is if the patient ethnicity was documented incorrectly. However, this confounder cannot be tested in the MIMIC III dataset.

3. If a person over 75 years of age is prescribed a beta blocker, then they are more likely to have a longer duration in the hospital compared to people under the age of 75 because studies have shown that beta blockers are not as effective for older people.

    a. Rule out people not prescribed beta blockers
    b. Filter for people over the age over 75
    c. Find the average admit duration for people over 75 that were prescribed beta blockers
    d. Filter for people under 75 that were prescribed beta blockers
    e. Find the average admit duration for people under 75 that were prescribed beta blockers
    f. Compare the average admit duration between the two groups
    g. Run a t-test in Jupyter Notebook to find the p-value

A possible confounder is knowing whether or not the patient actually took the beta blockers or not, however, this confounder cannot be tested in the MIMIC III dataset.

4. If a person of color was treated with morphine, then they are less likely to have been prescribed a beta blocker compared to a white person who was also treated with morphine because studies have suggested that beta blockers may not be effective in black people.

    a. Rule out people who did not receive morphine
    b. Determine how many people of color received Beta Blockers of those who received morphine

c. Determine how many white people received beta blockers of those who received morphine
d. Determine how many people of color did not receive beta blockers
e. Determine how many white people were not prescribed beta blockers
f. Compare the four values to validate hypothesis
g. Run a t-test in Jupyter Notebook to find the p-value

To account for the confounder of age we ruled out everyone in the dataset over the age of 75. The following is the study design to account for this confounder:

a. Rule out people who did not receive morphine
b. Rule out people older than 75 years of age
c. Determine how many people of color received Beta Blockers of those who received morphine
d. Determine how many white people received beta blockers of those who received morphine
e. Determine how many people of color did not receive beta blockers
f. Determine how many white people were not prescribed beta blockers
g. Compare the four values to validate hypothesis
h. Run a t-test in Jupyter Notebook to find the p-value

5. If a patient was prescribed both a beta blocker and aspirin, then the dose of aspirin prescribed will not differ by gender because treatment guidelines for myocardial infarction recommend that all patients receive 81mg to 325mg of aspirin and doesn't consider the gender of the patient.
    a. Rule out people that did not receive beta blockers
    b. Rule out people that did not receive aspirin
    c. Measure the dosage of aspirin that the remaining females received
    d. Measure the dosage of aspirin that the remaining females received
    e. Find the average of dosages and compare the two groups

RESULTS:

Hypothesis 1:

Before Confounder

Black	White
# black people that received prescription for beta blocker: 3/129 Admit Mean: 10.6 days	# white people that received prescription for beta blocker: 52/129 Admit Mean: 8.8 days

P-Value: 0.982 (not statistically significant)

After Confounder

Black	White
# black people that received prescription for beta blocker: 3/129 Admit Mean: 10.6 days	# white people that received prescription for beta blocker: 48/129 Admit Mean: 8.8 days

P-Value: 0.9452 (not statistically significant)

Hypothesis 2:

Females of Color	White Females
Total # of females in the dataset: 59 Females of color that received beta blocker prescription: 7 Probability: 0.429	Total # of females in the dataset: 59 White female patients that received beta blocker prescription: 27 Probability: 0.65

P-Value: 0.682

Hypothesis 3:

Patients over 75	Patient below 75
Received beta blocker prescription: 41/66 Average admit duration: 8.22 days	Received beta blocker prescription: 25/66 Average admit duration: 12.92 days

P-Value: 0.8792 (not statistically significant)

Hypothesis 4:

Before Confounder:

Received Beta Blockers	Did Not Receive Beta Blockers
People of Color that received prescription for both morphine and beta blocker 5/64 = 8%	People of Color that received prescription for morphine but not beta blocker 13/64 = 20%
White people that received prescription for both morphine and beta blocker 25/64 = 39%	White people that received prescription for morphine but not beta blocker 20/64 = 31%

P-Value: 0.243

After Confounder:

Received Beta Blockers	Did Not Receive Beta Blockers
People of Color that received prescription for both morphine and beta blocker 3/38 = 8%	People of Color that received prescription for morphine but not beta blocker 12/38 = 20%
White people that received prescription for both morphine and beta blocker 25/38 = 39%	White people that received prescription for morphine but not beta blocker 20/38 = 31%

P-Value: 0.0557

Hypothesis 5:

Female patients	Male patients
Total # of people who received prescription for both aspirin and beta blocker: 26 15/26 Average dose: 460.53 mg	Total # of people who received prescription for both aspirin and beta blocker: 26 11/26 Average: 315 mg

P-Value: 0.2648

DISCUSSION:

Research Question 1: We aimed to determine whether time to discharge differs by ethnicity for MIMIC III patients who were prescribed beta blockers. Because studies have shown that beta blockers are not as effective in black people, we expected that black people that were prescribed beta blockers will take a longer time to be discharged from the hospital because the medicine wouldn't work for them as compared to white people that were prescribed beta blockers. However, the hypothesis was rejected due to the p-value of 0.94 which suggests that time to discharge does not differ by ethnicity for patients who were prescribed beta blockers. Limitations of this analysis include small sample size and the fact that the dataset doesn't indicate whether the patient actually took the medication, only that it was prescribed.

Research Question 2: This question sought to determine whether the prescription of beta blockers differs by ethnicity for females that were prescribed beta blockers in the MIMIC III dataset. Because studies have shown that beta blockers are less effective in black patients, we expected the same to be true for other races of color. We expected people of color to be less likely to receive beta blockers because of this. Although the probabilities suggested the hypothesis might be true, the p-value was 0.682 which caused the hypothesis to be rejected. This implies that there are no ethnic differences in the prescription of beta blockers for females in the MIMIC III dataset. Limitations of this experiment include small sample size. We also intended to look at black people specifically, but the sample size did not allow for that.

Research Question 3: This question aimed to determine if the time to discharge a patient differs by age for patients who were prescribed beta blockers. In order to do this, we used 75 years of age as the marker for elderness. Previous studies have shown that beta blockers may be less effective in older people. Therefore, we expected elderly people to have a longer stay in the hospital because the medication wouldn't work for them. Our hypothesis was rejected because the p-value of 0.8792 indicates the opposite is to be true, that the time to discharge for patients who were prescribed beta blockers does not differ by age. Limitations of this study include small sample size, and the fact that there was not a very diverse range of ages in the dataset.

Research Question 4: The goal of this question was to determine whether the prescription of beta blockers differs by ethnicity for patients in the MIMIC III dataset who were simultaneously prescribed morphine. We expected patients of color to be less likely to be prescribed beta blockers based on evidence from the literature. The hypothesis was rejected due to the p-value of 0.0557, which suggests that the prescription of beta blockers does not differ by ethnicity for patients who were simultaneously prescribed morphine. Limitations in this experiment include the small sample size and the uneven ratio of white to ethnic minority patients.

Research Question 5: The aim of this question was to determine whether the dose of aspirin prescribed differs by gender for patients that were prescribed both beta blockers and aspirin. We did not expect the dose of aspirin prescribed to differ by gender because treatment guidelines for myocardial infarction recommend that all patients receive 81 mg to 325 mg of aspirin and don't consider the gender of the patient. The average prescription of aspirin for females was 461 mg while males had an average of 315 mg. However, the p-value was 0.2648 which caused us to reject the hypothesis and conclude that the dose of aspirin prescribed differs by gender. Limitations of this analysis include the fact that the dosage recommendation only applies to patients diagnosed with myocardial infarction and the small sample size was too small to allow analysis of only patients with myocardial infarction.

CONCLUSION:

For four of the five hypotheses tested, there were no ethnic, gender or age differences in the prescribing patterns of beta blockers for patients in the MIMIC III dataset. The only exception was that the dose of aspirin prescribed differed by gender for patients that were prescribed both beta blockers and aspirin.

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How does gender produce disparities in response to insulin treatment and quantities of insulin ordered for patients with type-2 diabetes in the elCU dataset?

ABSTRACT:

The question being asked in this experiment is, “How does gender produce disparities in response to insulin treatment and quantities of insulin ordered for patients with type-2 diabetes in the eICU dataset?” With this question, we tested the hypothesis, “When prescribed the same insulin treatment, women will be revealed to have more hypoglycemic symptoms, such as hypertension, than men resulting in them having a higher insulin order.” The patients included in the testing of this experiment were over the age of forty-five and they have been diagnosed with type-2 diabetes in order to measure how gender would produce disparities when given insulin through testing whether they had hypertension or not. We began our experiment by grouping patients over the age of 45 with type-2 diabetes into their specific genders. Next, we separated those who had received insulin from those who did not. These steps allowed us to determine which sex had higher hypoglycemia rates which contributed to the amount of insulin needed for their treatment plan. Then we separated men and women who had hypertension from those who did not. Through this we were able to ascertain which gender requires greater insulin orders depending on if they had hypertension. Hypertension is defined as your blood pressure rising to above 140/90 and is considered to be severe if it rises to be above 180/120. Hypoglycemia, which is low blood sugar and is your body's main source of energy, tends to lead to hypertension because your body releases a hormone called adrenaline in order to help raise your blood sugar. Women tend to be composed of lower skeletal muscle mass, higher adipose tissue mass, increased circulation of free fatty acids, and elevated intramyocellular lipid content, all of which are components that lead to insulin resistance. This increase in insulin resistance due to these factors leads to women requiring greater amounts of insulin than men in order to combat the effects of the resistance. Consequently, the increase in insulin does lead to higher blood pressure and lower blood sugar levels since insulin aids in transporting glucose out of the bloodstream and into the cells. Taking into account the potential confounder that women tend to be more

obese, we filtered through the data set and separated men and women who were considered obese (women over 170.6 lbs and men over 197.6 pounds). To conclude, our results proved that women do in fact have more hypoglycemic symptoms, such as hypertension, than men since most women have various symptoms and body composition factors that lead to an increased insulin resistance that men are not composed of. 38% of men and 42% of women received insulin, had hypertension, had type-2 diabetes, and were over the age of forty-five, while 62% of men and 58% of women did not have hypertension, but received insulin, had type-2 diabetes, and were over the age of forty-five. The results of the confounder were revealed to be that men who were over the weight considered to be obese and were medically diagnosed was 44% of the men tested. Their female counterparts were revealed to be 55% of the women containing the given variables. The rest of the paper will go into greater depth exploring the different hypotheses used to answer the given research question.

INTRODUCTION:

The question being asked in this experiment is, "How does gender produce disparities in response to insulin treatment and quantities of insulin ordered for patients with type-2 diabetes in the elCU dataset?" In this observational study, we will use the quantitative data in the retrospective elCU dataset to determine the disparities by gender in insulin orders placed for patients with type two diabetes. Men and women are substantially different when it comes to our body composition, insulin resistance, fat distribution, and energy balance. These factors lead to a difference in which gender is more likely to develop certain disabilities and in this case, type-2 diabetes. Prior research (3) has shown that men are two times more likely to develop type-2 diabetes due to an increased amount of metabolically active visceral fat present in their bodies leading to a greater amount of insulin orders compared to women who, instead, have a heightened risk of subcutaneous fat. The presence of visceral fat (usually abdominal) leads to an increase in the development of insulin resistance resulting in heightened glucose levels and since this type of fat is more common in the male gender, they are at a greater risk to develop type-2 diabetes. In contrast, women do tend to have a more difficult time reaching an ideal glycemic objective when receiving insulin glargine than men regardless of the fact that women receive higher insulin doses (due to fasting plasma glucose) and endured increased hypoglycemic events compared to men. Due to an increased insulin resistance, women are required to inject more insulin into their bodies in order to combat the insulin resistance created. Although pregnant women do tend to require greater amounts of insulin in view of the fact that the hormones the placenta makes aid in the development of the baby in the womb. While this is occurring, the hormones produced by the placenta obstruct the action of the mother's insulin. The increased levels of insulin lead to lower hypoglycemia rates because insulin aids in transporting glucose out of the bloodstream and into the cells. The cells will then use the glucose for energy while storing the remaining amounts of glucose in your fat, muscles, and liver for later use. To conclude, men will have greater amounts of insulin orders compared to women.

METHODS AND MATERIALS:

The dataset that we used to test our hypotheses in order to answer our research question is the eICU database. The Electronic Intensive Care Unit (eICU) database is a collaborative, demo, anonymized, and research database, collected through the Philips eICU program, containing health data collected from over 2,000 entrances into ICUs between 2014 and 2015 all across the United States. This database is a telehealth system that uses this data to support the management

of critically ill patients and contains data selected from 20 of the larger hospitals in the eICU dataset in over 2,500 unit stays. Within the eICU database, concealed health data is combined with information consisting of vital sign measurements, care plan documentation, austerity of illnesses, diagnosis information, and treatment information. Through the Philip eICU system, information is distributed to caretakers at bedside.Within the dataset, the health information of these patients is sorted into common warehouses depending on the connections the patients have in common.These allow for data to be separated and loaded depending on the warehouse and connections searched.

In order to answer our research question as to how gender produces disparities in response to the prescribed insulin orders and the quantities ordered, we tested the hypothesis, "Between men and women with type-2 diabetes, smaller symptomatic disparities in the body composition of each gender are more likely to result in greater differences due to whether or not they received the prescribed insulin treatment in both sexes." The patients included in the testing of this experiment were men and women over the age of forty-five, who had been medically diagnosed with type-2 diabetes. The patient cohort selection aided us in elucidating how smaller symptomatic disparities in the body composition creates differences amongst each gender when prescribed their specific insulin treatment. First, patients were separated into their gender. Each group was then split into categories of those over the age of 45 and those below. Next, men and women were separated into groups depending on whether or not they had received insulin. Through this we then calculated the average weight of each group between genders in order to determine whether or not there were smaller or larger symptomatic disparities between the two through their body composition. Lastly, men and women were then grouped into categories depending on if they received insulin or not as part of their treatment plan, which revealed if the average person who receives insulin is typically overweight or underweight. To take into account the potential confounder that increased male patients may have hypertension compared to women, we filtered through the database and separated men and women into groups depending on if they were diagnosed with hypertension or not.

With the hypothesis, "Between men and women with type-2 diabetes, larger symptomatic disparities in combination with larger body composition of each gender are more likely to result in similar prescribed insulin treatment in both sexes when compared to the average BMI (BMI>30 = obese)," we were able to determine how gender produces disparities in response to insulin treatment and quantities of insulin ordered for patients with type-2 diabetes. The patients that were tested in the orchestration of this experiment were required to be men and women over the age of forty-five who had also been medically diagnosed with type-2 diabetes. In order to test this hypothesis to answer our question, patients were separated into their specific gender of either female or male. Each group was then split into those over the age of 45 and those below and we only ran the test on those who were over the given age since forty-five and older which was the most accustomed age for patients to receive a diagnosis for type-2 diabetes. Next, we converted the patient's heights from centimeters to meters in order to calculate the body mass index (BMI) of each person. We determined the BMI by dividing each patient's weight (kilograms) by their height (meters). Through the computation of their BMI's, we filtered through who is considered to obtain a healthy BMI (30 or greater is considered to be obese) compared to those who did not have a healthy one. Lastly, in both the healthy BMI category and the obese BMI category, we determined the average BMI. To take into account the potential confounder that women tend to have more body mass than men and hypertension could come into play, we tested men and

women who received insulin, have type-2 diabetes, have hypertension, are considered obese (over 197.6 in men and over 170.6 in women), and are also over the age of forty-five. Through this we separated those over the average weight and those under or equal to the average weight. Our results proved that the majority of individuals who have type-2 diabetes, received insulin, and are over forty-five, tended to be obese in view of the fact that the majority had a BMI of over 30.

With the hypothesis, "Of men and women who have type-2 diabetes, men are more likely to have a greater number of insulin orders due to the fact that men tend to have higher insulin resistance than women," we were able to determine how gender produces disparities in response to insulin treatments. The patients that were tested in the orchestration of this experiment, had been medically diagnosed with type-2 diabetes and were over the age of forty-five. To begin testing this hypothesis, we will group men and women into their specific genders in the eICU dataset who are over the age of 45 and have been diagnosed with type-2 diabetes. We looked at females with diabetes and calculated how many females received insulin orders. Then we looked at the males who have been medically diagnosed with diabetes and calculated the number of insulin orders given amongst the males. Taking into the consideration that men on average are more overweight than women, we filtered through the dataset by separating men who were over 197.6 pounds and women who were over 170.6 pounds.

The hypothesis, "Between men and women who have type-2 diabetes, men tend to have greater insulin orders due to the increased amount of metabolically active visceral fat present in their bodies," will assist us in answering our given research question as stated. The patient cohort criteria included men and women who were over the age of forty-five, along with being medically diagnosed with type-2 diabetes. To begin testing this hypothesis, we grouped patients diagnosed with type-2 diabetes over the age of 45 into their designated gender. Between these two groups, patients were then separated based on whether or not they were considered to be overweight or underweight. We would have preferred to have data on body composition in order to test for subcutaneous fat and visceral fat, but the dataset did not provide us with this information, so we used weight and height values in order to calculate body mass index. The amount of visceral fat in one's body can be linked to high blood pressure, raised cholesterol, metabolic syndrome, and atypical blood lipids. Visceral and subcutaneous fat can be measured by calculating body mass index (BMI), 90% of which will be subcutaneous fat and the other 10% will be visceral fat. Through this, the BMI of both men and women will be calculated in both patients who received insulin and those who did not receive insulin. These steps will help us determine whether those who have higher levels of visceral fat or subcutaneous fat require greater amounts of insulin. The potential confounder that men with type-2 diabetes generally have higher blood sugar levels than women was generated, but was untestable with the dataset that we were provided. Consequently, we will be able to ascertain whether men or women require greater insulin dosages resulting in greater insulin orders.

RESULTS:

Our results proved that men who possessed the given patient cohort criteria and received insulin had an average weight of 83.06 kilograms or 183.116 pounds, which is 18% of the total 113 men tested. Women with the same factors had an average weight of 82.57 kilograms or 182.116 pounds, which is 31% of the total 80 women tested. Men who obtained the patient cohort criteria and did not receive the prescribed insulin treatment had an average weight of

82.89 kilograms or 182.74 pounds, which is 82% of the 131 men tested. Women who possessed the given criteria, along with being separated into the group that did not receive insulin, obtained an average weight of 82.86 kilograms or 182.675 pounds, which is 69% of the 80 women tested. When taking into account the confounder, men with the given criteria who had hypertension, were revealed to be 33% of the 12 men. While their female counterpart was revealed to be 55% of the 11 women who were medically diagnosed with hypertension and contain the given criteria. These results draw the conclusion that gender does not necessarily produce a disparity in the average weight of the person and neither does the statistic of whether insulin was received by the patient or not. The main difference between men and women who received insulin and men and women who did not receive insulin was that the number of men who obtained insulin versus the number of men who did not obtain the prescribed treatment, was significantly greater in numbers of men who did not acquire insulin as part of their type-2 diabetes treatment. Not only that, but the weight difference of men who received insulin was slightly higher than that of those who didn't. Although in the category of women, there was a diminutive difference between the two groups who received insulin, with those who received having a smaller average weight than those who did not. In conclusion, the hypothesis of, "Between men and women with type-2 diabetes, smaller symptomatic disparities in the body composition of each gender are more likely to result in greater differences due to whether or not they received the prescribed insulin treatment" aids us in the answering of our given research question, while the results prove that the eICU database does in fact support this hypothesis. Along with the data being supported, the experiment is also statistically significant with a p-value of 0.026.

The count of men who had a healthy body mass index was 3 out of 22, which is 14% and together they had an average BMI of 28.47. The count of women who had a healthy BMI with the given factors resulted in being 0 out of the 24 women, consequently giving them an average BMI of zero. The count of men who had a body mass index of over 30, putting them into the obese category, was 19 out of 22, which is 86% of them and gave them an average BMI of 54.65. Women who had a body mass index of greater than 30, was 24 out of the 24 women tested, which is 100% and gave them an average BMI of 53.41. The results of the confounder were revealed to be that men who were over the weight considered to be obese and were medically diagnosed was 44% of the men tested. Their female counterparts were revealed to be 55% of the women containing the given variables. These results prove that there are in fact larger symptomatic disparities in combination with larger body composition of each gender are more likely to result in similar prescribed insulin treatment in both sexes when compared to the average BMI. Therefore, the dataset does support the hypothesis.

The results drew the conclusion that women with diabetes, on average, were reported to have been given greater amounts of insulin orders with an average of 31%, in comparison to their male counterparts who averaged at 19%. The average dosage of insulin for women was 0.31, while the average dosage of insulin for men was 0.19. Women who did not receive insulin, but were also diagnosed with type-2 diabetes, were averaged to be 69% of the 101 patients, while their male counterparts with the same components were averaged at 81%. The confounder testing gave us the results that 42% of men have a body mass index greater or equal to 30, while 48% of women have a BMI of greater or equal to 30. The dataset did not support the hypothesis, but through further research we too came to the conclusion that women have greater insulin resistance due to many bodily components and hormones that men are not composed of, which is all stated in the previous paragraph.

The results proved that females with diabetes, on average, give an account that they had been given greater insulin orders with an average of 31%, while they also were reported to have higher BMI scores, indicating the presence of increased visceral fat with an average of 30.9. On the other hand, their male counterparts averaged at 19% receiving insulin resulting in an average BMI score of 30.1. Females who did not receive the prescribed insulin order was 70 out of 101 resulting in 69% of the group tested, while the males with the same factors were 140 out of the 173, giving them a result of 81%. The data collected from the eICU database does not support the hypothesis that men tend to have greater insulin orders due to an increased amount of metabolically active visceral fat present in their bodies, which was an unexpected result considering the research done prior to the test.

DISCUSSION:

By all counts, and with proven results, we can conclude that gender will produce a disparity in response to insulin treatment and quantities of insulin ordered for patients with type-2 diabetes in the eICU dataset, but in the end, it comes down to your body composition. There is a disparity produced since women are composed of lower skeletal muscle mass, higher adipose tissue mass, increased circulation of free fatty acids, and elevated intramyocellular lipid content, all of which are components that lead to insulin resistance consequently producing a disparity between males and females. Therefore, women do tend to require greater orders of insulin than men due to this with women receiving an average of 0.31 insulin, while men only received an insulin dosage of 0.19. Additionally, women were also revealed to obtain increased hypoglycemic symptoms, such as hypertension, than men due to the fact that women will require greater amounts of insulin in order to combat insulin resistance that is created through the composition of their bodies. In contrast, it was discovered that men and women do share the common factor that weight does play a role in the levels of insulin received. It was ascertained that men and women who received insulin, are indubitably going to be obese and will have a body mass index of over or equal to 30. A surprising result was that women were revealed to have a higher composition of visceral fat than men because multiple research articles done prior to the test had come to the conclusion that men would have greater amounts of visceral fat due to higher dietary fat ingestion which accumulates greater amounts of abdominal visceral fat. Furthermore, these hypotheses can be explored in greater depth by expanding the age restrictions used for this particular experiment to include patients younger than the age of 45 in order to account for a wider demographic of people, further improving the accuracy of our findings. Therefore, we can come to the conclusion that gender does in fact produce a disparity in response to insulin treatment and quantities of insulin ordered for patients with type-2 diabetes in the eICU dataset through the testing of various hypotheses.

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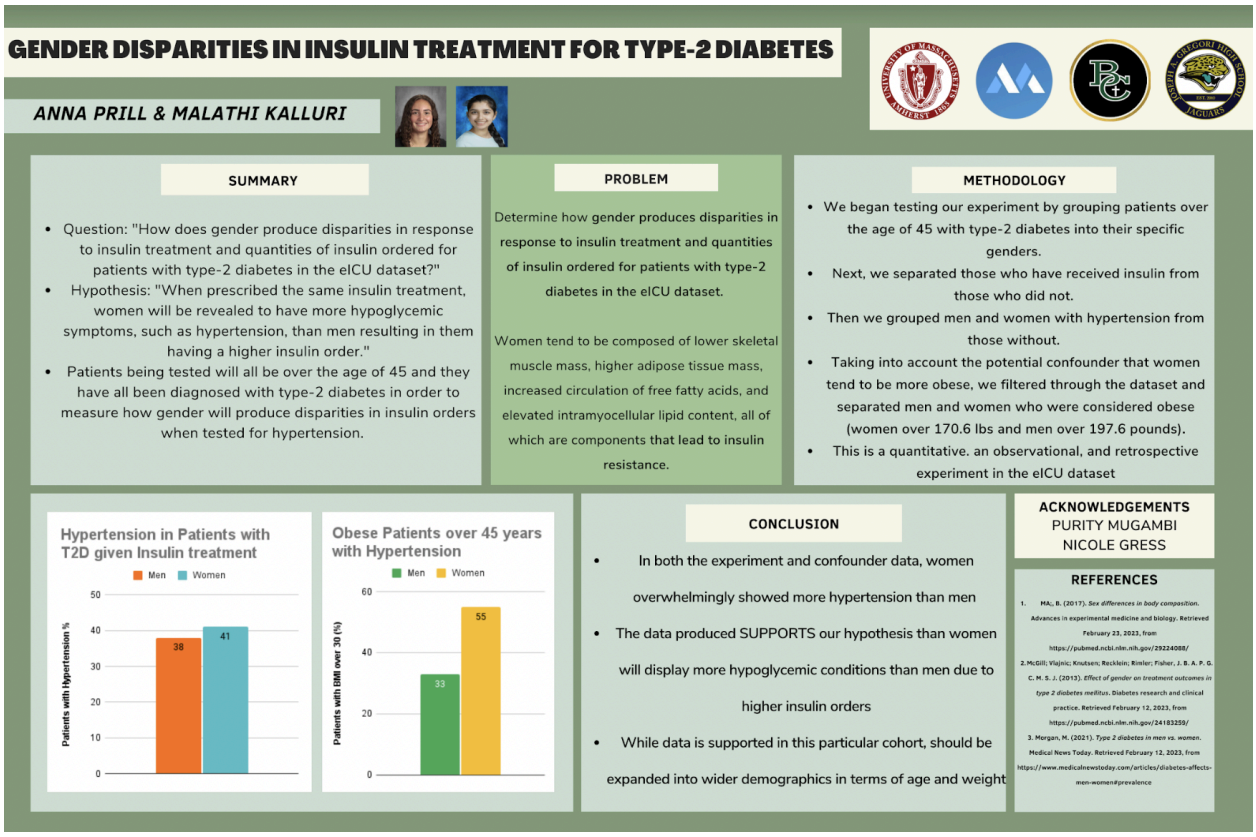

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Impact of Race and Gender on Aspirin Dosages

ABSTRACT:

Racial and gender disparities among healthcare treatment is well documented. In this experiment, we sought to determine the association of race and gender to the average doses of aspirin given to ischemic heart disease patients. Based on prior research, we believed aspirin dosages based on race from highest to lowest would be white, asian, hispanic, and then black, and the aspirin dosages based on gender would be male and then female. For this reason, we hypothesized that the biggest disparity in dosage amounts will be between black women and white men, favoring white men.

To test this, we filtered out patients using a selection criteria, and then split patients up based on their race and gender. After this, we compared the ratio of the average doses of aspirin that certain groups had received to the recommended dosages. We found that the data set we used proved our initial hypothesis incorrect, as the white males on average received less aspirin than the black females. We also saw that gender has shown to be a bigger proponent of aspirin dosages than race, in favor of female patients. Additionally, race has had a small difference for males, and a large difference for females other than for hispanics, for whom race is a larger determinant of aspirin dosages rather than gender.

INTRODUCTION:

The question that we focused on was seeing how race and gender affected the dosages of aspirin given to patients with ischemic heart disease. The main problem addressed in this paper is the disparities in the aspirin dosages given to ischemic heart disease patients, and how the factors mentioned earlier may create inconsistencies among different demographic groups. In this paper, we will be numerically and statistically using data to find if the aspirin dosages given to patients are equal or not, based on the patient's race and gender. This will help to shed light on an important issue in modern healthcare, and contribute to efforts to promote equity and fairness in medical treatment.

For this experiment, we tested 5 hypotheses with various races and genders. The first hypothesis we tested was that the received vs expected aspirin dose is higher among white men when compared with black women, and as stated before we tested this because the two groups should have the biggest difference based on prior research. The second hypothesis we tested was that the

ratio of received vs expected aspirin dose is higher among white women when compared to black men. We used this hypothesis because we wanted to test if disparities between races are larger than the disparities caused by gender. The third hypothesis we tested was that the ratio of received vs expected aspirin dose is higher among asian patients when compared to white patients. We tested this hypothesis because we wanted to see if there was any difference between these groups as their public perceptions are typically similar. The fourth hypothesis is that the ratio of received vs expected aspirin dose is higher among white men when compared to asian women. We tested this because we wanted to see if gender disparities could contribute to a greater difference if there was one between the two groups. The fifth hypothesis is that the ratio of received vs expected aspirin dose is the lowest for latino women compared to all other patient demographics. We wanted to test this as latinos are the lowest insured race in America, but other races may be underrepresented because of their numbers.

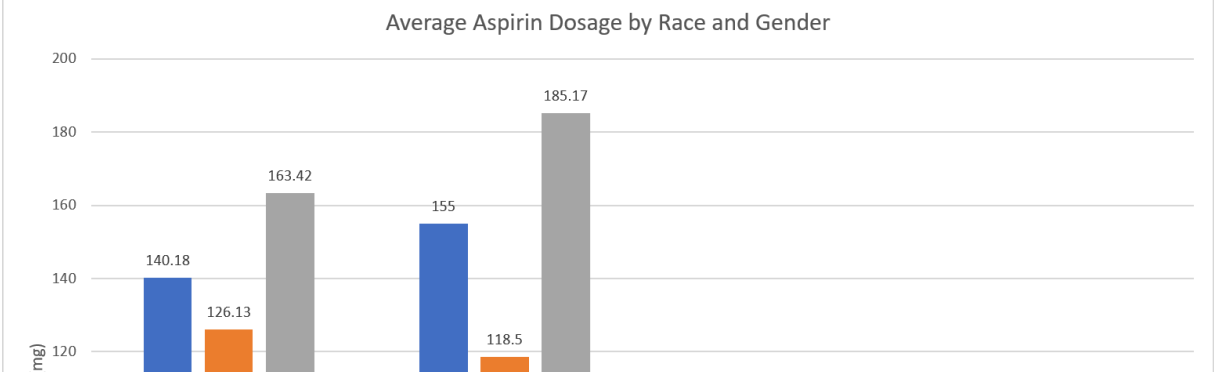
MATERIALS AND METHODS:

For this experiment, we conducted a quantitative observational retrospective study using the eICU dataset to calculate the average doses of aspirin among these groups and compare them across racial and gender. This dataset includes data from over 200,000 anonymized patient admissions into the ICU between 2014-2015, and lists out patients information, the conditions they have, and the treatments they received.

We had certain inclusion criteria to gather patients in the dataset who we could use for our experiment. Our first criteria was that the patients must have ischemic heart disease, as patients with this disease are the ones we want to focus on. Our second criteria was that the patients had to be over the age of 55, as that is the common age that ischemic heart disease develops in both men and women, and patients below this age may be given greater aspirin dosages as it is seen as an anomaly. Once we had a group of patients that fit within these criteria, we split them up based on the race and gender we had selected for each hypothesis, and labeled them accordingly (Ex: White Women receiving Aspirin labeled as WW-A). Next, we calculated the ratio of average received aspirin to recommended aspirin between the 2 groups. After this, we utilized the jupyter notebook to find the statistical significance of the results that we found in the form of the p-value.

The limitations of this dataset and study design is that hospital locations are not shown, so we are not able to isolate gender and race from economic disparities and prejudices (such as a black woman going to a richer predominantly white area hospital). There is also not an equal and large enough sample population for each group that fits within our inclusion criteria.

RESULTS:



Hypothesis 1:

Sex	Aspirin Dosage
WM-A	Total aspirin dose (mg): 11478 # of patients: 91 Avg aspirin dose(mg): 126.13 Ratio: 1.06 : 1 | (126.13 : 118.5)
BF-A	Total aspirin dose (mg): 1111 # of patients: 6 Avg aspirin dose(mg): 185.17 Ratio: 1.56 : 1 | (185.17 : 118.5)

p-value: 0.6276

Hypothesis 2:

Sex	Aspirin Dosage
WW-A	Total aspirin dose (mg): 8988 # of patients: 55 Avg aspirin dose(mg): 163.42 Ratio: 1.38 : 1 | (163.42 : 118.5)
BM-A	Total aspirin dose (mg): 948 # of patients: 8 Avg aspirin dose(mg): 118.5 Ratio: 1 : 1 | (118.5 : 118.5)

p-value = 0.9652

Hypothesis 3:

Sex	Aspirin Dosage
AP-A	Total aspirin dose (mg): 0 # of patients: 3 Avg aspirin dose(mg): 0 Ratio: 0 : 1 | (0 : 118.5)
WP-A	Total aspirin dose (mg): 20466 # of patients: 146 Avg aspirin dose(mg): 140.18 Ratio: 1.18 : 1 | (140.18 : 118.5)

p-value = 0.393

Hypothesis 4:

Sex	Aspirin Dosage
WM-A	Total aspirin dose (mg): 11478 # of patients: 91 Avg aspirin dose(mg): 126.1 Ratio: 1.06 : 1 | (126.1 : 118.5)
AF-A	Total aspirin dose (mg): 0 # of patients: 0 Avg aspirin dose(mg): 0 Ratio: 0 : 1 | (0 : 118.5)

p-value: NaN

Hypothesis 5:

Sex	Aspirin Dosage
HW-A	Total aspirin dose (mg): 0 # of patients: 3 Avg aspirin dose(mg): 0 Ratio: 0 : 1 | (0 : 118.5)
OR-A	Total aspirin dose (mg): 24715 # of patients: 170 Avg aspirin dose(mg): 145.38 Ratio: 1.23 : 1 | (145.38 : 118.5)

p-value = 0.3662

DISCUSSION:

The most significant result that we found was from testing hypothesis 1. Although our prior research had stated that black women, being disadvantaged in both race and sex, would receive the least doses of aspirin, our experiment found that they actually received the highest dose of aspirin on average out of all patients. However, as our p-value test shows, a p-value of 0.63 is very large which could suggest that the results that we obtained in this experiment could be due to chance.

The discrepancies in this experiment from our research could be explained by a number of reasons. First, the eICU dataset that we used did not have a large number of patients for us to gather data from, which also explains why the p-value for most of the experiments is very high

as the results are more likely to be due to chance with a smaller sample size. As mentioned before, another limitation of the dataset not including the geographical location of where the data was collected could contribute to this. Factors such as the stereotypes held there, the economic status, the political beliefs, and others could skew the results inaccurately portraying one group or certain patients as having an exaggerated high or low dose of aspirin given.

Overall, the results of our study have disproved our initial assumptions regarding the correlation between race, gender, and the dosage of aspirin given. The assumption that African Americans recieve the lowest dosage of aspirin and white people receive the highest dosage of aspirin has been proven by our dataset to be incorrect, and the average dosage received by female patients is higher than that of male patients in most populations, excluding Hispanics, who appear to be most adversely affected by race in terms of the dosage of aspirin that they receive. However, due to the limited sample size of the dataset, further research with greater numbers of patients and more information about them (such as location) is necessary to confirm these findings. Race and gender have a great impact on the aspirin dosages given, but gender seems to be the most significant factor in determining the expected dosages for patients with ischemic heart disease.

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Maanya Patel

Distinctions of Patients with Hypertension and Type-2 Diabetes

ABSTRACT:

This study examines the differences between patients with hypertension and type-2 diabetes. I have many hypotheses listed in the research guide, but I decided to talk about one hypothesis that interested me. I am interested in this hypothesis: "Patients with hypertension, after receiving beta-blockers, tend to gain more weight than patients with type-2 diabetes who receive beta-blockers." My research informed me that when patients change from taking a water pill (diuretic) to a beta blocker as a treatment or medication for high blood pressure, they might increase a few pounds of fluid that the diuretic drove back. Here are the methods and steps I took to test my hypothesis. First, I filtered out and separated the patients with hypertension and type-2 diabetes who received beta-blockers in the eICU dataset. Second, I split the patients with type-2 diabetes and hypertension who received beta-blockers from the rest of the patients in the dataset. Third, I would find the weight for these two types of patients. Fourth, I would compare the weights of the patients. Fifth, I would compare how much weight the patient had when being admitted into a hospital and how much weight they had after leaving the hospital. Sixth, I would find out which type of patients have more weight after taking the beta-blockers and leaving the hospital. Then, I would find the average weight for both types of patients when entering and after leaving the hospital. Lastly, I would find the differences between the admission weight and discharge weight for both types of patients. After I compare them, I will make a table and graph to show my results. I will also calculate the p-value. Here are my main findings, which include p-value with other research. The p-value I have gotten from my data when doing statistical testing is the **t-test p-value = 0.2559**, which means my hypothesis is not statistically significant. In conclusion, my hypothesis was false and not supported by the eICU dataset. The patients with hypertension who took beta blockers lost weight; the average admission weight was 83, and the average discharge weight was 82.968, meaning that the average patient lost about 0.032 pounds. The patients with type-2 diabetes who took beta-blockers ended up gaining weight, the average admission weight was 82.52, and the average admission weight was 82.94, meaning that after taking the beta-blockers, the patients gained about 0.42 pounds. I am surprised that my hypothesis was false because weight gain is a side-effect of beta-blockers, and my p-value was not statistically significant. When patients take beta-blockers, it decreases their metabolism; thus,

they gain more weight. According to my research, the average weight gain from beta-blockers patients is about 1.2 kilograms or 2.6 pounds. Some researchers in the past also thought this was true that beta-blockers cause weight gain, and lowers metabolism, so the patients burn fewer calories. The beta-blockers calm the body and decrease small movements, lowering the calorie shortage by a hundred per day. It makes the body tired, decreasing the patient's endurance and eagerness to work out or exercise.

INTRODUCTION:

Original question: Differences in pain treatment of patients with hypertension and type-2 diabetes in the eICU dataset

My Research Question: What are the most common pain management medications prescribed for patients in the eICU dataset with hypertension and type 2 diabetes, which of these two diseases has more impact on the human body, what differences can be found, and how do their side effects compare?

Dependent variable: Patients with hypertension and type-2 diabetes

Independent variable: Pain medications and treatments

My Five Hypotheses:

(1) Patients with hypertension, after receiving beta-blockers, tend to gain more weight than patients with type-2 diabetes who receive beta-blockers.

In my research, I was informed that when patients switch from taking a water pill (diuretic) to a beta blocker as a treatment for high blood pressure, they might increase a few pounds of fluid that the diuretic keeps off.

(2) More male patients have hypertension than female patients.

According to my research, even though both women and men develop hypertension, there are a lot of gender differences in the incidence and severity of hypertension that are well recognized where men have a higher rate of hypertension compared with women of the same age until the sixth decade of life (50 - 69).

(3) The pain treatment for the patients diagnosed with hypertension will require more total morphine doses than the patients diagnosed with type-2 diabetes.

In my research, it had informed me that patients with hypertension use morphine because it can help decrease blood pressure, venous return, and heart rate but not too often. Patients with type-2 diabetes use larger doses of morphine because it has an analgesic (pain-relieving) effect in hyperglycemic conditions (high blood glucose or sugar).

(4) Patients diagnosed with hypertension receive a total dose of more aspirin than patients diagnosed with type-2 diabetes for pain treatment.

According to my research, it is told that patients with type 2 diabetes who take more aspirin decrease the risk of serious vascular events among people with increased cardiovascular risk in type-2 diabetes, while patients with hypertension usually take a low dose because it is regarded as a healthy and safe way to lower your blood pressure and the chance of heart disease.

(5) Patients diagnosed with hypertension tend to be older than patients diagnosed with type 2 diabetes.

In my research, it is shown that hypertension is mainly a common health problem for older people because your body's system of blood vessels (vascular system) changes with age and blood pressure goes up as your arteries get stiffer. In my research, it has informed me that though type-2 diabetes often develops in people who are over the age of 45, but now more young adults, teens, and children are also developing it.

MATERIALS AND METHODS:

How did you answer this question? Describe the data set. What methods did you use? Don't put results in this section.

Study Design:

The study design I would use is an observational study of both qualitative and quantitative data.

Patient cohort selection criteria

#1 Results:

	Patients with hypertension who received beta-blockers	Patient with type-2 diabetes who received beta-blockers
Patient's average admission weight	Average admission weight of patients with hypertension who received beta-blockers: 83	Average admission weight of patients with type-2 diabetes who received beta-blockers: 82.52

Patient's average discharge weight	Average discharge weight of patient with hypertension who received beta-blockers: 82.968	Average discharge weight of patients with type-2 diabetes who received beta-blockers: 82.94

Hypothesis #1: Patients with hypertension, after receiving beta-blockers, tend to gain more weight than patients with type-2 diabetes who receive beta-blockers.

Steps:

· Filter and separate patients who received beta-blockers

· Separate out patients with type-2 diabetes and hypertension

· Find the weight for these types of patients

· Compare the weights of the patients

· Compare how much weight, the patient had when being admitted into a hospital and how much weight, they had after leaving the hospital

· Find which type of patients have more weight after leaving the hospital

· Find the average for it

Hypothesis is false because the eICU dataset informs and proves that patients with hypertension who receive beta-blockers whose average weight when coming into the hospital is 83, and when leaving the hospital, it is 82.968 which shows that the difference for this is a decrease of 0.032. Patients with type-2 diabetes who receive beta-blockers whose average weight when coming into the hospital is 82.52 and when leaving the hospital, it is 82.94, so their weight increased by 0.42. In conclusion, the patients with hypertension who receive beta-blockers (before entering and after leaving the hospital) actually lose weight, and patients with type-2 diabetes who receive beta-blockers (before entering and after leaving the hospital) gain more weight.

t-test p-value = 0.2559

Confounding variable: A potential confounding variable would be the amount of dosage of beta-blockers taken in the hospital. Another confounding variable would be the patient's weight.

(Handling confounders) - I would average out the amount of dosage of beta blockers taken by patients in the hospital because even though the amount of dosage of blockers is a confounding variable, it is beneficial to include for precise results. I would also keep the patient's amount of weight instead of separating it from the rest of the patients because even if they start with more or less weight, results vary, so it is better to keep it.

#2 Results:

	Total amount of patients with hypertension	Total amount of patients without hypertension
Female patients	Total amount of female patients with hypertension: 83 patients	Total amount of female patients without hypertension: 120 patients
Male patients	Total amount of male patients with hypertension: 118 patients	Total amount of male patients without hypertension: 235

Hypothesis #2: More male patients have hypertension than female patients.

Steps:

- Separate the patients with hypertension from all the other patients
- Separate the male and female patients with hypertension in the dataset
- Compare the male and female patients
- Find out which group of patients has more hypertension than the other

Hypothesis is true because the eICU dataset proves that there are about 118 male patients with hypertension in the dataset while there are about 83 female patients with hypertension in the dataset. This is a 35-person difference when comparing the amount to each other.

contingency_table = [[83, 120], [118, 235]]

exact-test p-value = 0.0822

Confounding variable: Patients who are overweight would be a potential confounding variable. Another potential confounding variable would be older patients (mainly those who are over the age of 65).

(Handling confounders) - I would filter and separate the overweight patients from the normal-weight patients in the dataset to stop it from affecting the other variables. For patients

who are old, I would just include it and patients of any age instead of filtering it out. I would do this in order to get accurate results because, at some point, any patient regardless of age could have hypertension.

{female - group1}

{male - group2}

#3 Results:

	Patients with hypertension	Patients with type-2 diabetes
Total number of patients who receive morphine	Total number of patients with hypertension who receive morphine: 42 patients	Total number of patients with type-2 diabetes who receive morphine: 24 patients
Total and average amount of morphine (mg) taken by patients	Total amount of morphine taken by patients with hypertension: 213.5 mg Average amount of morphine taken by patients with hypertension: 5.08 mg	Total amount of morphine taken by patients with type-2 diabetes: 97.5 mg Average amount of morphine taken by patients with type-2 diabetes: 4.06 mg

Hypothesis #3: The pain treatment for the patients diagnosed with hypertension will require more total morphine doses than the patients diagnosed with type-2 diabetes.

Steps:

- Separate the patients with hypertension and type-2 diabetes
- Find the total amount of morphine doses, the type of patients take it
- Compare the results

Hypothesis is supported by the data because the eICU dataset shows that the total amount of morphine taken by patients with hypertension is 213.5 mg while the total amount of morphine taken by patients with type-2 diabetes is 97.5 mg. The difference in the total amount of morphine taken by patients with hypertension and type-2 diabetes is 116. The average amount of morphine taken by patients with hypertension is 5.08 mg, while the average amount of morphine taken by patients with type-2 diabetes is 4.06 mg. The difference is that the patients with hypertension have taken 1.02 more as their average amount of morphine than patients with type-2 diabetes.

t-test p-value = 0.129

Confounding variable: A potential confounding variable would be patients who are afflicted with any type of serious pain. Another potential confounding variable would be patients who have hyperglycemic conditions such as high blood glucose or sugar.

(Handling confounders) - The types of pain are not listed in the eICU dataset; thus it will not affect the hypothesis. Even though patients who have hyperglycemic conditions would mean they have type-2 diabetes, it was never specified in the dataset, if they had these conditions.

#4 Results:

	Patients who have Hypertension	Patients who have type-2 diabetes
Total number of patients who received aspirin	Total patients with hypertension: 54 patients with hypertension take aspirin	Total patients with type-2 diabetes: 17 patients with type-2 diabetes take aspirin
Total and average dose of Aspirin (mg) received 48.75 mg (avg)	Total dose of aspirin is 14,182 milligrams Average dose of aspirin: 262.63 milligrams	Total dose of aspirin is 2,837 milligrams Average dose of aspirin: 166.88 milligrams

Hypothesis #4: Patients diagnosed with type -2 diabetes receive a total dose of more aspirin than patients diagnosed with hypertension for pain treatment.

Steps:

· Separate patients with hypertension and patients with type 2 diabetes who have received aspirin

· Search for the patients with hypertension and type -2 diabetes who have received more dose of aspirin (mg) in the eICU dataset

· Compare the results of which patient has received more than the other do

Hypothesis is false because the total dose of aspirin for patients with hypertension is 14,182 mg while the total dose of aspirin for patients with type-2 diabetes is 2,837 mg. The difference between the total dose of aspirin for patients with hypertension and type-2 diabetes is 11,345 mg.

t-test p-value = 0.0

Confounding variable: Age would be a potential confounding variable. Another confounding variable would be patients who have cardiovascular risks and diseases.

(Handling confounders) - I would leave the age to be neutral, meaning I would just leave it the same without changing or filtering it in the dataset. Ischemic heart disease is included in the dataset which is a cardiovascular disease so I would filter it out.

#5 Results:

	Patients with hypertension	Patients with type-2 diabetes
Total amount of age for patients	Total amount of age for patients with hypertension: 13,979	Total amount of age for patients with type-2 diabetes: 10,293
Average amount of age for patients	Average amount of age for patients with hypertension: 60.51	Average amount of age for patients with type-2 diabetes: 57.5

Hypothesis #5: Patients diagnosed with hypertension tend to be older than patients diagnosed with type 2 diabetes.

Steps:

- Separate the patients with hypertension and type-2 diabetes
- Find the age of patients with hypertension and type-2 diabetes
- Separate them and compare the results of which patient group is more older

Hypothesis is true because the total amount of age for patients with hypertension is 13,979 while the total amount of age for patients with type-2 diabetes is 10,293. The difference of the total amount of age for patients with hypertension and type-2 diabetes is 3,686. The average age for patients with hypertension is 60.51, while the average age for patients with type-2 diabetes is 57.5. The difference between the average amount of age for patients with hypertension and type-2 diabetes is 3.01.

t-test p-value = 0.0336

Confounding variable: A potential confounding variable could be gender. Blood pressure could also be another potential confounding variable.

(Handling confounders) - I could handle the confounding variable by just leaving the gender to be both male and female instead of separating it. Even though blood pressure levels could be a confounding variable, it is not mentioned in the dataset, so it would not affect my hypothesis.

eICU Dataset description:

This dataset is both qualitative and quantitative data.

The Philips eICU program "(a vital telehealth care program that delivers information to caregivers at the bedside)" collected the data. The dataset includes data associated with (ICU) stays; over 2,500 unit stays were chosen from 20 of the largest hospitals in the eICU Collaborative Research Database. Philips Healthcare created a telehealth system for ill patients and gave 24-hour support to caregivers at the bedside. It is another addition to the bedside team, and remote caregivers who used this data would file it away for research purposes. A part of the data is available for researchers with the eICU Collaborative Research Database. Researchers can look at this open-access demo and determine whether the eICU Collaborative Research Database is proper for their work.

This data has been collected and includes a multi-center database consisting of identified health data (except for stuff like patient's name, address, health, and medical records) for over two hundred thousand admissions to the eICU Collaborative Research Database across the US between 2014 to 2015. The database also includes care plan documentation, treatment information, vital sign measurements, diagnosis information, and APACHE severity of illness measures.

The grants from the National Institutes of Health supported this work. Philips Healthcare funded the MIT Laboratory for Computational Physiology to begin work on the database. The authors of the database thanked the Philips eICU Research Institute and Philips Healthcare for their help and support on the data. The authors also thanked Dina Demner-Fushman, who made beneficial comments on the identification process (which filtered the patient's real name, address, and medical records), and Andrew A Kramer, who made understanding comments about the data.

The dataset also includes things like the patient's admission id, sex, age, admission duration(days), ethnicity, hospital discharge location, admission height, admission weight, discharge weight, diagnoses text, diagnoses icd9, diagnosis priority, if they received pain med, received narcotic, if they received beta-blocker if they received morphine if they received aspirin if they received insulin, total dose(mg) of morphine, and total dose(mg) of aspirin.

RESULTS:

Hypothesis #1 Results:

	Patients with hypertension who received beta-blockers	Patient with type-2 diabetes who received beta-blockers
Patient's average admission weight	Average admission weight of patients with hypertension who received beta-blockers: 83	Average admission weight of patients with type-2 diabetes who received beta-blockers: 82.52
Patient's average discharge weight	Average discharge weight of patient with hypertension who received beta-blockers: 82.968	Average discharge weight of patients with type-2 diabetes who received beta-blockers: 82.94

t-test p-value = 0.2559

Hypothesis #2 Results:

	Total amount of patients with hypertension	Total amount of patients without hypertension
Female patients with hypertension	Total amount of female patients with hypertension: 83 patients	Total amount of female patients without hypertension: 120 patients
Male patients with hypertension	Total amount of male patients with hypertension: 118 patients	Total amount of male patients without hypertension: 235

contingency_table = [[83, 120], [118, 235]]

exact-test p-value = 0.0822

Hypothesis #3 Results:

	Patients with hypertension	Patients with type-2 diabetes
Total number of patients who receive morphine	Total number of patients with hypertension who receive morphine: 42 patients	Total number of patients with type-2 diabetes who receive morphine: 24 patients

Total and average amount of morphine (mg) taken by patients	Total amount of morphine taken by patients with hypertension: 213.5 mg Average amount of morphine taken by patients with hypertension: 5.08 mg	Total amount of morphine taken by patients with type-2 diabetes: 97.5 mg Average amount of morphine taken by patients with type-2 diabetes: 4.06 mg

t-test p-value = 0.129

Hypothesis #4 Results:

	Patients who have Hypertension	Patients who have type-2 diabetes
Total number of patients who received aspirin	Total patients with hypertension: 54 patients with hypertension take aspirin	Total patients with type-2 diabetes: 17 patients with type-2 diabetes take aspirin
Total and average dose of Aspirin (mg) received 48.75 mg (avg)	Total dose of aspirin is 14,182 milligrams Average dose of aspirin: 262.63 milligrams	Total dose of aspirin is 2,837 milligrams Average dose of aspirin: 166.88 milligrams

t-test p-value = 0.0

Hypothesis #5 Results:

	Patients with hypertension	Patients with type-2 diabetes
Total amount of age for patients	Total amount of age for patients with hypertension: 13,979	Total amount of age for patients with type-2 diabetes: 10,293
Average amount of age for patients	Average amount of age for patients with hypertension: 60.51	Average amount of age for patients with type-2 diabetes: 57.5

t-test p-value = 0.0336

DISCUSSION:

I enjoyed developing and researching these hypotheses. I kind of expected hypothesis #3 and #5 to be true because of my educated research on it. In hypothesis #2, I made an educated guess based on the research I did on it. Some of the results I was surprised by, such as Hypothesis #1 because I thought that patients with hypertension would increase a few pounds after taking beta-blockers as treatments but it was proven false. I also thought that beta-blockers would slow down your body's metabolism. It could stop a patient's body from quickly converting the food they eat into energy, which ultimately leads to a weight gain due to the excess calories. Another reason, I thought that patients with hypertension would gain weight due to beta-blockers because beta-blockers cause fatigue which could prevent the patient from exercising or doing any physical activities. This would make the patients burn only a few calories, leading to weight gain. If patients take beta-blockers for heart failure and if they notice weight gain, it could be a sign to a more serious problem. This would mean that your heart failure is becoming worse and the medications the patient is taking are not working well as they should have been working. I was also surprised by the fact that male patients have hypertension more than female patients because everyone has the risk of having this medical condition. I would use this data in the future by using it more accurately, making better-educated guesses, and do more research on the topic when making hypotheses in the future. Not only could I use the dataset, but even healthcare providers and researchers used this dataset and others to create and develop better care plans and document placements at the suitable and appropriate care level. This experiment could possibly help medical researchers which could lead to better improving medical care. These hypotheses could support other scientific research and possibly create a breakthrough in knowledge in medical care. A takeaway from this experiment that I have learned is that when testing a

hypothesis, it could strengthen and support the quality of the quantitative studies and data, which could increase the generality of the findings and give more dependable knowledge. Another takeaway is that when making a hypothesis, they cannot be just a simple guess. It should be formulated and be based on knowledge and theories that exist. The hypotheses have to be testable, which means that the researchers have to support or disprove them through their scientific research methods, such as observations, experiments, and statistical data analysis.

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ABSTRACT:

This study explores the effects of gender in insulin treatment and whether it creates disparities in the amount prescribed to patients with type-2 diabetes. When prescribed the same insulin treatment, women will be observed to have more hypoglycemic symptoms, such as hypertension, than men, which would result in the former possessing a higher insulin order in the eICU dataset. To begin, patients already given insulin treatment were separated into those with and without

T2D. Among these patients, male and female patients were put into separate cohorts. Within these two groups, we calculated the amount of females and males that displayed signs of hypertension. Overall, 41% of women were shown to have signs of hypertension in comparison to 38% of men, furthermore proving to be statistically significant with a p-value of 0.026. Based on prior research, these results proved to be unexpectant, mainly due to the preconception that men would require higher levels of insulin regardless of hypoglycemic conditions due to certain prejudices in the healthcare system. Nevertheless, our hypothesis was supported with the data acquired from our experiment, indicating that female patients with type-2 diabetes would possess higher insulin orders than their male counterparts. This brings forth a discussion regarding health equity in the United States, and whether or not our preconceived notions that men receive more effective healthcare than women must be reconsidered.

INTRODUCTION:

Differences in orders of insulin for patients with type-2 diabetes (icd9 code 250) in the eICU dataset.

This experiment will discuss the effect that gender has in regards to the prescription of insulin treatment for type-2 diabetes.

Women had a harder time reaching an ideal glycemic target from receiving insulin glargine than men despite receiving higher insulin doses (due to reductions in FPG) and enduring more hypoglycemic events. On average, women had higher annual rates of severe symptomatic hypoglycemia than men. (McGill et al, 2013)

Men tend to have a higher resilience to insulin due to the greater amounts of visceral and hepatic adipose tissue, combined with the lack of effect of estrogen and lower adiponectin levels, and furthermore result in women possessing a more “insulin-sensitive environment” in comparison to men (Geer & Shen, 2009)

Research Question: How does gender produce disparities in response to insulin treatment for type-2 diabetes?

Independent Variable: Gender

Dependent Variable: Insulin treatment

Hypotheses:

1. Between men and women with type-2 diabetes, larger symptomatic disparities in the body composition of each gender are more likely to result in greater differences in the prescribed insulin treatment in both sexes depending on if they are considered overweight compared to the average (BMI of over 30 or 197.6 pounds for men and a BMI of over 30 or 170.6 pounds for women).
2. Between men and women with type-2 diabetes, smaller symptomatic disparities in the body composition of each gender are less likely to result in differences in the prescribed insulin treatment in both sexes due to height when compared to the averages for each gender (5 feet 6 inches for men and 5 feet 2 inches for women).

3. When prescribed the same insulin treatment, women will be revealed to have more hypoglycemic symptoms, such as hypertension, than men resulting in them having a higher insulin order in the eICU dataset.
4. Of men and women who have type-2 diabetes, men are more likely to have a greater number of insulin orders due to the fact that men tend to have higher insulin resistance than women.
5. Between men and women who have type-2 diabetes, men tend to have greater insulin orders due to the increased amount of metabolically active visceral fat present in their bodies.

MATERIALS AND METHODS:

Study Design

Data Description:

This dataset contains information from ICU stays from over 2,500 unit stays obtained from 20 of the larger hospitals in the eICU database. The collected data includes vital signs, laboratory measurements, admission diagnosis, medication, and care plan information through different interfaces. Note that if a care unit does not have a certain interface, there will be no available data in the database regarding that particular interface.

This is a retrospective observational based quantitative analysis. This is due to the fact that our experiment is based on previously collected data that we are now interpreting in order to present a response to our specific research question.

Inclusion Criteria: Men and women with type-2 diabetes over the age of 45

Study Design:

We will use the quantitative data in the retrospective elCU dataset to determine differences in insulin treatment in patients who have type-two diabetes and how their numbers determine the amount of insulin orders placed in an observational experiment.

1) Between men and women with type-2 diabetes, larger disparity in the body composition of each gender are more likely to result in greater differences in the prescribed insulin treatment in both sexes.

   Patient Cohort Selection Criteria- Men and women over the age of 45 who have type-2 diabetes

   Experimental Design:

   Running our experiment on patients who are either men or women over the age of 45 that have been diagnosed with type-2 diabetes will allow us to distinguish the amounts of insulin given to each patient of either sex through comparing averages in insulin treatment in both men and women. We will then be able to determine which sex received more or less insulin overall, allowing us to calculate which gender had greater insulin orders required for their treatment. First, patients will be separated into their gender. Each group will then be split into those over the

age of 45 and those below. Then we will measure whether insulin was prescribed to each patient, with male patients most likely receiving greater amounts of insulin on average than female patients.

2) Between men and women with type-2 diabetes, smaller symptomatic disparities in the body composition of each gender are less likely to result in differences in the prescribed insulin treatment in both sexes.

   Patient Cohort Selection Criteria- Men and women over the age of 45 who have type-2 diabetes

   Experimental Design:

   Running our experiment on patients who are either men or women over the age of 45 that have been diagnosed with type-2 diabetes will allow us to distinguish the amounts of insulin given to each patient of either sex. We will then be able to determine which sex received more or less insulin overall, leading us to calculate which gender had greater insulin orders required for their treatment. First, patients 45 years old and above will be separated into groups based on their gender. Then, we will observe the body composition of patients in both sexes, particularly in their average BMI. From there, we will determine whether or not these differences contribute to the insulin treatment prescribed to each patient by measuring the average level of insulin dosage given to male and female patients separately.

3) When prescribed the same insulin treatment, women will be revealed to have more hypoglycemic symptoms than men.

   Patient Cohort Selection Criteria- Men and women over the age of 45 who have been diagnosed with type-2 diabetes and hypoglycemia.

   Experimental Design:

   We will begin our experiment by grouping patients over the age of 45 with type-2 diabetes into their specific genders. Next, we will separate those who have hypoglycemia from those who do not. These steps will allow us to determine which sex has higher hypoglycemia rates through symptoms such as respiratory distress, hypertension, etc. which will contribute to the amount of insulin needed for their treatment plan. Finally, we would be able to ascertain which gender requires greater insulin orders.

4) Of men and women who have type-2 diabetes, men are more likely to have higher insulin orders due to a greater amount of visceral fat which is metabolically active.

   Patient Cohort Selection Criteria- Men and women over the age of 45 who have been diagnosed with type-2 diabetes.

   Experimental Design:

To begin testing this hypothesis, we will group patients diagnosed with type-2 diabetes over the age of 45 into their designated gender. Between these two groups, patients will be then separated based on whether or not they are considered to be overweight or underweight. Then they will be grouped into those who have more visceral fat and those who have subcutaneous fat, which can be estimated through calculation of their BMIs (Body Mass Index) These steps will help us determine whether those who have higher levels of visceral fat or subcutaneous fat require greater amounts of insulin. Consequently, we will be able to ascertain what group has greater insulin orders.

5) Between men and women who have type-2 diabetes, men tend to have greater insulin orders due to the increased amount of metabolically active visceral fat present in their bodies.

   Patient Cohort Selection Criteria- Men and women over the age of 45 who have been diagnosed with type-2 diabetes.

   Experimental Design:

   To begin testing this hypothesis, we will group patients diagnosed with type-2 diabetes over the age of 45 into their designated gender. Between these two groups, patients will be then separated based on whether or not they are considered to be overweight or underweight. Then they will be grouped into those who have more visceral fat and those who have subcutaneous fat, which will be determined through calculating the average body fat percentage. These steps will help us determine whether those who have higher levels of visceral fat or subcutaneous fat require greater amounts of insulin. Consequently, we will be able to ascertain what group has greater insulin orders.

Confounders

Hypothesis 1: Between men and women with type-2 diabetes, larger symptomatic disparities in the body composition of each gender are more likely to result in greater differences in the prescribed insulin treatment in both sexes depending on if they are considered overweight compared to the average (BMI of over 30 or 197.6 pounds for men and a BMI of over 30 or 170.6 pounds for women).

Men over 197.6 pounds with type-2 diabetes, over 45, and have received insulin

Count: 12

Total: 23

12/23 = 52%

Women over 170.6 pounds with type-2 diabetes, over 45, and have received insulin

Count: 11

Total: 26

11/26 = 42%

P-VALUE = 0.1014 → NOT STATISTICALLY SIGNIFICANT

Potential Confounder: more male patients had hypertension

Men over 197.6 pounds with type-2 diabetes, over 45, have hypertension, and have received insulin

Count: 4

Total: 12

4/12 = 33%

Women over 170.6 pounds with type-2 diabetes, over 45, have hypertension, and have received insulin

Count: 6

Total: 11

6/11 = 55%

The hypothesis is supported.

Hypothesis 2: Between men and women with type-2 diabetes, smaller symptomatic disparities in the body composition of each gender are less likely to result in differences in the prescribed insulin treatment in both sexes due to height when compared to the averages for each gender (5 feet 6 inches for men and 5 feet 2 inches for women).

Men over 5 ft. 6 in. who have type-2 diabetes, received insulin, and are over 45

Count: 16

Total: 24

16/24 = 67%

Women over 5 ft. 2 in. who have type-2 diabetes, received insulin, and are over 45

Count: 19

Total: 25

19/25 = 76%

P-VALUE = 0.026 → STATISTICALLY SIGNIFICANT

Potential Confounder: women tend to be more obese

Men over 5 ft. 6 in. who have type-2 diabetes, received insulin, considered obese, and are over 45

Count: 11

Total: 16

11/16 = 69%

Women over 5 ft. 2 in. who have type-2 diabetes, received insulin, considered obese, and are over 45

Count: 7

Total: 19

7/19 = 37%

The hypothesis is supported.

Hypothesis 3: When prescribed the same insulin treatment, women will be revealed to have more hypoglycemic symptoms, such as hypertension, than men, resulting in women having a higher insulin order in the eICU dataset.

Men who received insulin, have type-2 diabetes, and are over 45

Have Hypertension

Count: 9

Total: 24

9/24 = 38%

Women who received insulin, have type-2 diabetes, and are over 45

Have Hypertension

Count: 11

Total: 27

11/27 = 41%

P-VALUE = 0.779 → NOT STATISTICALLY SIGNIFICANT.

Potential confounder: women tend to be more obese

Men who received insulin, have type-2 diabetes, are considered obese(over 197.6), and are over 45

Have hypertension

Count: 4

Total: 19

4/12 = 33%

Women who received insulin, have type-2 diabetes, are considered obese (over 170.6 pounds), and are over 45

Have hypertension

Count: 6

Total: 27

6/11 = 55%

The hypothesis is supported.

Hypothesis 4: Of men and women who have type-2 diabetes, men are more likely to have a greater number of insulin orders due to the fact that men tend to have higher insulin resistance than women.

F-D-IT (Female-Diabetes-Insulin Treatment)

Count: 31

Total: 101

Percentage: 31/101 = 31%

Avg I: 0.31

M-D-IT

Count: 33

Total: 173

Percentage: 33/173 = 19%

Avg. I: 0.19

F-D-NIT

Female

Count: 70

Total: 101

Percentage: 70/101 = 69%

M-D-NIT

Count: 140

Total: 173

Percentage: 140/173 = 81%

Data does not support hypothesis.

P-VALUE = 0.0378 → STATISTICALLY SIGNIFICANT

Potential Confounder: Men on average have a larger body mass than women.

Men with diabetes + insulin treatment: **33** Women with diabetes + insulin treatment: **31**

BMI ≥ 30: **14**	BMI < 30: **19**	BMI ≥ 30: **15**	BMI < 30: **16**
Percentage: **42%**	Percentage: **58%**	Percentage: **48%**	Percentage: **52%**

The data does not support the hypothesis.

Hypothesis 5: Between men and women who have type-2 diabetes, men tend to have greater insulin orders due to the increased amount of metabolically active visceral fat present in their bodies.

F-D-IT

Count: 31

Total: 101

Percentage: 31/101 = 31%

Avg BMI: 30.9

M-D-IT

Count: 33

Total: 173

Percentage: 33/173 = 19%

Avg. BMI: 30.1

F-D-NIT

Count: 70

Total: 101

Percentage: 70/101 = 69%

M-D-NIT

Count: 140

Total: 173

Percentage: 140/173 = 81%

Data does not support hypothesis.

P-VALUE: 0.4173 → NOT STATISTICALLY SIGNIFICANT

Potential Confounder: Men with T2D generally have higher blood sugar levels than women.

**The data to test this hypothesis was not present in the eICU dataset.

DISCUSSION:

In our research, we discovered that of patients with type-2 diabetes, gender disparities can be observed in insulin treatment especially due to the body composition of the two sexes. Statistically, the amount of female patients with type-2 diabetes that possessed a BMI of 30 or more in the eICU dataset was more than the amount of male patients under similar conditions, which resulted in a tendency to prescribe more insulin on average to the former than the latter. Women also tended to be prescribed insulin more frequently than men regardless of differences in height nor insulin resistance that seems to be more present on average in their male counterparts. Both of these results proved to be statistically significant, with p-values of 0.026 and 0.0378 (respectively).

Our findings were quite contrary to what we had expected in our hypotheses, which mostly predict that men would be prescribed with more insulin than women based on research done prior to the experiment. This is most likely due to the fact that the data produced from the eICU dataset contradicted previous findings that revealed the discrepancy in insulin treatment between male and female patients with type-2 diabetes, working in the favor of men. Additionally, initial research suggested that men possessing physiological traits, such as higher insulin resistance and more visceral/subcutaneous fat, would receive more insulin in comparison to their female counterparts. Furthermore, the eICU dataset does not have access to supplemental data that would reveal more symptomatic differences between men and women with type-2 diabetes that could possibly account for reasons that women would require/receive more insulin orders than men.

While the dataset provided information on whether or not a patient received insulin, it failed to include the *amount* of insulin prescribed to each patient. This leaves aspects of the research question incomplete, as one of the main objectives was to find inconsistencies in insulin doses between male and female patients with T2D. Our research would also benefit from extending the age restriction of the experiment (45 years or older) to those younger than 45, to observe possible trends in insulin treatment/dosage regarding differences in age. Expanding the demographic of this topic would allow us to produce more accurate findings and conclude proper steps moving forward.

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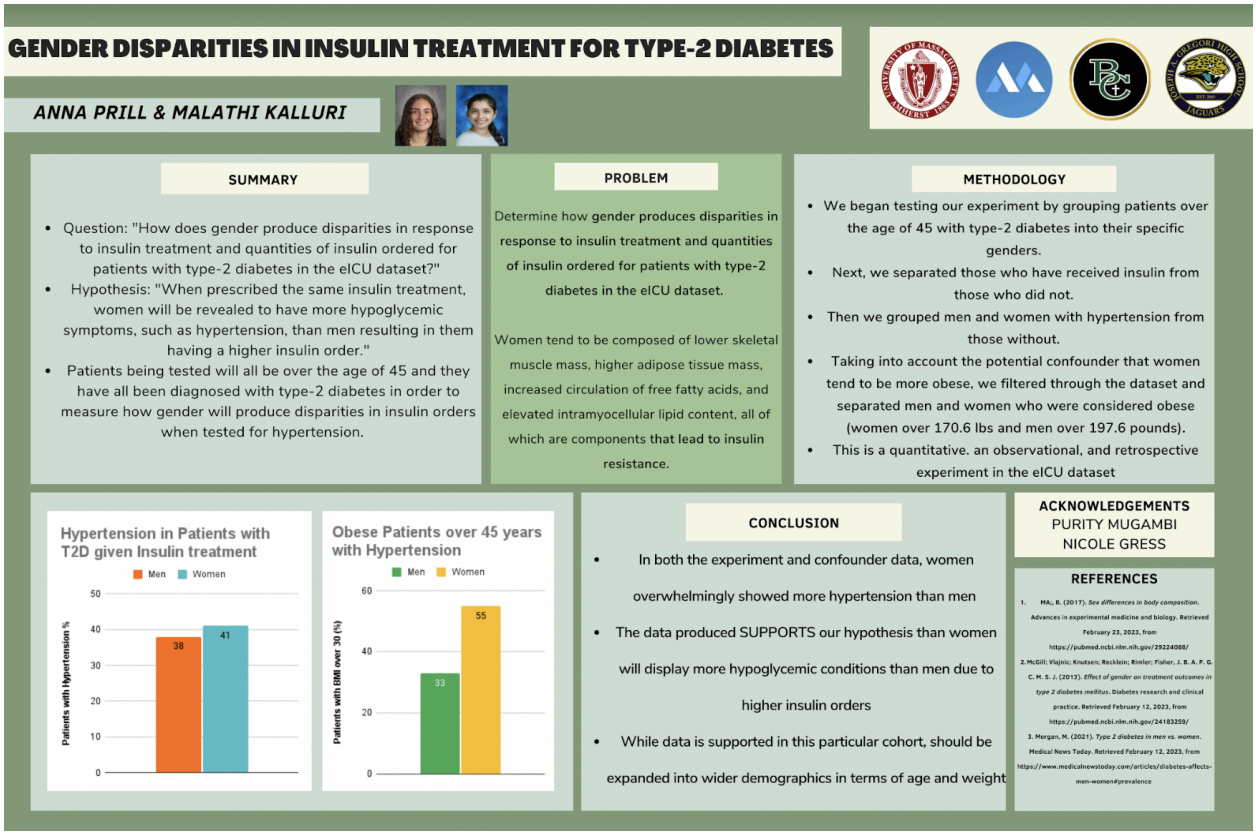

Ria Velvadapu

ABSTRACT:

The purpose of this study was to determine if there is any correlation between a patient's insurance plan and their aspirin prescription. This was a means of studying health equity and determining if insurance, as a socioeconomic factor, affected patients in terms of their access to medications. This study was performed using the MIMIC Ⅲ dataset, which looked at past data of patients with various insurance plans and whether or not they were given certain medications or treatments. Results showed that patients with insurance plans that typically offer more coverage don't necessarily receive aspirin more often than patients with insurance plans that offer less coverage. That being said, results did show that a patient's insurance plan can impact whether they will be prescribed pain medications over aspirin.

INTRODUCTION:

Health equity is a rising problem globally, and I am looking to see if patients with different financial statuses as measured through the type of insurance plan they have are affected in regards to being prescribed aspirin for their health conditions. The question I asked in my experiment was how socioeconomic class affects the way in which a patient will be prescribed aspirin. Because it is difficult to measure a person's socioeconomic status through the data set that I utilized, I measured different insurance plans that people had and linked it to the level of access they had to medications like aspirin. My hypothesis was that patients who are on Medicare health insurance are less likely to receive aspirin than pain medications.

Health insurance plans usually cover the majority of the costs of prescription drugs given by doctors. However, there is still an amount of money one will have to pay out of pocket. In addition, not all medications are covered, so there are instances where one would have to pay completely out of pocket. Different insurance companies will have different policies on what they will cover and what they won't. This is where certain insurance plans become more beneficial than others, depending on a person's needs. For example, where Medicare has gaps in coverage, private insurance covers. This benefit comes with a higher price, though, that people might not be able to afford- and therefore might miss out on affordable payment plans for necessary treatments and medications. This raises the question of whether a person's insurance plan affects their prescriptions.

MATERIALS AND METHODS:

I conducted an observational, retrospective, quantitative study on differences in aspirin prescription of patients represented in the MIMIC dataset. I used the MIMIC dataset to observe past data on patients with varying insurance plans and their aspirin prescriptions and see if I can draw conclusions based on those findings. Because the purpose of this study is to compare insurance plans, this study will examine every individual in the dataset. There is no exclusion criteria. Different experiments within the study will focus on one type of insurance plan over others, but ultimately every insurance plan will be used in order to come to meaningful conclusions. The experimental design for this study included specific filtering. The first step was to separate all the individuals in the MIMIC dataset into two groups: those who had Medicare health insurance and those who didn't. The individuals who did not have Medicare had other health insurance plans. The next step was, within the group that had Medicare, to measure the amount of patients who received aspirin and those who only received pain medications. The same process is to be repeated for the group of individuals who did not have Medicare- the amount of patients who received aspirin versus those who received pain medications was

measured and used as a means of comparison. The next step was to divide the number of people who received aspirin by the total number of people with Medicare and divide the number of people who received pain medication by the total number of people with Medicare to calculate exact percentages.

RESULTS:

A total of 99 patients had Medicare health insurance in the MIMIC dataset. Of those 99, 40 individuals received aspirin, and 58 individuals only received pain medications. A total of 32 patients did not have Medicare, and instead had other insurance plans in the MIMIC dataset. Of those 32, 3 individuals received aspirin, and 21 individuals only received pain medications. So, 40% of patients with Medicare received aspirin, and 58% of patients with Medicare received only pain medications. This supports the hypothesis that patients with Medicare are less likely to receive aspirin than pain medications. In order to confirm that these results are statistically significant, I tested for the p-value. The p-value was 0.0009, which means that these results are statistically significant because the p-value is less than 0.05. That being said, it is worthwhile to consider other factors that could impact whether or not a patient will receive aspirin. One confounder is that patients who did not receive aspirin could have had kidney disease. In this case, aspirin is not recommended because it may increase the patient's tendency to bleed.

DISCUSSION:

The most significant results of this study were that insurance plans can impact whether or not a patient receives medication to treat their condition versus just pain medications. This is substantial when talking about health equity and affordability in healthcare because the differences in treatments among patients is putting those who are underinsured at a noticeable disadvantage, despite the fact that quality healthcare should be accessible to everyone. While aspirin may be a relatively inexpensive drug, its price inflates in hospital and ER settings, and the costs for patients is primarily based on how much their insurance covers. Because of this drastic inflation, patients who are underinsured are at risk because they aren't able to afford aspirin at its inflated price and might have to settle for other medications. This study's results serve to highlight the imbalances in treatments from patient to patient, and can be applied to multiple instances where patients are jeopardized because their financial situations put them at a disadvantage. The disparities that are highlighted in this study between people who have the financial resources to support themselves and those who lack those resources are applicable not only in conversations about the healthcare system, but also in all aspects of today's society where basic human necessities become privileges.

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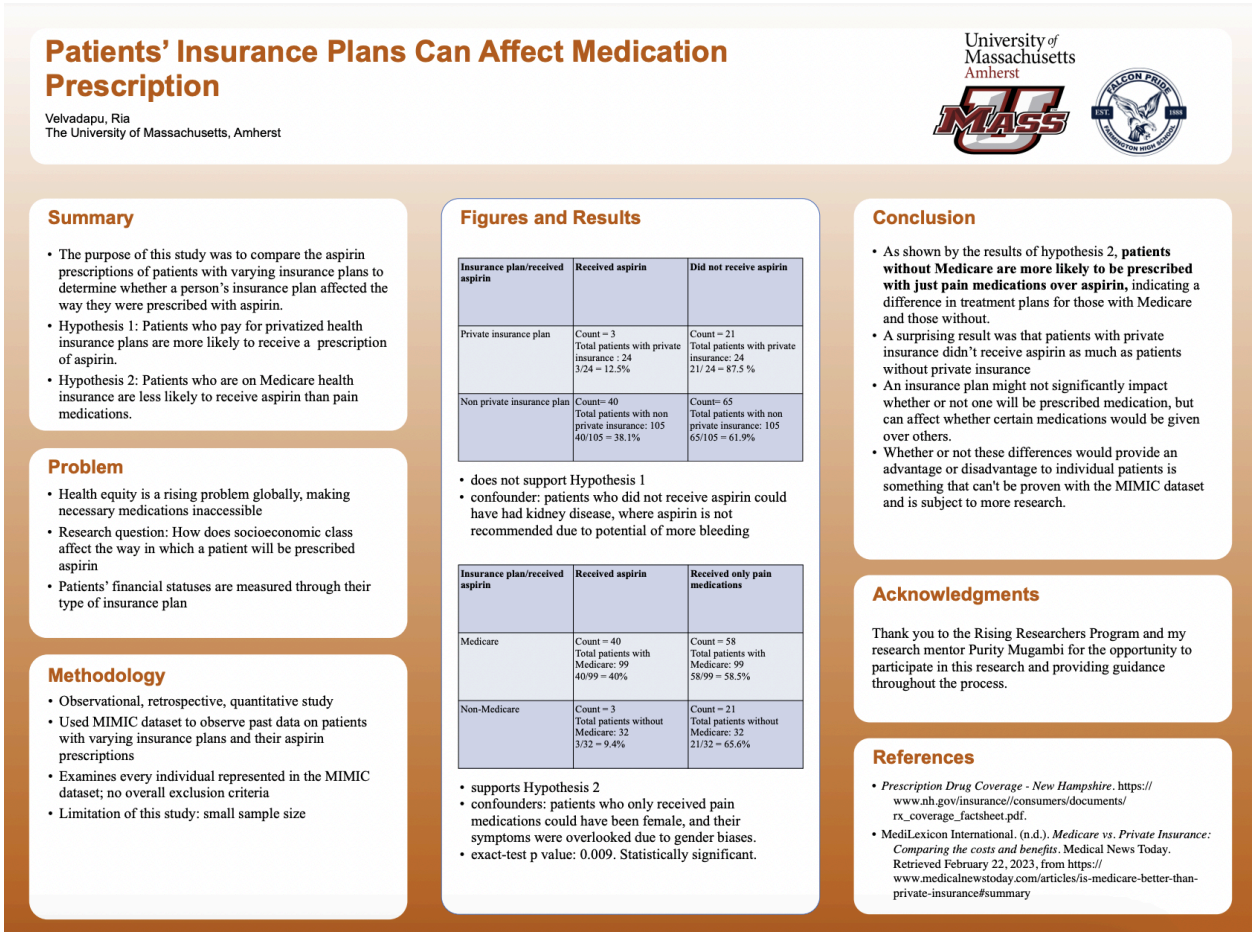

Patients' Insurance Plans Can Affect Medication Prescription

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Summary

- The purpose of this study was to compare the aspirin prescriptions of patients with varying insurance plans to determine whether a person's insurance plan affected the way they were prescribed with aspirin.
- Hypothesis 1: Patients who pay for privatized health insurance plans are more likely to receive a prescription of aspirin.
- Hypothesis 2: Patients who are on Medicare health insurance are less likely to receive aspirin than pain medications.

Problem

- Health equity is a rising problem globally, making necessary medications inaccessible
- Research question: How does socioeconomic class affect the way in which a patient will be prescribed aspirin
- Patients' financial statuses are measured through their type of insurance plan

Methodology

- Observational, retrospective, quantitative study
- Used MIMIC dataset to observe past data on patients with varying insurance plans and their aspirin prescriptions
- Examines every individual represented in the MIMIC dataset; no overall exclusion criteria
- Limitation of this study: small sample size

Figures and Results

Insurance plan/received aspirin	Received aspirin	Did not receive aspirin
Private insurance plan	Count = 3 Total patients with private insurance : 24 3/24 = 12.5%	Count = 21 Total patients with private insurance: 24 21/ 24 = 87.5 %
Non private insurance plan	Count= 40 Total patients with non private insurance: 105 40/105 = 38.1%	Count= 65 Total patients with non private insurance: 105 65/105 = 61.9%

- does not support Hypothesis 1
- confounder: patients who did not receive aspirin could have had kidney disease, where aspirin is not recommended due to potential of more bleeding

Insurance plan/received aspirin	Received aspirin	Received only pain medications
Medicare	Count = 40 Total patients with Medicare: 99 40/99 = 40%	Count = 58 Total patients with Medicare: 99 58/99 = 58.5%
Non-Medicare	Count = 3 Total patients without Medicare: 32 3/32 = 9.4%	Count = 21 Total patients without Medicare: 32 21/32 = 65.6%

- supports Hypothesis 2
- confounders: patients who only received pain medications could have been female, and their symptoms were overlooked due to gender biases.
- exact-test p value: 0.009. Statistically significant.

Conclusion

- As shown by the results of hypothesis 2, **patients without Medicare are more likely to be prescribed with just pain medications over aspirin,** indicating a difference in treatment plans for those with Medicare and those without.
- A surprising result was that patients with private insurance didn't receive aspirin as much as patients without private insurance
- An insurance plan might not significantly impact whether or not one will be prescribed medication, but can affect whether certain medications would be given over others.
- Whether or not these differences would provide an advantage or disadvantage to individual patients is something that can't be proven with the MIMIC dataset and is subject to more research.

Acknowledgments

Thank you to the Rising Researchers Program and my research mentor Purity Mugambi for the opportunity to participate in this research and providing guidance throughout the process.

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Differences in Beta-Blockers through Ethnicity, Gender, and Age

ABSTRACT:

Research was done on how the prescription of Beta-Blockers differs between ethnicities, age, and gender among patients throughout the MIMIC III dataset. To test these hypotheses quantitative data was used from past clinical care shown through the MIMIC III demo dataset. After testing these hypotheses the P-Value was found for each hypothesis and confounder. Differences in morphine prescription, duration of stay in the hospital, aspirin dosages, the type of medical insurance patients had, and orders for beta-blockers were all tested.

INTRODUCTION

How does the prescription of Beta-Blockers differ by ethnicities, age, and gender among the patients in MIMIC III dataset?

Hypotheses-

1. If a person of color can be treated with morphine, then they are less likely to get prescribed Beta Blockers compared to a white person that also is treated with morphine.
2. If a person of African American descent is prescribed Beta-Blockers, then it will take less time for them to be discharged from the hospital compared to a white person.
3. If a female patient received Beta-Blockers, then they are more likely to have a higher dosage of aspirin compared to males that also received Beta-Blockers.
4. If a female patient of color can be treated by Beta-Blockers, then it is less likely they will receive the drug compared to a white female patient.
5. If a patient 75 and over has received Beta-Blockers then they are more likely to have a longer duration in the hospital.

The independent variable in the experiments is patient ethnicity, age, and gender. The dependent variable is the effectiveness of Beta-Blockers. Effectiveness was measured by looking at the variables that could have affected patients after being prescribed Beta-Blockers, such as duration of stay and different medical insurances.

MATERIALS AND METHODS:

An observational and retrospective study was conducted. Using quantitative data from past clinical care, the data set was analyzed and observed to find differences in prescription of Beta-Blockers by age, gender, and ethnicity.

Included were all patients in the MIMIC III demo dataset, with the exception of patients ages 12 years and below and patients who have not received Beta-Blockers.

This study was conducted on the MIMIC-III demo dataset [1], which is a smaller data sample obtained from MIMIC-III clinical database [2]. It contains all intensive care unit (ICU) stays for 100 patients who were randomly selected from the larger (MIMIC-III clinical dataset) which contains data for over 40000 patients. All the patients in the demo dataset died, but not necessarily during their hospitalization. This data was collected between 2001 and 2012, and is made available through Physionet [3]. The data are anonymized and provided freely without requiring an IRB. It contains data on patients' diagnoses, drug prescriptions, labs, medical procedures, recordings of vitals and other essential measurements, and clinician notes. This research was focused on the patient's demographic information sex, ethnicity, and age, the type

of medical insurance patients had, orders for beta-blockers, morphine prescription, aspirin dosages, and duration of stay in the hospital.

I. For the first hypothesis, people who did not receive morphine were ruled out to measure how many patients of color and white patients received Beta-Blockers. Then, how many patients of color and white patients that did not receive Beta-Blockers was calculated. Comparing these four values, to see if people of color are less likely to be prescribed Beta-Blockers after receiving morphine.

To cater for the confounder age, people older than 75 years of age were ruled out because if you are elderly, morphine is not advised to be taken. Then, measured was how many patients of color and white patients received Beta-Blockers of those who received morphine. Next, how many patients of color and white patients that were not prescribed Beta-Blockers of those who received morphine was measured. To see if age effects being prescribed Beta-Blockers these four values were compared.

II. For the second hypothesis, people not prescribed Beta-Blockers were ruled out. Then, African American patients that were prescribed Beta-Blockers were calculated to find the average admit duration of this group. Next, White patients that were prescribed Beta-Blockers were calculated to find the average admit duration of this group as well. These durations were compared, to see if a person of African American descent takes less time to be discharged from the hospital.

The dataset does not allow experimentation for a valid confounder.

III. For the third hypothesis, the dosages of aspirin of female and male patients that received Beta-Blockers were measured. Then, the average of these two groups were calculated and compared to see if female patients receive a higher dosage of aspirin compared to males.

To cater for the confounder duration, people not prescribed Beta-Blockers were ruled out. Then, the sum of the duration of female and male patients that received aspirin were found and calculated to find the average duration of these two groups. These two averages were compared to see if their duration affected the amount of aspirin the patient groups received.

IV. For the fourth hypothesis, white females that received Beta-Blockers and patients of color that received Beta-Blockers were measured. Then, the probability of female patients of color and white female patients being prescribed Beta-Blockers was calculated. These two probabilities were compared to see if the female patients of color are less likely to receive the drug.

To cater for the confounder duration, people not prescribed Beta-Blockers were ruled out. Then, the sum of durations of female patients of color and white female patients of color were measured. Next, the average duration of the two groups were calculated. These two average durations were compared to see if their insurance affected them being able to receive the drug.

V. For the fifth hypothesis, the duration it takes to be discharged for a patient aged 75 and over and a patient under 75 that has received Beta-Blockers was measured. These two durations were compared to see if the patient 75 and over has a longer duration.

To cater for the confounder insurance, people not prescribed Beta-Blockers were ruled out. Then, which insurance patients 75 and over and below 75 received was counted. Next,

totaled was the duration of days of medicare and private insurance. These two durations were compared to see if their insurance affected the patient's duration.

RESULTS:

Hypothesis 1-

P-Value: 0.557

Received Beta-Blockers	Did not receive Beta-Blockers
Patients that received morphine - 63 Person of color that received Beta-Blockers- 5/63 = 8%	Patients that received morphine - 63 Person of color that did not receive Beta-Blockers - 13/63 = 21%
Patients that received morphine - 63 White patients that received Beta-Blockers - 25/63 = 40%	Patients that received morphine - 63 White patients that did not receive Beta-Blockers - 20/63 = 32%

Confounder: Age, P-Value: 0.0243

Patients above 75 that received Beta-Blockers	Patients below 75 that did not receive Beta-Blockers
Person of color that received Beta-Blockers 3/38 = 8%	Person of color that did not receive Beta-Blockers 12/38 = 20%
Not person of color that received Beta-Blockers 25/38 = 39%	Not a person of color that did not receive Beta-Blockers 20/38 = 31%

Hypothesis 2-

P-Value: 0.982

African American	White
Total Patients - 3 Sum of Duration- 32 days 8, 17, 7 Admit mean = 10.6 days	Total Patients - 52 Sum of Duration - 567 days Admit mean = 10.9 days

Hypothesis 3-

P-Value: 0.06

Female patients that have received Beta-Blockers	Male patients that have received Beta-Blockers
Total number of female patients that received aspirin- 15 Total aspirin dose- 6908mg Average aspirin dose- 6908/15= 460.53mg	Total number of male patients that received aspirin- 11 Total aspirin dose- 3465mg Average aspirin dose- 3465/11= 315mg

Confounder: Duration, P-Value: 0.2854

Female patients that have received Beta-Blockers	Male patients that have received Beta-Blockers
Total number of female patients that received aspirin- 15 Sum of duration- 144 days Average duration- 144/15= 9.6	Total number of male patients that received aspirin- 11 Sum of duration- 75 days Average duration= 75/11= 6.8

Hypothesis 4-

P-Value: 0.0001

Female patient of color that received Beta-Blockers	White female patient that received Beta-Blockers
Total Amount of female patients of color and white- 35 Female patients of color that received Beta-Blockers- 3 Percentage- 3/35= .09%	Total Amount of female patients of color and white- 35 White female patients that received Beta-Blockers- 27 Percentage- 27/35= 77%

Confounder: Duration, P-Value: 0.9894

Female patient of color that received Beta-Blockers	White female patient that received Beta-Blockers
Female patients of color that received Beta-Blockers- 3 Sum of duration- 30 days Average duration- 30/3= 10	White female patients that received Beta-Blockers- 27 Sum of duration- 268 days Average duration- 268/27=9.92

Hypothesis 5-

P-Value: 0.2541

Patient 75 and over that have received Beta-Blockers	Patient below 75 that have received Beta-Blockers
Total Count of Patients- 41 Sum of Duration- 337 days Average hospital length of stay (in days): 337/41 = 8.213 days	Total Count of Patients- 41 Sum of Duration- 337 days Average hospital length of stay (in days): 337/41 = 8.213 days

Confounder: Insurance, P-Value: 0.4827, 0.4254

Patients 75 and over that received Beta-Blockers	Patients below 75 that received Beta-Blockers
Number of patients that have private insurance- 2 Number of patients that have medicare insurance- 39 Duration of private insurance- 17 days/2 = 8.5 Duration of medicare insurance- 320 days/39 = 8.2	Number of patients that have private insurance- 11 Number of patients that have medicare insurance- 12 Duration of private insurance- 236 days/11 = 21.4 Duration of medicare insurance- 78 days/12 = 6.5

DISCUSSION:

After testing all the hypotheses and their confounders, significant results were found. In the first hypothesis, the conclusion came to that patients of color that received morphine are less likely to receive Beta-Blockers compared to white patients. 8% of people of color receive Beta-Blockers while 50% of white people receive Beta-Blockers. The p-value of this came out to be 0.557. A limitation of this experiment was that there are significantly more white patients then patients of color, 18 patients of color and 45 white patients. After testing for the confounder age, patients were grouped based on age groups of 75 because morphine is not advised to be taken if you are elderly. This resulted in more white patients receiving Beta-Blockers without being affected by their age and was also not significant because there are more white patients in the dataset. The p-value is 0.557.

Next in the second hypothesis, the conclusion came to that African American patients that are prescribed Beta-Blockers have a less duration in the hospital compared to white patients. The average duration for African American patients is 10.6 days while for white patients it's 10.9 days. A limitation to this study is that in the dataset, there are only 3 African American patients but 52 white patients and the p-value is 0.982. The dataset did not allow an experiment for a confounder for the hypothesis.

Then in hypothesis three, concluded that female patients that have received Beta-Blockers receive a higher dosage of aspirin compared to male patients that have also received Beta-Blockers. The average morphine dosage for females is 460.53 mg while male patients received 315mg. Also, the p-value for this experiment is 0.06. When catering for the confounder duration, the conclusion was that female patients had a longer duration than male patients which could have affected their aspirin dosage. Female patients had an average of 9.6 days while male patients had an average of 6.8 days. This p-value is 0.2854 and a limitation to this study is that there are 15 female patients but 11 male patients.

After testing hypothesis four, the conclusion came to that female patients of color that can be treated by Beta-Blockers are less likely to receive the drug compared to white female patients. .09% of female patients of color received Beta-Blockers while 77% of white female patients received Beta-Blockers. In the dataset, there were only 3 female patients of color yet 27 white female patients and 5 of the 35 patient's ethnicities were unknown. The p-value of this is 0.0001. After catering for the confounder duration, it did not affect the outcome of the hypothesis because the average duration for female patients of color is 10 days while white female patients is 9.92 and the p-value is 0.9894.

Lastly, the fifth hypothesis concluded that patients below the age of 75 that have received Beta-Blockers have a longer duration in the hospital compared to patients aged 75 and above. The average duration for patients aged 75 and above is 8.213 days and the average duration for patients below the age of 75 is 12.92. The p-value of this is 0.2541. After testing for the confounder insurance, the conclusion was that if a patient has private insurance instead of medicare insurance it results in them having a longer duration in the hospital. In patients aged 75 and above, the average duration with private insurance is 8.5 days while medicare is 8.2 days. In patients below the age of 75, the average duration with private insurance is 21.4 days while with medicare insurance it is 6.5 days. The p-value for private insurance is 0.4827 and the p-value for medicare insurance is 0.4254.

In conclusion, some of these results were expected while others were not. For example, my fifth hypothesis was unexpected because patients below 75 that received Beta-Blockers had a longer duration of stay in the hospital compared to patients above the age of 75. From these experiments, I can apply it by further researching Beta-Blockers on patients in a more broad and larger dataset to explain my results. By using this data I have collected I can also compare it to future experiments. In addition, through my hypotheses dealing with ethnicity, the results show discrepancy within patients of color and white patients in the healthcare system. However, throughout the dataset there was a substantial amount of White patients compared to African American patients. In summary, these results can be used in the future to compare to larger datasets, to research further why these results occurred through reasons outside of the MIMIC III demo dataset, and inform people on the discrepancy of ethnicities in the healthcare system.

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Patients below 75 that have received Beta-Blockers have a longer duration in the hospital

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Summary/Problem

My hypothesis is that if a patient 75 and above has received Beta-Blockers then they are more likely to have a longer duration in the hospital.

After testing for this hypothesis, I tested for the confounder insurance because it effected the duration of stay for the patients I tested based on which insurance they had.

Methods

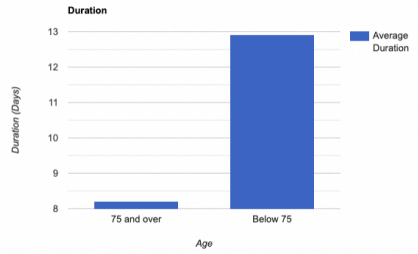
Using quantitative data from past clinical care, I analyzed the MIMIC III demo dataset to observe differences in prescription of Beta-Blockers by age to test for my hypothesis. A limitation of this dataset is there are not a large amount of patients in it.

To test for the hypothesis, I compared the two average durations of stay in the hospital of patients 75 and over and patients below 75 that have both received Beta-Blockers.

Then, I catered for the confounder insurance. To do this, I compared the two durations of stay while using medicare or private insurance within the different age groups.

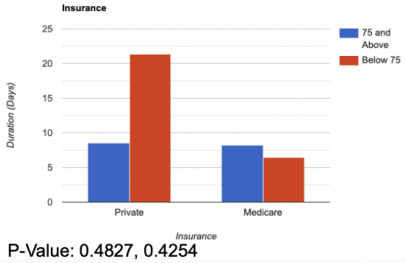
Figures and Results

Hypothesis:



P-Value: 0.2541

Confounder:



P-Value: 0.4827, 0.4254

Results/Conclusion

Patients below the age 75 that have received Beta-Blockers have a longer duration in the hospital compared to patients 75 and above. These findings did not support the original hypothesis.

The average length in stay for patients below 75 is 12.92 days while patients 75 and over is 8.213 days.

In addition, the insurance the patients have effect their duration. Patients with private insurance are shown the have a longer duration than patients with medicare insurance. Private insurance averaged to be 8.5 and 21.4 days while medicare insurance is 8.2 and 6.5 days.

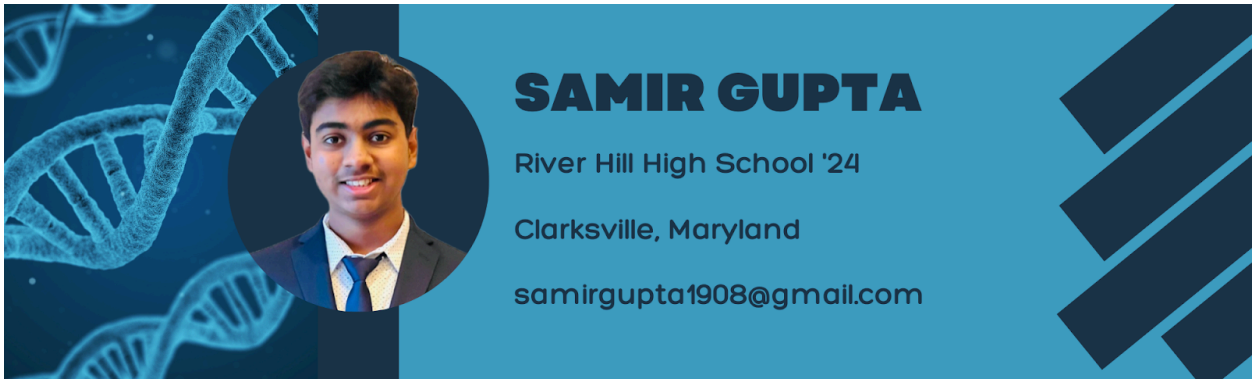
Acknowledgments

Thank you to Purity Mugambi, Nicole at Moon Prep, and the Rising Researchers Program for guidance throughout my research process.

References

MIMIC III Demo Dataset
MIMIC-III updated demo - mini File

Samir Gupta



Differences in Pain Treatment of Patients with Hypertension and Type-2 Diabetes

ABSTRACT:

This study examines the differences in pain treatment of patients with hypertension and type-2 diabetes in the eICU dataset. Specifically, I hypothesized that patients with hypertension or type-2 diabetes will have a longer admission duration than the other patients in the eICU dataset. Using the eICU dataset, I grouped the patients into two groups: patients with hypertension or type-2 diabetes and patients without hypertension or type-2 diabetes. Then I computed the average admission duration of each subgroup, and compared the two values. To account for the effect of age on the results, I computed the average age of the patients for the two main groups. I used t-tests to compute the statistical significance of the results. On average, the patients with hypertension or type-2 diabetes had a longer admission duration, p-value is 0.0153. This was true even when confounding for age, because the average age of patients with hypertension or type-2 diabetes was higher than the average age of patients without hypertension or type-2 diabetes. I conclude that patients with hypertension or type-2 diabetes have a longer admission duration than patients without either medical condition. These results support current admission duration research.

RESEARCH QUESTION:

Research Question: What are the differences in pain treatment for patients with hypertension and type-2 diabetes in the eICU dataset?

Dependent Variable: differences in pain treatment

Independent Variable: patients with hypertension or type 2 diabetes and patients without hypertension or type-2 diabetes in the eICU dataset

INTRODUCTION:

5 Hypotheses:

1. Patients with hypertension or type-2 diabetes will have a higher mean blood pressure than the other patients in the eICU dataset.
2. Patients with hypertension or type-2 diabetes will have lower sodium levels than the other patients in the eICU dataset.
3. Patients with hypertension or type-2 diabetes will have higher glucose levels than the other patients in the eICU dataset.
4. Patients with hypertension or type-2 diabetes will have a longer admission duration than the other patients in the eICU dataset.
5. Patients with hypertension or type-2 diabetes will have a higher heart rate than the other patients in the eICU dataset.

Initial Research: The preliminary research showed that hypertension is high blood pressure, and that type-2 diabetes is a chronic condition that affects the way the body processes blood sugar. Upon further research, I also discovered that patients with high blood pressure and type-2 diabetes are very similar as they both have things like high blood pressure, high glucose levels, and increased heart rate. Based on this information, I decided to combine the hypertension patients and type-2 diabetes patients in the eICU dataset and view them as one research group and compare them to my second research group, the rest of the patients in the eICU datasets.

Hypothesis #1 Research: The preliminary research showed that hypertension and type-2 diabetes can cause high blood pressure.

Hypothesis #2 Research: The preliminary research showed that the diets for patients with hypertension and type-2 diabetes are relatively low in sodium compared to the diet of the average person which is why we expect for their blood sodium levels to be low because the patients with hypertension and type-2 diabetes are advised to consume less sodium than the average person.

Hypothesis #3 Research: The preliminary research showed that hypertension and type-2 diabetes can cause high glucose levels.

Hypothesis #4 Research: The preliminary research showed that the average admission duration for hypertension patients is 3.53 days and that the average admission duration for type-2 diabetes patients is 8.2 days. The average admission duration for hypertension and type-2 diabetes patients is 5.865 days. The average admission duration for all patients is 4.6 days.

Hypothesis #5 Research: The preliminary research showed that hypertension and type-2 diabetes can cause higher heart rates.

MATERIALS AND METHODS:

Study Design:

I am conducting an observational and retrospective study. I will answer my question by looking at the quantitative data found in the eICU dataset. I will look at different dependent variables like blood pressure, sodium levels, glucose levels, admission duration, and heart rate. I will look at my different independent variables which are my two research groups: one is patients with

hypertension or type-2 diabetes and the other one is patients without hypertension or type-2 diabetes.

Dataset:

The data included in the eICU dataset is quantitative. The dataset consists of data associated with over 2,500 ICU unit stays selected from 20 of the larger hospitals in the eICU Collaborative Research Database. The data was collected through an eICU telehealth system for critically ill patients, developed by Philips Healthcare, which provides 24 hour support for caregivers at the bedside. The data was collected from ICUs all across the United States between 2014-2015. The data in the dataset include information about vital signs, medications, care plan information, and patient history As the data is anonymized, the US Health Insurance Portability and Accountability Act (HIPAA) in collaboration with Privacert (Cambridge, MA) approved the research and collection of data.

Cohort Groups:

1. Patients with hypertension or type-2 diabetes
2. Patients without hypertension or type-2 diabetes

Exclusion Criteria:

- Exclude patients in certain hypothesis that have null data for the corresponding dependent variable

Base Experiment Design for all Hypotheses:

Separate all the patients in the eICU dataset into two groups: people who have hypertension or type-2 diabetes and people who do not have hypertension or type-2 diabetes. Among these two groups, exclude patients with null data and count patients with actual data.

Experiment Design for hypothesis #1:

Hypothesis #1: Patients with hypertension or type-2 diabetes will have a higher mean blood pressure than the other patients in the eICU dataset.

For patients with hypertension and type-2 diabetes, find the total sum of mean blood pressure values and then compute the average blood pressure (in mmHg), labeling it HD-MBP. For patients without hypertension and type-2 diabetes, find the total sum of mean blood pressure values and then compute the average blood pressure (in mmHg), labeling it NHD-MBP. I expect to find that HD-MBP will be higher than NHD-MBP.

Experiment Design for hypothesis #2:

Hypothesis #2: Patients with hypertension or type-2 diabetes will have lower sodium levels than the other patients in the eICU dataset.

For patients with hypertension and type-2 diabetes, find the total sum of sodium level values and then compute the average sodium level (in mEq/L), labeling it HD-SL. For patients without hypertension and type-2 diabetes, find the total sum of sodium level values and then compute the

average sodium level (in mEq/L), labeling it NHD-SL. I expect to find that HD-SL will be lower than NHD-SL.

Experiment Design for hypothesis #3:

Hypothesis #3: Patients with hypertension or type-2 diabetes will have higher glucose levels than the other patients in the eICU dataset.

For patients with hypertension and type-2 diabetes, find the total sum of glucose level values and then compute the average glucose level (in mg/dL), labeling it HD-GL. For patients without hypertension and type-2 diabetes, find the total sum of glucose level values and then compute the average glucose level (in mg/dL), labeling it NHD-GL. I expect to find that HD-GL will be higher than NHD-GL.

Experiment Design for hypothesis #4:

Hypothesis #4: Patients with hypertension or type-2 diabetes will have a longer admission duration than the other patients in the eICU dataset.

For patients with hypertension and type-2 diabetes, find the total sum of admission duration values and then compute the average admission duration (in days), labeling it HD-AD. For patients without hypertension and type-2 diabetes, find the total sum of admission duration values and then compute the average admission duration (in days), labeling it NHD-AD. I expect to find that HD-AD will be higher than NHD-AD.

Experiment Design for hypothesis #5:

Hypothesis #5: Patients with hypertension or type-2 diabetes will have a higher heart rate than the other patients in the eICU dataset.

For patients with hypertension and type-2 diabetes, find the total sum of heart rate values and then compute the average heart rate (in bpm), labeling it HD-HR. For patients without hypertension and type-2 diabetes, find the total sum of heart rate values and then compute the average heart rate (in bpm), labeling it NHD-HR. I expect to find that HD-HR will be higher than NHD-HR.

Limitations of the Data:

A limitation of the data is that there are missing values for heart rate, blood pressure, glucose level, and sodium level for some patients in the eICU dataset.

RESULTS:

Hypothesis #1: Patients with hypertension or type-2 diabetes will have a higher mean blood pressure than the other patients in the eICU dataset.

- Separate all patients in the eICU dataset into patients with hypertension or type-2 diabetes and patients without hypertension or type-2 diabetes

- Among patients with hypertension or type-2 diabetes, exclude patients with null data, count patients with actual data, find the total sum of mean blood pressure (in mmHg), then compute the average, label this HD-MBP
- Among patients without hypertension or type-2 diabetes, exclude patients with null data, count patients with actual data, find the total sum of mean blood pressure (in mmHg), then compute the average, label this NHD-MBP
- Compare HD-MBP with NHD-MBP, HD-MBP should be higher
- Hypothesis is supported by the data in the eICU dataset
- P-value is 0.0082 → very statistically significant

Patients with hypertension or type-2 diabetes	Patients without hypertension or type-2 diabetes
Hypertension: 214 Type-2 diabetes: 172 H+D: 90 Total Count: 476 Sum (in mmHg): 20123 + 13468 + 8846 = 42437 Average mean blood pressure (in mmHg): 42437/476 = 89.15 (HD-MBP)	Count: 1669 Sum (in mmHg): 139606 Average mean blood pressure (in mmHg): 139606/1669 = 83.65 (NHD-MBP)

Confounding Variable for Hypothesis #1: Age

- To cater for age…
- Separate all patients in the eICU dataset into patients with hypertension or type-2 diabetes and patients without hypertension or type-2 diabetes
- Among patients with hypertension or type-2 diabetes, exclude patients with null mean blood pressure data and null age data, set patients with age>89 to age=89, find the total sum of ages (in years), then compute the average, label this HD-MBP-A
- Among patients without hypertension or type-2 diabetes, exclude patients with null mean blood pressure data and null age data, set patients with age>89 to age=89, find the total sum of ages (in years), then compute the average, label this NHD-MBP-A
- Compare HD-MBP-A with NHD-MBP-A

Patients with hypertension or type-2 diabetes	Patients without hypertension or type-2 diabetes
Hypertension: 214 Type-2 diabetes: 170 H+D: 90 Total Count: 474	Count: 1669 Sum (in years): 104595 Average age (in years):

Sum (in years): 14192 + 10243 + 5767 = 30202 Average age (in years): 30202/474 = 63.72 (HD-MBP-A)	104595/1669 = 62.67 (NHD-MBP-A)

Hypothesis #2: Patients with hypertension or type-2 diabetes will have lower sodium levels than the other patients in the eICU dataset.

- Separate all patients in the eICU dataset into patients with hypertension or type-2 diabetes and patients without hypertension or type-2 diabetes
- Among patients with hypertension or type-2 diabetes, exclude patients with null data, count patients with actual data, find the total sum of sodium levels (in mEq/L), then compute the average, label this HD-SL
- Among patients without hypertension or type-2 diabetes, exclude patients with null data, count patients with actual data, find the total sum of sodium levels (in mEq/L), then compute the average, label this NHD-SL
- Compare HD-SL with NHD-SL, HD-SL should be lower
- Hypothesis is not supported by the data in the eICU dataset
- P-value is 0.9871 → not statistically significant

Patients with hypertension or type-2 diabetes	Patients without hypertension or type-2 diabetes
Hypertension: 169 Type-2 diabetes: 148 H+D: 72 Total Count: 389 Sum (in mEq/L): 23377 + 20335 + 9930 = 53642 Average sodium level (in mEq/L): 53642/389 = 137.90 (HD-SL)	Count: 1261 Sum (in mEq/L): 173881.4 Average sodium level (in mEq/L): 173881.4/1261 = 137.89 (NHD-SL)

Confounding Variable for Hypothesis #2: Age

- To cater for age…
- Separate all patients in the eICU dataset into patients with hypertension or type-2 diabetes and patients without hypertension or type-2 diabetes

- Among patients with hypertension or type-2 diabetes, exclude patients with null sodium level data and null age data, set patients with age>89 to age=89, find the total sum of ages (in years), then compute the average, label this HD-SL-A
- Among patients without hypertension or type-2 diabetes, exclude patients with null sodium level data and null age data, set patients with age>89 to age=89, find the total sum of ages (in years), then compute the average, label this NHD-SL-A
- Compare HD-SL-A with NHD-SL-A

Patients with hypertension or type-2 diabetes	Patients without hypertension or type-2 diabetes
Hypertension: 169 Type-2 diabetes: 146 H+D: 72 Total Count: 387 Sum (in years): 11268 + 8757 + 4564 = 24589 Average age (in years): 24589/387 = 63.54 (HD-SL-A)	Count: 1261 Sum (in years): 78553 Average age (in years): 78553/1261 = 62.29 (NHD-SL-A)

Hypothesis #3: Patients with hypertension or type-2 diabetes will have higher glucose levels than the other patients in the eICU dataset.

- Separate all patients in the eICU dataset into patients with hypertension or type-2 diabetes and patients without hypertension or type-2 diabetes
- Among patients with hypertension or type-2 diabetes, exclude patients with null data, count patients with actual data, find the total sum of glucose levels (in mg/dL), then compute the average, label this HD-GL
- Among patients without hypertension or type-2 diabetes, exclude patients with null data, count patients with actual data, find the total sum of glucose levels (in mg/dL), then compute the average, label this NHD-GL
- Compare HD-GL with NHD-GL, HD-GL should be higher
- Hypothesis is supported by the data in the eICU dataset
- P-value is less than 0.0001 → extremely statistically significant

Patients with hypertension or type-2 diabetes	Patients without hypertension or type-2 diabetes
Hypertension: 184 Type-2 diabetes: 165	Count: 1387 Sum (in mg/dL): 214338

H+D: 81 Total Count: 430 Sum (in mg/dL): 25962 + 40364 + 17424 = 83750 Average glucose level (in mg/dL): 83750/430 = 194.77 (HD-GL)	Average glucose level (in mg/dL): 214338/1387 = 154.53 (NHD-GL)

Confounding Variable for Hypothesis #3: Age

- To cater for age…
- Separate all patients in the eICU dataset into patients with hypertension or type-2 diabetes and patients without hypertension or type-2 diabetes
- Among patients with hypertension or type-2 diabetes, exclude patients with null glucose level data and null age data, set patients with age>89 to age=89, find the total sum of ages (in years), then compute the average, label this HD-GL-A
- Among patients without hypertension or type-2 diabetes, exclude patients with null glucose level data and null age data, set patients with age>89 to age=89, find the total sum of ages (in years), then compute the average, label this NHD-GL-A
- Compare HD-GL-A with NHD-GL-A

Patients with hypertension or type-2 diabetes	Patients without hypertension or type-2 diabetes
Hypertension: 184 Type-2 diabetes: 163 H+D: 81 Total Count: 428 Sum (in years): 12321 + 9786 + 5246 = 27353 Average age (in years): 27353/428 = 63.91 (HD-GL-A)	Count: 1387 Sum (in years): 87068 Average age (in years): 87068/1387 = 62.77 (NHD-GL-A)

Hypothesis #4: Patients with hypertension or type-2 diabetes will have a longer admission duration than the other patients in the eICU dataset.

- Separate all patients in the eICU dataset into patients with hypertension or type-2 diabetes and patients without hypertension or type-2 diabetes

- Among patients with hypertension or type-2 diabetes, exclude patients with null data, count patients with actual data, find the total sum of admission duration (in days), then compute the average, label this HD-AD
- Among patients without hypertension or type-2 diabetes, exclude patients with null data, count patients with actual data, find the total sum of admission duration (in days), then compute the average, label this NHD-AD
- Compare HD-AD with NHD-AD, HD-AD should be higher
- Hypothesis is supported by the data in the eICU dataset
- P-value is 0.0153 → statistically significant

Patients with hypertension or type-2 diabetes	Patients without hypertension or type-2 diabetes
Hypertension: 231 Type-2 diabetes: 179 H+D: 96 Total Count: 506 Sum (in days): 2103.48 + 1235.54 + 585.76 = 3924.78 Average admission duration (in days): 3924.78/506 = 7.76 (HD-AD)	Count: 2014 Sum (in days): 13652.2 Average admission duration (in days): 13652.2/2014 = 6.78 (NHD-AD)

Confounding Variable for Hypothesis #4: Age

- To cater for age…
- Separate all patients in the eICU dataset into patients with hypertension or type-2 diabetes and patients without hypertension or type-2 diabetes
- Among patients with hypertension or type-2 diabetes, exclude patients with null admission duration data and null age data, set patients with age>89 to age=89, find the total sum of ages (in years), then compute the average, label this HD-AD-A
- Among patients without hypertension or type-2 diabetes, exclude patients with null admission duration data and null age data, set patients with age>89 to age=89, find the total sum of ages (in years), then compute the average, label this NHD-AD-A
- Compare HD-AD-A with NHD-AD-A

Patients with hypertension or type-2 diabetes	Patients without hypertension or type-2 diabetes
Hypertension: 231 Type-2 diabetes: 176 H+D: 96 Total Count: 503	Count: 2013 Sum (in years): 127156 Average age (in years):

Sum (in years): 15225 + 10560 + 6176 = 31961 Average age (in years): 31961/503 = 63.54 (HD-AD-A)	127156/2013 = 63.17 (NHD-AD-A)

Hypothesis #5: Patients with hypertension or type-2 diabetes will have a higher heart rate than the other patients in the eICU dataset.

- Separate all patients in the eICU dataset into patients with hypertension or type-2 diabetes and patients without hypertension or type-2 diabetes
- Among patients with hypertension or type-2 diabetes, exclude patients with null data, count patients with actual data, find the total sum of heart rates (in bpm), then compute the average, label this HD-HR
- Among patients without hypertension or type-2 diabetes, exclude patients with null data, count patients with actual data, find the total sum of heart rates (in bpm), then compute the average, label this NHD-HR
- Compare HD-HR with NHD-HR, HD-HR should be higher
- Hypothesis is not supported by the data in the eICU dataset
- P-value is 0.0069 → very statistically significant

Patients with hypertension or type-2 diabetes	Patients without hypertension or type-2 diabetes
Hypertension: 220 Type-2 diabetes: 173 H+D: 92 Total Count: 485 Sum (in bpm): 20368 + 17610 + 8989 = 46967 Average heart rate (in bpm): 46967/485 = 96.84 (HD-HR)	Count: 1678 Sum (in bpm): 169881 Average heart rate (in bpm): 169881/1678 = 101.24 (NHD-HR)

Confounding Variable for Hypothesis #5: Age

- To cater for age…
- Separate all patients in the eICU dataset into patients with hypertension or type-2 diabetes and patients without hypertension or type-2 diabetes

- Among patients with hypertension or type-2 diabetes, exclude patients with null heart rate data and null age data, set patients with age>89 to age=89, find the total sum of ages (in years), then compute the average, label this HD-HR-A
- Among patients without hypertension or type-2 diabetes, exclude patients with null heart rate data and null age data, set patients with age>89 to age=89, find the total sum of ages (in years), then compute the average, label this NHD-HR-A
- Compare HD-HR-A with NHD-HR-A

Patients with hypertension or type-2 diabetes	Patients without hypertension or type-2 diabetes
Hypertension: 220 Type-2 diabetes: 171 H+D: 92 Total Count: 483 Sum (in years): 14605 + 10269 + 5935 = 30809 Average age (in years): 30809/483 = 63.79 (HD-HR-A)	Count: 1678 Sum (in years): 105061 Average age (in years): 105061/1678 = 62.61 (NHD-HR-A)

DISCUSSION:

I found that patients with hypertension or type-2 diabetes have a higher mean blood pressure than the other patients in the eICU dataset. This result is statistically significant with a p-value of 0.0082. In addition, I found that patients with hypertension or type-2 diabetes have higher sodium levels than the other patients in the eICU dataset. I also found that patients with hypertension or type-2 diabetes have higher glucose levels than the other patients in the eICU dataset. This result is statistically significant with a p-value of less than 0.0001. Additionally, I found that patients with hypertension or type-2 diabetes have a longer admission duration than the other patients in the eICU dataset. This result is statistically significant with a p-value of 0.0153. Finally, I found that patients with hypertension or type-2 diabetes have a lower heart rate than the other patients in the eICU dataset. This result is statistically significant with a p-value of 0.0069.

Some of these findings support their respective hypotheses of this study. The findings for hypotheses 1, 3, and 4 are consistent with prior research. However, some findings did not support their respective hypotheses of this study. The findings for hypotheses 2 and 5 were not similar to prior research. I don't know why these results were different, but I think further research is needed to investigate these findings. A limitation of the study is the retrospective design, which could introduce recall bias or other forms of bias into the results. A limitation of the data is that

some patients had missing data for certain dependent variables like heart rate, glucose level, sodium level, and blood pressure.

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Differences in Pain Treatment of Patients with Hypertension and Type-2 Diabetes

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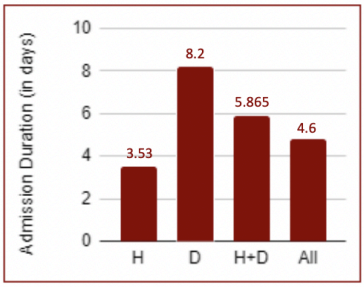
Research Goal

The goal of this research was to be able to examine the differences in pain treatment of patients with hypertension and type-2 diabetes in the eICU dataset.

Differences in pain treatment: ***admission duration***, blood pressure, glucose level, sodium level, heart rate

Introduction

Preliminary Research:
- Hypertension is high blood pressure[1]
- Type-2 diabetes is a chronic condition that affects the way the body processes blood sugar[2]
- First column[3], second column[4], fourth column[5]



Hypothesis: Patients with hypertension or type-2 diabetes will have a longer admission duration than the other patients in the eICU dataset.

Methods

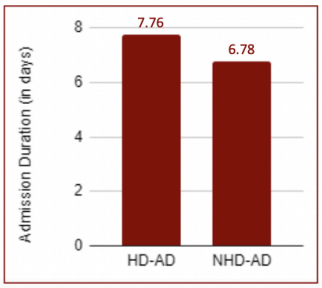
- Observational and retrospective study
- eICU dataset

Research Groups:
1. Patients with hypertension or type-2 diabetes
2. Patients without hypertension or type-2 diabetes

Experiment Design:
1. Separate patients into two groups
2. Exclude patients with null data
3. Compute average admission duration (in days)
4. For group 1, label it HD-AD
5. For group 2, label it NHD-AD
6. I expect to find HD-AD > NHD-AD

Results

- Hypothesis is supported by the data in the eICU dataset
- P-value is 0.0153 → statistically significant



Conclusion

- I found that patients with hypertension or type-2 diabetes have a longer admission duration than the other patients in the eICU dataset
- This finding is consistent with prior research

Limitations:
1. Retrospective design → could introduce recall bias in results
2. Missing data for certain dependent variables

Acknowledgments

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Sheryl Lawrence and Soukya Chimmalagi

The Effects Of Age And Race On Pain Treatment

ABSTRACT:

This experiment was conducted in order to analyze the disparities caused by age and race in the treatment of patients with organ failure. The scientific question was, “How do age and race affect the pain treatment individuals with organ failure receive?”It was hypothesized that white individuals older than 70 would be likely to receive higher doses of morphine compared to Hispanics and Blacks younger than 70. In order to conduct this experiment, organ failure patients of specific races in the MIMIC III dataset were selected and placed into age groups so that their dosages of morphine could be recorded, compared, and analyzed. The results of the experiment showed that the white individuals older than 70 did receive higher dosages or morphine compared to the Hispanics and Blacks younger than 70. It could be concluded that White individuals and individuals older than 70 years of age could be subject to receiving higher doses than Hispanic and Black individuals and individuals younger than 70 when being prescribed pain medication for organ failure. The hypothesis was supported.

INTRODUCTION:

The research question for this experiment was “How do age and race affect the pain treatment individuals with organ failure receive?” The independent variables in this experiment are the age and race of the people analyzed. The dependent variable is the pain treatment that the individuals receive.

Racial and ethnic disparities in the prescription of pain medication are widely seen in medical settings (Tamayo-Sarver et al., 2003). Ageism is also a common problem in healthcare that has been documented in numerous studies (Elwell, 2022). This experiment aims to evaluate these disparities using the MIMIC III dataset in consideration of patients with organ failure.

It is hypothesized that white individuals older than 70 years of age are likely to receive higher doses of morphine compared to Hispanic and Black individuals younger than 70.

MATERIALS AND METHODS:

This project is an observational, retrospective, and quantitative study that seeks to evaluate disparities based on age and race in the pain treatment of patients with organ failure using MIMIC III. The MIMIC dataset is a large, single-center database with information about patients admitted to critical care units in a large tertiary care hospital. Some drawbacks of this study are that the data might be outdated, various races are not included within the dataset or are limited,

and a minimal amount of patient data with organ failure is provided. Due to this, the data is limited for this specific project. The identified inclusion factors were that the patient had to have organ failure and received morphine. The exclusion factors were patients that have other diseases alongside organ failure or are still taking painkillers for previous diseases. The hypothesi had the following procedures:

1. White individuals older than 70 years of age are likely to receive more than 50 mg of morphine compared to white individuals younger than 70 for organ failure.

Common Confounds: Gender of the patients (females or males could have higher or lower pain tolerances). Diagnosed with other diseases that require pain medication. The patient's addiction to medication may be a hindrance (this cannot, however, be tracked with the dataset). The location of these individuals and access to hospitals can affect the dataset. The patient's addiction to medication may be a hindrance (this cannot, however, be tracked with the dataset).

Confounds: The lifestyle of the individuals could affect the data because people older than 70 tend to be more inactive and less healthy overall (however cant be tracked in the dataset).

1. Out of the MIMIC III dataset, select patients that have organ failure.
2. Select patients of the White race.
3. Categorize data by age. Group patients into "older than 70 years of age" and "younger than 70 years of age."
4. Record doses of morphine for each individual group. Record dosages for "White - Older than 70" and "White - Younger than 70"
5. Average doses of morphine within each group.
6. Determine whether the averages of each group are below or above 50 mg of morphine.
7. Compare averages between the two groups to analyze data and draw conclusions. It is expected that the "White - Older than 70" will have 50 mg of morphine or higher, while the "White - Younger than 70" will have lower than 50 mg of morphine.

2. Hispanic and African American individuals younger than the age of 70 are likely to receive less than 50 mg of morphine for organ failure.

Common Confounds: Gender of the patients (females or males could have higher or lower pain tolerances). Diagnosed with other diseases that require pain medication. The patient's addiction to medication may be a hindrance (this cannot, however, be tracked with the dataset). The location of these individuals and access to hospitals can affect the dataset. The patient's addiction to medication may be a hindrance (this cannot, however, be tracked with the dataset).

Confounds: The lifestyle of the individuals could affect the data because people under the age of 70 tend to be more active and healthier (however cant be tracked in the dataset). Addiction rates in communities of color may affect the dataset (this cannot, however, be tracked with the dataset).

1. Out of the MIMIC III dataset, select patients that have organ failure.
2. Select patients of Hispanic ethnicity and Black race.

3. Select patients younger than the age of 70.
4. Record the number of patients with less than 50 mg of morphine.
5. Record the number of patients with more than 50 mg of morphine.
6. Determine what percent of the patients received more than 50 mg of morphine, and what percent received less than 50 mg of morphine.
7. Analyze data to draw results. It is expected that the percentage of patients that received less than 50 mg of morphine will be higher.

3. Hispanic individuals younger than 70 years of age are likely to receive fewer doses of morphine than their white counterparts for organ failure.

Common Confounds: Gender of the patients (females or males could have higher or lower pain tolerances). Diagnosed with other diseases that require pain medication. The patient's addiction to medication may be a hindrance (this cannot, however, be tracked with the dataset). The location of these individuals and access to hospitals can affect the dataset. The patient's addiction to medication may be a hindrance (this cannot, however, be tracked with the dataset).

Confounds: The lifestyle of the individuals could affect the data because people under the age of 70 tend to be more active and healthier (however cant be tracked in the dataset). Addiction rates in communities of color may affect the dataset (this cannot, however, be tracked with the dataset).

1. Out of the MIMIC III dataset, select patients that have organ failure.
2. Select patients of White race and Hispanic ethnicity.
3. Select patients younger than 70 years of age.
4. Record the number of doses of Hispanic patients and find the average.
5. Record the number of doses of White patients and find the average.
6. Compare the two averages to determine which group had the higher dosages.
7. Analyze data to draw results. It is expected that the White group will have received higher dosages compared to the Hispanic group.

4. Black/African American individuals older than 70 years of age are likely to receive fewer doses of morphine than their white counterparts for organ failure.

Common Confounds: Gender of the patients (females or males could have higher or lower pain tolerances). Diagnosed with other diseases that require pain medication, especially because this is an older group. The patient's addiction to medication may be a hindrance (this cannot, however, be tracked with the dataset). The location of these individuals and access to hospitals can affect the dataset. The patient's addiction to medication may be a hindrance (this cannot, however, be tracked with the dataset).

The patient's addiction to medication may be a hindrance (this cannot, however, be tracked with the dataset).

Confounds: The lifestyle of the individuals could affect the data because people older than 70 tend to be more inactive and less healthy overall (however cant be tracked in the dataset). Addiction rates in communities of color may affect the dataset (this cannot, however, be tracked with the dataset).

1. Out of the MIMIC III dataset, select patients that have organ failure.
2. Select patients of Black/African American and White race.
3. Select patients older than 70 years of age.
4. Record the number of doses of Black patients and find the average.
5. Record the number of doses of White patients and find the average.
6. Compare the two averages to determine which group had the higher dosages.
7. Analyze data to draw results. It is expected that the White group will have received higher dosages compared to the Black group.

5. White individuals older than 70 years of age are likely to receive higher doses of morphine compared to Hispanic and Black individuals younger than 70 for organ failure.

Common Confounds: Gender of the patients (females or males could have higher or lower pain tolerances). Diagnosed with other diseases that require pain medication. The patient's addiction to medication may be a hindrance (this cannot, however, be tracked with the dataset). The location of these individuals and access to hospitals can affect the dataset. The patient's addiction to medication may be a hindrance (this cannot, however, be tracked with the dataset).

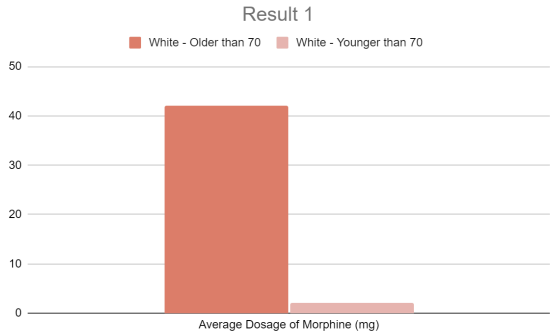
Confounds: The lifestyle of the individuals could affect the data because people older than 70 tend to be more inactive and less healthy overall (however cant be tracked in the dataset). Addiction rates in communities of color may affect the dataset (this cannot, however, be tracked with the dataset).

1. Out of the MIMIC III dataset, select patients that have organ failure.
2. Select patients of White and Black race and Hispanic ethnicity.
3. Divide patients into two groups. The first group will be White patients. Select White patients older than 70 years of age. The second group will be Black and Hispanic. Select Black and Hispanic patients younger than 70 years of age.
4. Record the average dosage of the "White - Older than 70" group.
5. Records the average dosage of the "Black and Hispanic - Younger than 70" group.
6. Compare the two averages to determine which group had the higher dosages.
7. Analyze data to draw results. It is expected that the "White - Older than 70" group will have received higher dosages compared to the "Black and Hispanic - Younger than 70" group.

RESULTS:

H1:

	White - Older than 70	White - Younger than 70
Average Dosage of Morphine	42.1 mg	2 mg

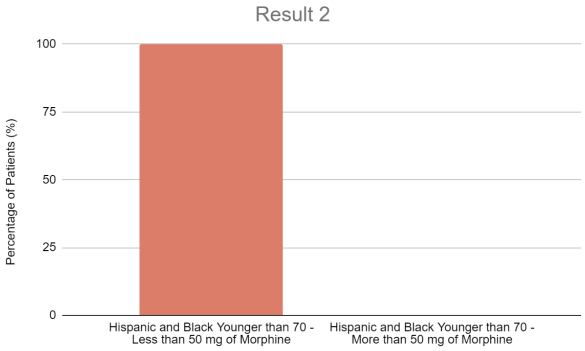


Whites older than the age of 70 received higher doses of morphine for organ failure than Whites younger than the age of 70. The hypothesis was supported.

P-Value: less than 0.01

H2:

	Hispanic and Black Younger than 70 - Less than 50 mg of morphine	Hispanic and Black Younger than 70 - More than 50 mg of morphine
Percentage of Patients	100%	0%

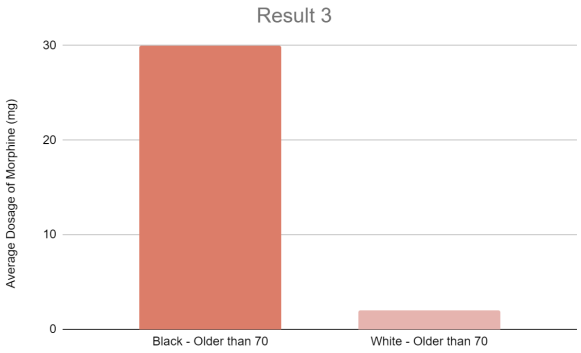


There was a higher percentage of Hispanics and Black younger than 70 that had less than 50 mg of morphine compared to more than 50 mg of morphine for organ failure. The hypothesis was supported.

P-Value: 0.33

H3:

	Hispanic - Younger than 70	White - Younger than 70
Average Dosage of Morphine	30 mg	2 mg

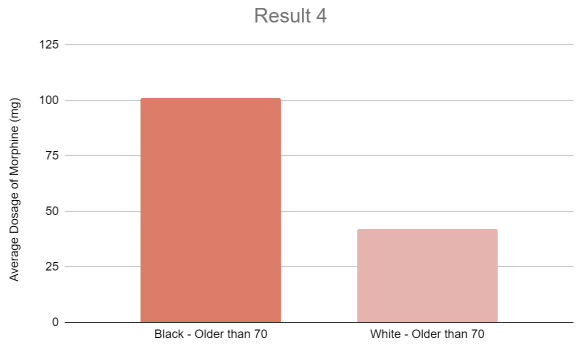


There was a higher average dosage of morphine for Hispanics younger than 70 compared to Whites younger than 70 for organ failure. The hypothesis was not supported.

P-Value: less than 0.01

H4:

	Black - Older than 70	White - Older than 70
Average Dosage of Morphine	101 mg	42.1 mg

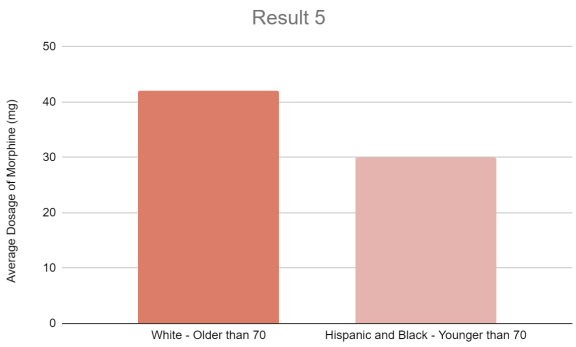


The average dosage of morphine was higher for Black older than 70 compared to Whites older than 70 for organ failure patients. The hypothesis was not supported.

P-Value: less than 0.01

H5:

	White - Older than 70	Hispanic and Black - Younger than 70
Average Dosage of Morphine	42.1 mg	30 mg



Whites older than 70 had a higher dosage average of morphine than Hispanics and Blacks younger than 70 for organ failure. The hypothesis was supported.

P-Value: less than 0.01

DISCUSSION:

It was significant to see Result 5, that white individuals older than 70 had higher doses than Hispanics and Blacks younger than 70. This highlights the disparities between Whites and people of color as well as older and younger individuals. This can also be supported by Result 1, which showcases the difference between age groups, and Result 2, which indicates the amount of pain treatment for people of color. These, once again, show an incline in pain treatment towards Whites and older people. Since there has been increased rates of racial discrimination in the health care system, this result is a reflection of the racial gap present in the medical system, these results were expected for the most part. I was surprised however to see the drastic difference in Result 2. This data can be used in the future to combat age and race related disparities in a healthcare system. However, this data does not only need to be applied in medical settings. The discrimination between people of different races can be seen across wide ranges and topics. Moving forward, it needs to be ensured that people of all races, ethnicities, and ages are treated equally within the healthcare system and across other areas of work. Overall, this experiment creates awareness of the disparities present in the medical field in order to address those issues.

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The Effects of Age and Race on Pain Treatment

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Introduction

The research question was "How do age and race affect the pain treatment individuals with organ failure receive?"

This experiment aims to evaluate disparities seen in patients with organ failure using the MIMIC III.

Hypothesis

It is hypothesized that white individuals older than 70 years of age are likely to receive higher doses of morphine compared to Hispanic and Black individuals younger than 70.

Methods

- Observational, retrospective, and quantitative study
- Possibly outdated data, exclusion of various races, and limited data
- Patients inspected have organ failure and received morphine
- Patients don't have other illnesses or pain medication for other diseases

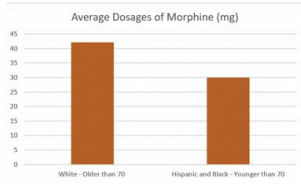
Procedure

1. Select patients that have organ failure.
2. Select patients of White and Black race and Hispanic ethnicity.
3. Divide patients into groups of White patients older than 70 and Black and Hispanic patients younger than 70 years of age.
4. Record the average dosage of each group.
5. Compare averages of the two groups.
6. Analyze data to draw results. It' expected that the "White - Older than 70" group will have received higher dosages compared to the "Black and Hispanic - Younger than 70" group.

Figures and Results

	White - Older than 70	Hispanic and Black - Younger than 70
Average Dosage of Morphine	42.1 mg	30 mg

P – Value: less than 0.01
Whites older than 70 had a higher dosage average of morphine than Hispanics and Blacks younger than 70 for organ failure. The hypothesis was supported.



Conclusion

- Results were significant as they highlighted disparities whites and people of color as well as older and younger individuals.
- Incline in pain treatment towards Whites and older people.
- Results were mostly expected
- Data can be used to combat age and race related disparities in healthcare system. Not subject to just medicine.
- All races, ethnicities, and ages should be treated equally within healthcare system and across other areas of work.

Acknowledgements

Thank you to Purity Mugambi and Nicole from Rising Researchers for assisting throughout the research process and providing ample support.

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Tamayo-Sarver, J. H., Hinze, S. W., Cydulka, R. K., & Baker, D. W. (2003, December). *Racial and ethnic disparities in emergency department analgesic prescription*. American journal of public health. Retrieved February 13, 2023, fromhttps://www.ncbi.nlm.nih.gov/pmc/articles/PMC1448154/

Elwell, V. (2022, March 8). *Combating ageism in Healthcare | UCI health | Orange County, CA*. UCI Health. Retrieved February 14, 2023, from https://www.ucihealth.org/blog/2022/03/combatting-ageism-in-healthcare

Sonal De Silva

Effects of Taking Both Morphine and Aspirin on Effectiveness of Treatment

ABSTRACT:

We wanted to see if Aspirin combined with Morphine were a better treatment option than just Morphine. We made a prediction that patients taking both Aspirin and Morphine would have a shorter admission than patients just taking Morphine. We tested this by conducting an

experiment with patients under 60 that survived the hospital discharge, had cardiovascular related issues, and were taking morphine and then divided them into two groups, taking aspirin and not taking aspirin. After categorizing the patients being tested we measured their admission days and found the averages for each. Then we did further research on the possible confounders, including how many people in each group had ischemic disease or outlier diagnoses such as cardiac arrest, and cardiac surgery. Even with these confounding variables controlled, patients taking both Aspirin and Morphine on average had longer admission duration than patients only taking Morphine. The average admission time for people taking both Aspirin and Morphine was 8.723 days and the average admission time for people taking no Aspirin and Morphine was 6.413 days.

INTRODUCTION:

When dealing with cardiovascular problems, aspirin is one of the most effective tools as it can help prevent blood clots from forming in the arteries and can help lower risk of a heart attack. Morphine is also very beneficial, calming down patients' bodies both physically (breathlessness) and mentally (anxiety). What interested us is whether combining both treatments together further improved treatment. We asked the question if having both morphine and aspirin at the same time would increase effectiveness of treatment. Our hypothesis is that the patients with cardiovascular problems, taking morphine, that are also being administered with Aspirin together will have a shorter admission duration than the patients administered with Morphine alone. The independent variable is whether they are taking aspirin or not and the dependent variable is the admission duration. We made the assumption that less days of admission would be an accurate way of measuring the effectiveness of treatment.

MATERIALS AND METHODS:

For the patients we will be including in our experiment we will be including patients younger than 60 because patients older than 60 will often have underlying health conditions that could be a confounder. There will only be patients that survive the hospital discharge because if a patient doesn’t survive their admission duration would be an inaccurate test of treatment. We will only be looking at cardiovascular problems only because when the problems are too different it can be difficult to make a comparison. Lastly our patients must be taking morphine as this study is testing the effects of two treatments versus one.

The dataset we will be using is the eicu-large dataset, a dataset with over 200,000 admissions across the United States between 2014-2015. This is an observational, retrospective study, where the data is mixed as we will be looking at both quantitative data (admission days) and qualitative data such as diagnostics to filter our patients.

Our experiment's procedure was first filtering out all patients over 60. Then we removed dead patients from the dataset. Afterwards we only included patients with cardiovascular related diagnosis, and made sure they were taking morphine. Afterwards we grouped patients into two groups, taking aspirin and not, measured the admission duration for each patient, and calculated the averages. If our hypothesis is supported, patients taking aspirin should have a much lower admission time than patients not taking it.

RESULTS:

Morphine - Aspirin : Total no of admission days : 226.8 Count : 26 people Avg : 8.723 days	Morphine - No aspirin : Total no of days in hospital : 102.9 Count : 16 people Avg : 6.413 days

P VALUE FOR THIS TEST : 0.04 statistically significant
The data does not support the hypothesis, but this could be because of confounders.

Confounders : yes they have been filtered by cardiovascular problems but they are varying. So we looked at the types of cardiovascular problems for each patient group. We filtered by how many of each group had ischemic disease and calculated the %. They should both have equal percentages.

Aspirin : 5/26 people have ischemic diseases 19.2% have ischemic with aspirin 80.8% no ischemic with aspirin	No Asprin : 1/16 people have ischemic diseases 6.25% have ischemic no aspirin 93.75% no ischemic no aspirin

The group taking aspirin had 307.2% more people with ischemic disease than the group not taking aspirin. This is a very significant confounder and could have greatly affected our results, making them unsupportive of the hypothesis.

To further look into how this affected the results, we redid the original test for our hypothesis but also made it so none of the patients being tested had ischemic diseases.

Aspirin : Total : 170.1 admission days Count : 20 people Avg : 8.505 days	No aspirin : Total : 99.8 admission days Count : 15 people Avg : 6.653 days

It didn't change the results too much so the data still doesn't support the hypothesis, this could mean that the patients taking aspirin could have other diseases other than ischemic ones that greatly affect admission times, We looked at the data and found that there were 2 main diagnosis that basically guaranteed to cause someone to stay in the hospital for much longer than regular times, cardiac surgeries and cardiac arrests. To see if this was a confounder we looked at the amounts of these diagnoses in each group and divided them into 4 groups, Aspirin with cs/ca, Aspirin without cs/ca, no Aspirin with cs/ca,no Aspirin without cs/ca . The group with aspirin should have a larger cs/ca % than the group without. If the group taking aspirin has a larger cs/ca this would hurt the results for Aspirin as the high admission times would bring up their scores enough to make the differences shown in the previous results.

Aspirin - with cs/ca - 10/26 people 38.46% of people taking aspirin Avg : 11.747 days	No aspirin - with cs/ca - 1/16 people 6.25% of people not taking aspirin Avg : 6.34 days(only one result)
Aspirin - without cs/ca - 16/26 people 61.54% of people taking aspirin Avg : 6.801 days	No aspirin - without cs/ca - 15/16 people 93.75% of people not taking aspirin Avg : 6.438 days

P VALUE FOR THIS TEST : 0.03 statistically significant

DISCUSSION:

While to us it felt obvious that two treatments were better than one, it turned out that the results were actually way more complicated than they first seemed and it ended up being the opposite. Patients who took both Aspirin and Morphine on average had higher admission durations than patients who just took Morphine. This also shows how significant certain diagnosis affected our results. Patients who took aspirin who were also having cardiac arrest/cardiac surgery had significantly higher admission durations on average than every other group. One important application of this experiment is to be very exact with what diagnosis each patient has. Unfortunately this was very difficult to do with our experiment as the amount of patients we had was very small.

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How Patients’ Sex and Age Affect Aspirin Prescription

ABSTRACT:

The purpose of this paper is to investigate how sex and age differences have an effect on orders of aspirin for patients with ischemic heart disease. Health disparities are an important problem and refer to differences in health and health care between groups. These differences arise from social and environmental factors, such as income, ethnicity, age, gender, and education. It is a widespread issue that needs to be overcome so that everyone can achieve the best state of health possible. The study we conducted was a retrospective, non-observational study, which used data from the eICU dataset, a database that contains information from a multitude of critical care units across the United States. The study included only patients with ischemic heart disease, and found that 44% of female patients were prescribed aspirin whereas 54% were not. In addition, 35% of male patients received aspirin while 65% did not. This indicates that female patients with ischemic heart disease are more likely to be prescribed aspirin than male patients. The study also found that 40% of older adult patients, older than 65, received aspirin while 61% did not. Meanwhile, 35% of younger adult patients, 65 years old and less, did receive aspirin, whereas 65% did not. These findings suggest that older adult patients are more likely to be prescribed aspirin than younger adult patients. For each hypothesis, we also tested one main confounding variable: the presence of diabetes. We reran each procedure and analysis after further dividing patient groups into patients who had diabetes and patients who did not. While the percentages did change, the results pointed to the same overall conclusions and the confounders did not end up changing the estimate of the correlation between the independent and dependent variables. With these outcomes, it is apparent that sex and age do have an effect on orders of aspirin for patients with ischemic heart disease.

INTRODUCTION:

In our experiment, we explored how extraneous predisposing factors, specifically sex and age, affect the way patients with ischemic heart disease are prescribed with aspirin. This paper deals with health equity, which is important because it seeks to overcome any obstacles such as social and environmental factors and ensure that everyone has an equal opportunity to attain the best health possible. This means to eliminate differences in both health and health care. In this paper, we will first determine the effect that being male or female has on the likelihood of being prescribed aspirin for patients with ischemic heart disease. This will allow us to determine if sex makes a difference in orders of aspirin for patients. We hypothesized that, if patients are male, they will be more likely to be prescribed aspirin than female patients. In addition, we tested the effect that age has on aspirin orders and prescriptions. We hypothesized that, if patients are older adults, or above the age of 65, that they will be more likely to be prescribed aspirin than patients who are younger adults, or 65 years old and below. In addition, we tested for one confounding variable that could have potentially interfered with our findings: diabetes. The presence of diabetes could increase aspirin intake for patients, so it was important to test this variable to ensure that the estimate of the association between the independent and dependent variable was as accurate as possible.

MATERIALS AND METHODS:

In order to answer this question, we designed a retrospective, non-observational study that reviewed existing quantitative data in order to obtain results. We acquired this data from the eICU dataset, which is a large database that houses information on over 200,000 patients, including their diagnoses, ethnicities, and medications. When designing the study, we created an inclusion/exclusion criteria, which specifies everyone who is being included in the experiment. We determined that the experiment would include everyone in the eICU dataset who was diagnosed with ischemic heart disease and exclude everyone else accordingly. To conduct this study, we followed a set of crucial and specific steps for each hypothesis. For hypothesis #1, which explores the influence sex has on orders of aspirin, we first separated patients in the eICU data into patients with ischemic heart disease and patients without. Next, we grouped these patients into males and females so that they would differ by sex. Afterwards, we looked at data for each group (females who received aspirin, females who didn’t, males who received aspirin, and males who didn’t). Among female patients with ischemic heart disease, we counted those who received aspirin, computed this percentage, and labeled it F-IHD-A. We repeated the same step for female patients who did not receive aspirin as treatment, and labeled this percentage F-IHD-NA. Likewise, among male patients with ischemic heart disease, we counted those who received aspirin, calculated this percentage, and labeled it M-IHD-A. Once again, we computed a different percentage for male patients who did not receive aspirin, and labeled it M-IHD-NA. To test the confounding variable (diabetes), we further divided each group (females and males) into females with/without diabetes and males with/without diabetes. We followed the same procedures, counting how many patients did or did not receive aspirin for each group and computing these percentages. For hypothesis #2, which determined the effect of age on aspirin orders, we followed a very similar set of steps. First, we separated all patients in the eICU dataset into patients who had ischemic heart disease and those who didn't. Second, among these patients, we further separated them into patients over the age of 65 and patients 65 years old and below.

Next, among older patients (>65 years) with ischemic heart disease, we counted those who received aspirin, computed this percentage, and labeled it O-IHD-A. We followed the same procedure for older patients with this condition who did not receive aspirin, counted this number, and obtained another percentage (labeled O-IHD-NA). Similarly, among younger patients (≤65 years) with ischemic heart disease, we counted those who received aspirin, computed this new percentage, and labeled it Y-IHD-A. Finally, among younger patients, we counted those who did not receive aspirin, computed this percentage, and labeled it Y-IHD-NA. The last step of our procedure was to compare these percentages with one another, keeping in mind our hypotheses. Since hypothesis #1 speculated that males are more likely to be prescribed aspirin than females, we compared M-IHD-A with F-IHD-A, expecting M-IHD-A to be higher. In addition, we compared M-IHD-NA with F-IHD-NA, expecting M-IHD-NA to be lower. In parallel, for hypothesis #2, since we conjectured that older patients are more likely to be prescribed aspirin than younger patients, we compared O-IHD-A with Y-IHD-A believing that O-IHD-A would be higher, and we compared O-IHD-NA with Y-IHD-NA, believing O-IHD-NA would be lower.

RESULTS:

The following results were obtained from the procedure for hypothesis #1:

Sex/received aspirin	Received aspirin	Did not receive aspirin
Female (with ischemic heart disease)	Count = 34 Total females = 77 F-IHD-A = 34/77 = 44%	Count = 42 Total females = 77 F-IHD-NA = 42/77 = 55%
Male (with ischemic heart disease)	Count = 54 Total males = 152 M-IHD-A = 54/152 = 35%	Count = 99 Total males = 152 M-IHD-NA = 99/152 = 65%

According to the table, 44% (34/77) of female patients with ischemic heart disease received aspirin, whereas 54% (42/77) did not. Also, 35% of male patients with ischemic heart disease received aspirin and 65% (99/152) did not. These results had a p-value of 0.1946.

Hypothesis #1 Confounder: Diabetes

Sex/Diabetes/Received aspirin	Received Aspirin	Did not receive aspirin
Female (with ischemic heart disease + diabetes)	Count = 3 Total female patients with diabetes = 11 3/11 = 33%	Count = 8 Total female patients with diabetes = 11 8/11 = 72%
Female (with ischemic heart disease + no diabetes)	Count = 31 Total female patients without diabetes = 65 31/65 = 48%	Count = 34 Total female patients without diabetes = 65 34/65 = 52%

Male (with ischemic heart disease + diabetes)	Count = 7 Total male patients with diabetes = 29 7/28 = 25%	Count = 22 Total male patients with diabetes = 29 22/28 = 79%
Male (with ischemic heart disease + no diabetes)	Count = 45 Total male patients without diabetes = 123 45/123 = 37%	Count = 78 Total male patients without diabetes = 123 78/123 = 63%

According to the table, 33% of female patients with diabetes received aspirin, and 72% did not. On the other hand, 48% of female patients with no diabetes received aspirin and 52% did not. In addition, for male patients with diabetes, 25% received aspirin and 79% did not. For male patients without diabetes, 37% received aspirin and 63% did not. The p-value for these results was 0.1608.

The following results were also obtained for hypothesis #2:

Age/received aspirin	**Received aspirin**	**Did not receive aspirin**
Older adults (>65) (with ischemic heart disease)	Count = 57 Total older patients= 141 O-IHD-A = 57/141 = 40%	Count = 86 Total older patients= 141 O-IHD-NA = 86/141 = 61%
Younger adults (≤65) (with ischemic heart disease)	Count = 30 Total younger patients= 86 Y-IHD-A = 30/86 = 35%	Count = 56 Total younger patients= 86 Y-IHD-NA =56/86 = 65%

According to this table, 40% (57/141) of older patients (above 65 years old) with ischemic heart disease received aspirin, whereas 61% (86/141) did not receive aspirin. In addition, 35% (30/86) of younger patients (65 years old or younger) with ischemic heart disease received aspirin and 65% (56/86) did not receive aspirin. These results had a p-value of 0.4844.

Hypothesis #2 Confounder: Diabetes

Age/Diabetes/Received aspirin	**Received Aspirin**	**Did not receive aspirin**
Older adults (>65) (with ischemic heart disease + diabetes)	Count = 8 Total older adults with diabetes = 29 8/29 = 28%	Count = 21 Total older adults with diabetes= 29 21/29 = 72%
Older adults (>65) (with ischemic heart disease + no diabetes)	Count = 48 Total older adults without	Count = 64 Total older adults without

	diabetes = 112 48/112 = 43%	diabetes = 112 64/112 = 57%
Younger adults (≤65) (with ischemic heart disease + diabetes)	Count = 2 Total younger adults with diabetes = 10 2/10 = 20%	Count = 8 Total younger adults with diabetes = 10 8/10 = 80%
Younger adults (≤65) (with ischemic heart disease + diabetes)	Count = 28 Total younger adults without diabetes = 76 28/76 = 37%	Count = 48 Total younger adults without diabetes = 76 48/76 = 63%

According to the table, 28% of older patients with diabetes received aspirin, and 72% did not. On the other hand, 43% of older patients with no diabetes received aspirin and 57% did not. In addition, for younger patients with diabetes, 20% received aspirin and 80% did not. For younger patients without diabetes, 37% received aspirin and 63% did not. The p-value for these results was 0.4508.

DISCUSSION:

The results of the first table did not support hypothesis #1. If they did, M-IHD-A would have been greater than F-IHD-A, and M-IHD-NA would have been lesser than F-IHD-NA. Instead, the opposite outcome occurred, with F-IHD-A being greater than M-IHD-A and F-IHD-NA being lesser than M-IHD-NA. These results had a p-value of 0.1946, meaning that they are not statistically significant. Overall, these findings indicate that female ischemic heart patients are more likely to be prescribed aspirin than male patients, which completely contradicts our initial thoughts. These results are surprising, since prior research has found that male patients are usually prescribed more aspirin than female patients (Opotowsky et al., 2007). Further research might be required in the future in order to investigate and explain these results. When testing for the confounding variable, diabetes, the same trends were found. Female patients (with or without diabetes) were more likely to be prescribed aspirin than male patients. This means that the confounding variable did not change the estimate of association between sex and aspirin prescription. The p-value of these results was 0.1608, so they are not statistically significant. Moving on to the correlation between age and aspirin prescription, the results of the second table did support hypothesis #2. As expected, O-IHD-A was greater than Y-IHD-A and O-IHD-NA was lesser than Y-IHD-NA. These results had a p-value of 0.4844, meaning that they are also not statistically significant. This indicates that older adult patients (over the age of 65) are more likely to be prescribed aspirin than younger adult patients (65 years old or less). This outcome was expected, since prior research has also agreed with these findings (Liu et al., 2021). Once again, the confounding variable did not change the estimate of association, since older patients (with or without diabetes) were more likely to be prescribed aspirin than male patients, as demonstrated in the table. These results were not statistically significant either, with a p-value of 0.4508. Conclusively, while some results differed from expectation, all outcomes answered our initial research question: predisposing factors, namely sex and age, DO have an effect on the way aspirin is prescribed. This data can be used in the future to fill in these gaps of health equity and

medication prescription and to make sure that everyone receives the same healthcare, despite differences in characteristics such as sex and age.

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Vaibav Ramu

Examining the correlation between various predisposing factors and average aspirin intake for patients with ischemic heart disease in the eICU dataset

ABSTRACT:

The objective of this study was to determine and discover any potential relationship between aspirin dosages and a variety of potential predisposing factors for patients with ischemic heart disease using the eICU database. Among the predisposing factors, my main focus was on trends in aspirin dosages in relation to increasing amounts of cardiovascular disease diagnoses in ischemic heart patients. I hypothesized that for all patients with ischemic heart disease, the aspirin dosage would increase by roughly 55 mg for every additional CVD diagnosis made. I accomplished this by first including three inclusion criteria: the patients presented with ischemic heart disease, they were above the age of 50, and that all the patients received aspirin (>0 mg). After doing this, I further filtered through the data and blocked each remaining patient into blocks based on their CVD quantity (i.e. patients with 1 CVD in one group, patients with 2 CVDs in another group, and on until 5). I considered two potential confounding factors: sex and age. However, neither were further pursued as the average aspirin intake for all eICU patients who were female was roughly equal to that of men; similarly, the patients who were between 50-69 had an average aspirin intake similar to that of patients aged 70 and older. Finally, I

measured the aspirin intake for each block and created a least-squares regression line and measured the slope, b, to find the average increase in aspirin intake compared to a single increase in CVD. I found that the slope was roughly 58 mg/CVD diagnosis. There was a moderately strong, positive relationship between the aspirin dosage and CVD quantity. There was one statistically significant p-value: 0.01318, but there were three other borderline significant values in this study that should be conducted with a larger sample size. Although research regarding this exact relationship is sparse, prior research has indicated that patients who have ischemic heart conditions or other CVDs are more susceptible to platelet-aggregation related issues. Therefore, they require aspirin to try and prevent any complications. It then follows that patients who present with relatively *more* CVDs, thus more chances for complications, would require higher doses of aspirin. My studies have provided results regarding the behavior of aspirin doses in response to several variables and can be used to study aspirin treatment further.

INTRODUCTION:

Background

Acetylsalicylic acid, more commonly known as aspirin, is a drug prescribed to a variety of patients for several reasons including: the relieving of arthritic symptoms, as a general pain reliever, blood thinner, and more. Among the most severe and common uses of aspirin is the "thinning" of blood - to acetylate the cyclooxygenase enzyme at the serine 529 position - and prevents the formation of thromboxane A_2 - a clotting agent in the blood. However, several factors - referred to as "risk factors"- can increase the likelihood of blood clots leading to heart attacks or ischemic strokes.

Studies show that platelet aggregation in response to adenosine diphosphate (ADP-induced platelet aggregation) is higher both at baseline and after aspirin administration in women than in men. This suggests that a larger dosage of aspirin is required in women to combat platelet aggression to the same extent as a lower dosage of aspirin in men.

Beta-blockers are drugs that repress the production of hormones/steroids such as adrenaline. They are commonly used in patients with hypertension or hypertensive conditions (relating or pertaining to conditions with high blood pressure). Studies show that patients with high blood pressure tend to have relatively higher platelet aggregation, suggesting more aspirin may be required to offset the increased aggregation.

Similar to beta-blockers, angiotensin-converting-enzyme (ACE) inhibitors are used to treat patients with high blood pressure. ACE Inhibitors function by relaxing the veins and arteries along with decreasing the overall blood volume, resulting in lower blood pressure and lower oxygen demanded. Specifically, as its name suggests, ACE inhibitors repress the angiotensin II enzyme that narrows blood vessels and raises blood pressure. Consequently, these patients have a higher risk of platelet aggregation, suggesting additional aspirin may be required.

Several "common" neurological conditions (i.e. stroke, cerebrovascular diseases, et. al.) are induced by or are *inducers* of conditions in the cardiovascular system. For example, injuries pertaining to cerebral vasculature (stroke) are often caused by high blood pressure - which, as mentioned previously, is a risk factor of increased platelet aggregation. Along with this, conditions such as hemorrhages, stenosis, and embolisms can also cause or result from

cardiovascular conditions. This proposes that the dosage of aspirin prescribed will be larger compared to patients who don't present with additional neurological diagnoses.

Aims

By examining the eICU dataset, we examined how extraneous potential predisposing factors affect the dosage of aspirin prescribed to patients presenting with ischemic heart diseases (icd9 410-414). This experiment utilizes the various extraneous factors as independent variables and the dosage of aspirin prescribed as the dependent variable.

This study will explore the relationship between the quantity of CVD diagnoses and their corresponding average aspirin dosages. I expect that patients presenting with two or more cardiovascular diagnoses will receive an increase of 55 mg of aspirin prescribed per additional diagnosis. This will henceforth be referred to as Hypothesis 1, or abbreviated H1. As mentioned above, female patients may differ in aspirin dosage than males. This study will attempt to reveal a correlation between aspirin dosages and sex. Furthermore, I expect that female patients receive 1.3 times more aspirin than male counterparts. The prior hypothesis will be henceforth referred to as Hypothesis 2, or abbreviated H2. I will examine the dataset for correlations between aspirin intake in patients who received beta-blockers versus those who did not. Specifically, I hypothesize that patients that received beta blockers will be prescribed 100 mg of aspirin in excess of the dosage of aspirin prescribed to patients who were not administered beta blockers. Throughout the remainder of this study, this will be referred to as Hypothesis 3, or H3. Similarly, I will also examine the study for a correlation between aspirin intake and whether or not the patients received ACE Inhibitors. Specifically, I hypothesize that patients prescribed ACE Inhibitors will be prescribed an additional 70 mg of aspirin on average, henceforth referred to as Hypothesis 4 (H4). As mentioned in the background, neurological conditions are often related to a cardiovascular defect or disease. Therefore, this study will also attempt to uncover a correlation between neurological conditions and aspirin dosages prescribed. I expect that patients presenting with neurological diagnoses (altered mental status, ALS/Lue Gehrig's disease, seizures, etc.) will consume an additional 30 mg of aspirin on average.

METHODS AND MATERIALS:

Experimental Design

The conducted study is a observational, retrospective, quantitative study examining past data collected in the eICU dataset. The study will be sorted by an inclusion criterion of the patient presenting with between one and four ischemic heart disease diagnoses and are at least 50 years old. Along with this, all patients need to have received some aspirin intake (>0 mg). Any patients that do not present with any ischemic heart disease or aspirin intake will be excluded from the parameters of this study. The eICU dataset provides the patients data along with admitted diagnosis, primary and secondary diagnoses, aspirin intake (y/n), the quantity of the intake, and more that aren't essential to this study. It contains over 2500 patients from over 20 major hospitals, making it relatively more reliable than a database with a smaller sample size, due to the Law of Large Numbers. The dataset has been stripped of any patient-identifying "clues" allowing the study to be as unbiased as possible, with the given data, and in compliance with HIPAA law.

Experimental Groups

H1: All patients presenting with any ischemic CVDs were sorted based on the quantity of CVDs they have. Therefore, I grouped patients with 1, 2, 3, 4, and 5 in separate groups.

There are several confounding factors for this experiment. One major factor is sex - different genders may receive different amounts of average aspirin dosage. There could be several potential reasons for this. For example, females may be more likely to tell doctors they are not comfortable with aspirin. Also, males may generally have a larger body mass, meaning they may require more aspirin. Sex was not grouped separately due to the average aspirin intake by sex being roughly equal, meaning that sex will not affect the result of the study: male $\bar{x} = 143.567$ mg, $\Sigma = 21680$, $N = 151$, and female $\bar{x} = 155.316$ mg, $\Sigma = 11804$, $N = 76$. Females received only 8 % more aspirin on average than males. When males and females are averaged, the small effect of the 8% would be negligible between CVD groups.

Another confounding factor is age, because people who are aged 50-69 may receive a different amount of average aspirin dosage than patients 70 and older. This is because younger aged people may be able to deal with higher doses of aspirin (may not be as harmful). Older people also may require more (younger people may be able to tolerate more pain). Age was not grouped separately because the average aspirin intakes between patients aged 50-69 was roughly equal to the average aspirin intake of patients 70 and over. The averages are as follows: aged 50-69: $\bar{x} = 149.476$, $\Sigma = 15396$, $N = 103$, aged 70+: $\bar{x} = 144.221$, $\Sigma = 14999$, $N = 104$. Patients aged 50-69 only received 3.6% more aspirin dosage. When averaged, the small effect of the the age would be negligible and would not taint the result of the study

Finally, I created a Least Squares Regression Line (LSRL) to calculate the slope. The LSRL equation: $y = a + bx$, a is the y-intercept, b is the slope - it gives average additional aspirin dosage per CVD, and y is average aspirin intake.

H2: To test for the correlation between sex and aspirin intake, females were first separated from the males in each group.

There are also a variety of confounding factors. One such factor is the amount of CVD . I created four primary groups/blocks: patients with 1 CVD, patients with 2 CVDs, patients with 3 CVDs, and patients with 4 CVDs. There was no group for patients with 5 CVDs because there is not enough data to generate a significant result. The average aspirin intake between males and females *does* differ significantly per CVD group. My solution was to group by CVD and conduct the experiment to look for general trend data.

Another such confounding factor is age. However, I didn't subgroup by age because age *does not* influence average aspirin intake by sex because there are roughly an equal proportion of males and females in each age group.

Finally, I examined average aspirin intake and compared them against their corresponding blocks.

H3: To determine the relationship between the administration of beta-blockers and aspirin dosages prescribed, I first blocked into two groups: BBY - patients prescribed beta-blockers and BBN - patients not prescribed beta-blockers.

There are also a variety of confounding factors for this experiment. Firstly, the quantity of CVDs could skew the results if not taken into account. However, there was no blocking by CVD because the average number of CVDs for patients with ischemic heart disease and aspirin intake is approximately equal: BBY: 2.563 CVDs/patient vs. BBN: 2.64 CVDs/patient. Both also had sample sizes larger than or equal to 25 people, so we can assume that the CVD quantity does not affect the outcome of the study.

Age is another confounding variable. Similar to CVD quantity, however, there will be no blocking by age. This is because the average ages for each group was approximately equal, with BBY averaging 69.9 years and BBN averaging 67.9 years. Again, both groups had sample sizes less than or equal to 25, so we can assume age is not a prominent threat to discovering a true correlation.

Finally, we will take the average of both groups and compare them to look for a trend in aspirin dosage prescribed.

H4: In order to test the effect of receiving ACE inhibitors on the patient's aspirin dosage, I first grouped all patients that received ACE inhibitors into one group (AIY) and the rest into another (AIN).

As with the other hypotheses, there are some factors that could influence the result if unaccounted for. Again, the number of CVDs a patient is diagnosed with could influence their aspirin intake. However, I found there to be no need to subgroup, considering that the average number of CVDs in both groups was approximately equal (AIY = 2.5 CVD, AIN = 2.6 CVD).

As mentioned earlier as well, age is a potential risk factor for more aspirin dosage that would skew the results in a negative way. By examining the dataset, I found that the average age between AIY and AIN was only 2 years off, with their average ages being 68 years and 70 years, respectively. Therefore, there was no need to subgroup.

Finally, I compared the results for both groups and looked for a correlation.

H5: For the final test conducted in this study, I examined the dataset to discover whether or not the additional presence of a neurological disease affected the aspirin dosage. To begin, I grouped all patients with neurological diseases and/or conditions into one group (NDY). I then grouped the remainder of the sample into another group (NDN).

I considered the number of CVDs in each patient to be a significant confounding factor; however, CVDs were not grouped separately because the average number of CVDs for NDY is 2.76, whereas the average number of CVDs for NDN is 2.54.

Similar to the other hypotheses, age was also considered a significant confounding factor. Once again, there was no blocking for age, since the proportion of patients aged 50-69 is roughly equal to the proportion of patients aged 70+ of all ischemic patients prescribed aspirin and diagnosed with a neurological condition.

Finally, I took the averages of the two subsets and compared them to look for a trend.

RESULTS:

The results I obtained from testing the dataset for each hypothesis are listed below:

H1:

# of CVDs	$\bar{x}$	N
1	343.4483 mg	29
2	375.9474 mg	19
3	344.5455 mg	11
4	381.2727 mg	11
5	631.5	6

P Value (1 and 2): 0.363

P Value (1 and 3): 0.496

P Value (1 and 4): 0.357

P Value (1 and 5): 0.013 *Statistically significant*

P Value (2 and 3): 0.109

P Value (2 and 4): 0.485

P Value (2 and 5): 0.078

P Value (3 and 4): 0.409

P Value (3 and 5): 0.074

P Value (4 and 5): 0.090

H2:

Male	Female	Δ (male-female)
1 CVD (n=14): 312.9286 mg	1 CVD (n=15): 371.9333 mg	-59.0047 mg
2 CVDs (n=15): 411.267 mg	2 CVDs (n=5): 243.5 mg	167.767 mg
3 CVDs (n=5): 563.4 mg	3 CVDs (n=6): 162.167 mg	401.233 mg
4 CVDs (n=8): 341.75 mg	4 CVDs (n=3): 486.667 mg	-144.917 mg

P Value (1 CVD): 0.299

P Value (2 CVD): 0.224

P Value (3 CVD): 0.040 *Statistically significant*

P Value (4 CVD): 0.287

H3:

Beta Blockers Y/N	Average Aspirin Intake
BBY (n=60)	424.633 mg
BBN (n=27)	296.519 mg

P Value: 0.049 *Statistically significant*

H4:

Ace Inhibitors (Y/N)	Average Aspirin Intake
AIY (n=28)	428.1071 mg
AIN (n=59)	364.356 mg

P Value: 0.201

H5:

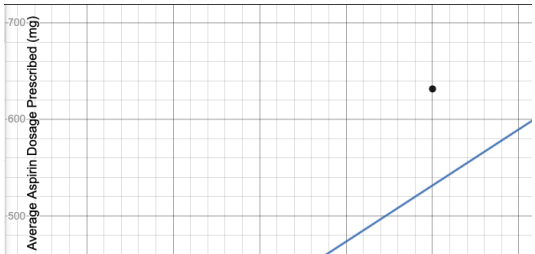
Neurological Diagnoses (Y/N)	Average Aspirin Intake
NDY (n=19)	413.789 mg
NDN (n=76)	376.6579 mg

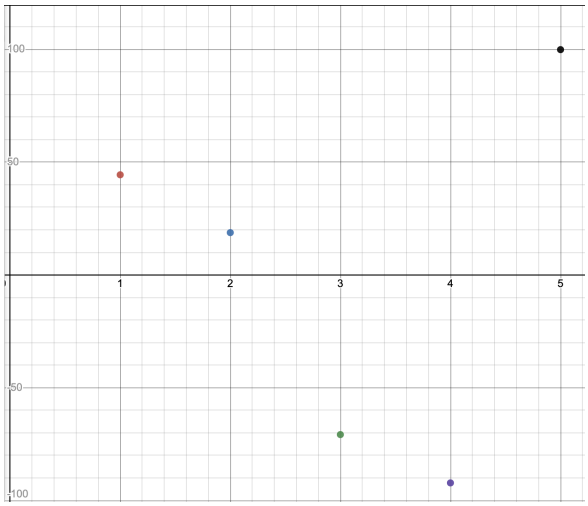
P Value: 0.164

DISCUSSION:

H1: After examining the data obtained from the eICU dataset, there are several relationships that can be obtained.

The experiment for Hypothesis 1 found a moderately strong, positive relationship between the average aspirin intake and the number of CVDs that a patient was diagnosed with. By calculating for the least-squares regression line, the equation $\hat{y} = 240.91417 + 58.143x$ was obtained, where $\hat{y}$ = predicted average dosage of aspirin prescribed, and x = CVD quantity. The graph of the LSRL (left), as well as the residual plot (right), are shown below.





As evidenced by the residual plot, the LSRL is a good fit for the data, as there is no evident pattern (such as a parabolic shape) created by the residuals. Using a significance level (α) of 0.05, there is 1 statistically significant result - comparing patients with 1 CVD and 5 CVDs. Therefore, we can generalize the result that there is a positive association between the aspirin intake and CVD quantity.

The LSRL has an $r = 0.753$, signifying that the relationship generated by the LSRL is a moderately strong, positive association. This also means that $r^2 = 0.567$, indicating that approximately 57 % of the variation in the vertical distances from the aspirin dosages and the LSRL can be attributed to the linear relationship between the CVD quantity and the aspirin dosages. This value is significantly high, considering this study is dependent on human-based results, which are often variable. Generally, high values of r^2 for human-dependent results are above 50% or 0.5, meaning that my value was quite high. As evidenced by the results, there are also three borderline significant values that should be examined in another experiment with a larger sample size to provide more significant results.

These findings supported the intuition gained after prior research. Prior research has shown that patients with ischemic heart disease or CVDs are generally more “at-risk” to platelet-aggregation related complications (*Aspirin: MedlinePlus Drug Information*, 2021).

I also acknowledge that there were some limitations with the study. Firstly, the sample size was not large enough to produce a large amount of statistically significant results. Secondly, data did not show whether or not certain patients or groups of patients also received another medication that may prevent clotting concurrently.

H2: After examining the data from experiment 2, regarding sex and aspirin dosage, there was no observable relationship that could be made.

The experiment only presented one statistically significant p-value. Along with this, the data did not show a general trend in the data. There was no evident data that proved one sex received more aspirin than the other. For patients with 1 and 4 CVDs, women presented with a higher average aspirin dosage. However, for patients with 2 and 3 CVDs, men presented with a higher average aspirin dosage.

These findings differed from previous studies. Several previous studies have found a discrepancy in aspirin intake and effectiveness in male and female patients (Friede et al., 2020). This may be because the sample sizes were not large enough to obtain reliable results. This may also be due to other conditions that were present in some patients that influenced their aspirin dosage. However, more investigation should be conducted regarding this to be conclusive.

As mentioned above, a potential limitation of this study was a lack of a large enough sample size. Along with this, additional conditions, patient requests, and concurrent medication were not all provided, so these factors may have also played a role in the result of this experiment.

H3: The data from this experiment showed that patients who received beta-blockers had higher doses of aspirin.

The p-value for this experiment was statistically significant, so the result can be generalized to a larger population. Along with this, the sample-sizes in both groups were relatively large for the eICU dataset, further strengthening this finding. The data showed that patients who received beta-blockers had an average aspirin intake that was 128.114 mg higher than their counterparts who did not receive beta-blockers.

My findings were similar to what I had hypothesized, although the real result was 30 mg more than what I had predicted. These findings also correspond closely with intuition based on prior research (Blann et al., 2003), (*Beta-Blockers*, 2019). Beta-blockers are prescribed to patients with high blood pressure and patients who have higher blood pressure also tend to be at higher risk of platelet-aggregation related complications. Therefore, it follows that patients who were administered beta-blockers would also be administered more aspirin than patients who were not administered beta-blockers.

There are still limitations regarding the eICU dataset in this experiment. Even though the sample size was relatively large for this database, it is still comparatively small to other studies that have sample sizes over 1,000.

H4: The results from this study showed that patients who received ACE-inhibitors received more aspirin (on average) than patients who were not prescribed ACE-inhibitors.

However, the calculated p-value was larger than my significance level, so the result is not statistically significant. However, this study should be replicated with a much larger sample size to see if the findings are consistent.

The finding supported my hypothesis, as I had hypothesized that AIY patients would receive 70 mg more of aspirin than AIN patients. The data shows that the gap was 63.7511, which is close to my hypothesized value. This finding is consistent with expectations based on prior research (Mayo Clinic, 2021).

There are some limitations of this experiment, however. This is mainly regarding the sample size. Although the results supported my hypothesis, the p-value was too high. This could be minimized by a larger sample size in a new study.

H5: This study was focused on finding a relationship between neurological conditions and aspirin dosages. The data showed that patients who had at least one neurological condition in

addition to their ischemic condition had a higher aspirin dosage than those without a neurological condition.

The calculated p-value was greater than the significance level, however, so the result was not statistically significant. Nevertheless, the data supported my hypothesis that patients with neurological conditions additionally would receive 30 mg more aspirin than their counterparts without additional neurological conditions on top of their ischemic condition. The real difference in the average was 37.1311 mg of aspirin. This is consistent with prior research (*Cerebrovascular Disease | Michigan Medicine*, n.d.).

Limitations for this study include the lack of a large sample size, which would have provided us with a more generalizable result. Further research is required to apply the results of this study to the population. Another limitation are any other predisposing factors that may have affected the risk of aspirin-related complications (and hence, patients may have been prescribed lesser amounts).

CONCLUSION:

In conclusion, my results disproved relationships between various potentially predisposing factors and their effects on the aspirin dosages prescribed to patients with ischemic heart disease. This study further explores trends in aspirin treatment and can be used to map new trends or expand upon other predisposing factors. The results of my study have both been in correspondence with and differ from prior research among the various experiments. Some findings, such as the hypothesis regarding Hypotheses 1, 3, 4, and 5, were supported by findings from previous research. However, the experiment regarding Hypothesis 2 was not supported by prior research because the results did not provide a conclusive effect of gender on the dosages of aspirin prescribed. Further research should be conducted to examine how other predisposing factors, besides the ones tested in this study, affect aspirin dosage. Along with this, the experiments in this study that did not provide a statistically significant p-value should be retested with a larger sample size to determine if the relationship remains true. This will improve our comprehension of the association between various predisposing factors and aspirin dosage, and can be compared against existing clinical guidelines.

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Increased Aspirin Prescribed based on CVD Quantity in Ischemic Heart Patients

Author

Vaibav V. Ramu

Summary

- Aspirin prescribed to patients to reduce risk of blood clotting
- Patients with cardiovascular/ischemic diagnoses are more susceptible to clotting complications
- eICU dataset contains 2000+ patient records from 20+ hospitals
- After examining data, slope of LSRL was approx. 58 mg
- Aspirin dosages were generally found to trend in the upward direction
  - Moderately strong, positive association (r=.75302)

Objective/Problem

- Determine correlation between CVD quantity in Ischemic Heart Patients and aspirin dosages
- Look for a general trend.

Hypothesis

- Patients will have an increase of 55 mg aspirin per additional diagnosis.

Methodology

- Inclusion Criteria:
  - Ischemic Heart Disease
  - Prescribed aspirin
- Patients will be blocked by CVD quantity
- Confounding factors:
  - Sex: not grouped separately
  - Age: not grouped separately
- Calculate average dosages for each CVD quantity (1-5)
- Create an LSRL (minimize residuals)
  - $\hat{y} = a + bx$, find b

Results

# of CVDs	$\bar{x}$	N
1	343.4483	29
2	375.9474	19
3	344.5455	11
4	381.2727	11
5	631.5	6

Analysis

- Computed p-values using
  - Null Hypothesis: $\mu1=\mu2$
  - Alternative Hypothesis: $\mu1<\mu2$
  - $\alpha=0.05$
- 1 Statistically Significant (red)
- 3 Nearly Significant (light brown)

- LSRL suggests for every increase in CVD quantity, aspirin dosages increase by 58.143 mg
- r=0.75302
- r-squared=0.567044

- Residual Plot shows no obvious pattern
  - Linear model is a good fit

P-VALUES: (α=0.05)

1 AND 2: 0.36349891

1 AND 3: 0.49589521

1 AND 4: 0.357164065

1 AND 5: 0.0131824

2 AND 3: 0.108880025

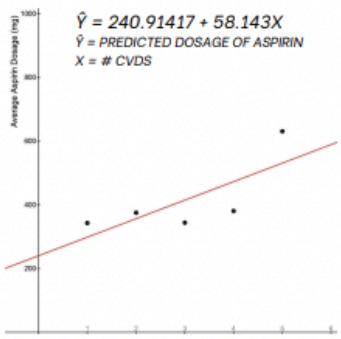
2 AND 4: 0.48504446

2 AND 5: 0.07767983

3 AND 4: 0.408915685

3 AND 5: 0.07368093

4 AND 5: 0.0898733



Least Squares Regression Line with Data Points

Conclusion

Since our **p-value of 0.0132 is less than our α of 0.05**, we **reject the claim** that the true dosage of aspirin is the same for differing quantities of CVDs. It appears **there is a moderately-strong, positive relationship** between average dosage of aspirin prescribed and the CVD quantity.

*Therefore, the data **supports** my hypothesis: for every additional CVD, approximately 55 additional mg of aspirin are prescribed.*

Related Literature

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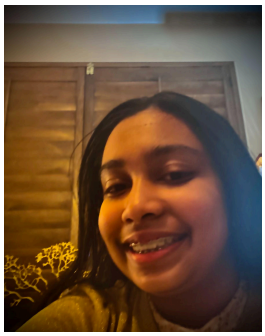
Independent Students

The following students did not participate in the 2023 Rising Researchers Course. They have conducted research outside of the course. After careful review, we have deemed their research worthy of publication in our scientific research journal.



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The Effect Of *Ocimum tenuiflorum* As Compared To Other Solution Types On The Rate Of Regeneration Of *Dugesia dorotocephala*

ABSTRACT:

The application of stem cells in regenerative medicine is an important ongoing subject in science and medicine research. The study of stem cell regeneration helps to better understand how diseases occur, and has a potential to find cures for chronic and serious diseases.[1] The objective of this project was to study the healing effects of *Ocimum tenuiflorum* on stem cells as compared to other solution types. The experiment was conducted by obtaining Planaria culture, cutting Planaria in small parts using scalpel, and observing the rate of growth in *Ocimum tenuiflorum* solution, baking soda solution, distilled vinegar solution, and normal spring water by measuring length of Planaria over 14 days. It was hypothesized that the rate of regeneration will be higher in the *Ocimum tenuiflorum* solution. The results also show that the rate of regeneration was fastest in *Ocimum tenuiflorum* solution.

INTRODUCTION:

Stem cell regeneration allows damaged or diseased tissues and cells to be repaired, as stem cells can be guided to become specific cells. If effective stem cell regeneration is achieved, researchers could generate healthy cells to replace diseased cells.[1]

Planaria can be used to model stem cells. Planaria are parasites that are able to extraordinarily regenerate through adult stem cells called neoblasts. The cells are able to replace themselves and make all cell types needed to create an adult worm, although the origin of those cells is still not clear.[6] When a Planarian is wounded, the neoblasts of the wound rapidly divide and create a blastema, which is a colorless tip of the regenerative tissue.[7] Planaria are usually found in freshwater environments at room temperature.[2] This is the reason why the control group is natural spring water and all solution mixtures contain natural spring water. Fresh water is neutral and ocean water is slightly alkaline. However, acidic and basic environments are not usual Planaria breeders. *Ocimum tenuiflorum* (Holy Basil) has therapeutic properties that accelerate and are known to accelerate healing in general. For example, it treats and moderates diabetes, decreases susceptibility to cancer, reduces respiratory disorders, etc.[3] These are the reasons why the experimental groups were distilled vinegar solution (acidic), baking soda solution (basic), and *Ocimum tenuiflorum* solution.

Research Question/Hypothesis:

This experiment focused on the effect of *Ocimum tenuiflorum* as compared to other solution types on the rate of regeneration of *Dugesia dorotocephala*. The hypothesis of the experiment was:

> H_0 (Null Hypothesis): There is no statistically significant relationship between type of solution and growth of regeneration of *Dugesia dorotocephala.* With change in type of solution, there is no difference in rate of growth of *Dugesia dorotocephala* (measured by length of *Dugesia dorotocephala* in each solution on day 1, day 7, and day 14).
>
> H_A (Alternate Hypothesis): There exists a statistically significant relationship between type of solution and growth of *Dugesia dorotocephala*. Regeneration growth of *Dugesia dorotocephala* varies with type of solution. In distilled Vinegar and Baking soda solution, the rate of regeneration will be slow and in *Ocimum tenuiflorum* solution it will be high.

METHODS:

Dugesia dorotocephala culture was obtained. A ceramic bowl was rinsed lightly with 50 mL of natural spring water. Natural spring water was poured in the bowl up to one fourth from the top brim. The *Dugesia dorotocephala* was transferred into the bowl, and placed in a dark place. This process was repeated every day. They were fed a pea size portion of boiled egg yolk once a week, and transferred to another bowl with natural spring water. This process was repeated for a week until the start of the experiment.

Four petri dishes were labeled “Normal”, “Distilled Vinegar”, “Baking Soda”, and “*Ocimum tenuiflorum*”. The distilled vinegar solution was prepared by mixing 100 mL of distilled vinegar and 100 mL of natural spring water. The baking soda solution was prepared by measuring 8.4 grams of baking soda and mixing it in 100 mL of natural spring water. The *Ocimum tenuiflorum* solution was prepared by taking 100 mL of natural spring water in a bowl and mixing 0.20 grams of crushed dried *Ocimum tenuiflorum* leaves in it. 3.5 mL each solution was poured into its corresponding petri dish. Natural spring water was poured in the petri dish labeled “Normal”.

One *Dugesia dorotocephala* was transferred from the culture bowl using a pipette to the petri dish marked "Normal". It was amputated into four small sections using a scalpel. The section with the head was transferred out of the petri dish using a new pipette. The three other sections remained in the petri dish. These steps were repeated for the petri dishes labeled "Distilled Vinegar", "Baking soda", and "*Ocimum tenuiflorum*". A new pipette was used for each petri dish. The length of each amputated *Dugesia dorotocephala* on day one was measured and recorded using a microscope. All petri dishes were placed in a dark place at room temperature. The *Dugesia dorotocephala* were not fed during this time and were not removed from their respective bowls. The *Dugesia dorotocephala* samples were monitored every day. Three trials were conducted for each of the four groups. The length of the *Dugesia dorotocephala* was also measured and recorded on day 7 and day 14 using a microscope.

STATISTICAL ANALYSIS:

A one-factor ANOVA test was carried out in order to determine whether or not a statistically significant difference existed between the four experimental groups and the control group. A one-factor ANOVA test evaluates the statistical significance of any differences that may exist across the different solution mixes by comparing the arithmetic means of the samples against one independent variable.

RESULTS:

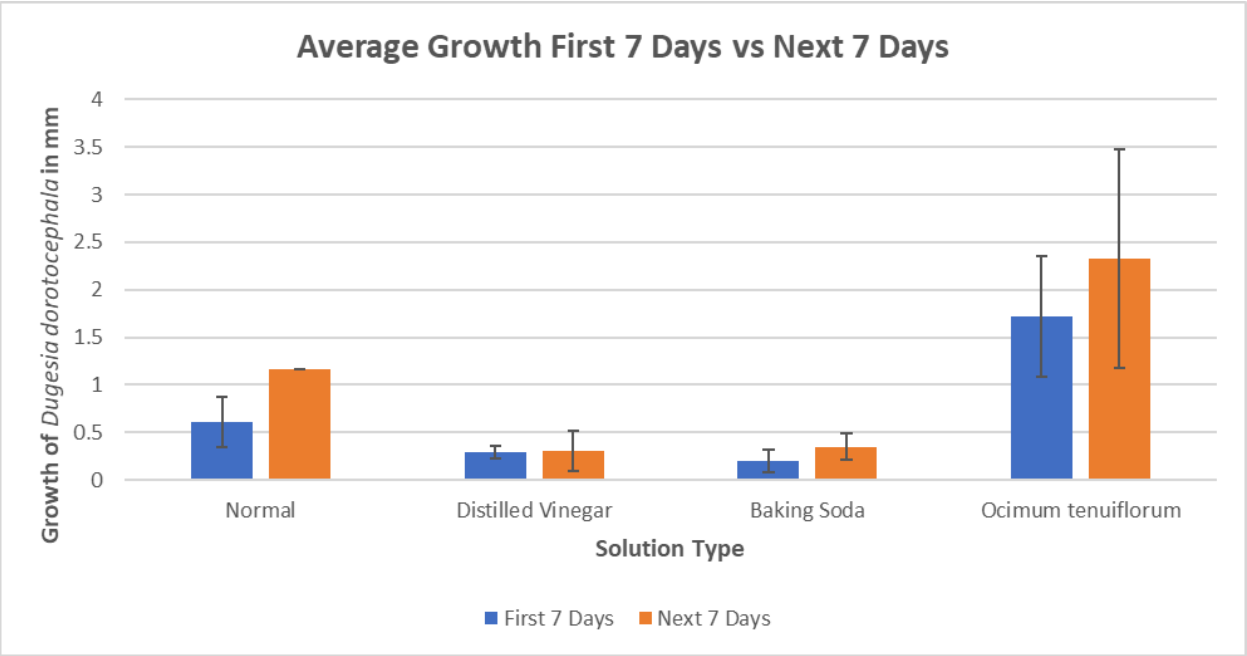
The objective of the experiment was to study the effect of *Ocimum tenuiflorum* as compared to other solution types on the rate of regeneration of *Dugesia dorotocephala*. The alternate hypothesis was that the relationship between type of solution and growth of *Dugesia dorotocephala* is statistically significant and varies with type of solution. In distilled vinegar and baking soda solution, the rate of regeneration will be slow and in *Ocimum tenuiflorum* solution it will be high. The results support the alternate hypothesis; therefore, I reject the null hypothesis. Low P-value of ANOVA test establishes that the relationship between the *Ocimum tenuiflorum* solution and the growth of *Dugesia dorotocephala* is statistically significant. Small standard deviation values confirm low variation in data.

Processed Data Table:

Average Planaria Growth/Regeneration		
Solution Type	**First 7 days St. Dev.**	**Next 7 days St. Dev.**
Normal	0.61 ± 0.26	1.17 ± 0
Distilled Vinegar	0.29 ± 0.07	0.31 ± 0.21
Baking Soda	0.20 ± 0.12	0.35 ± 0.14

Ocimum tenuiflorum	1.72 ± 0.63	2.33 ± 1.15

Data Graphs:



At 0.002365073, the calculated P-value is lower than my alpha level of 0.05, meaning that there is less than a 5% chance that my experimental results were due to chance. Thus, I can reject the null hypothesis and accept the alternative hypothesis: There exists a statistically significant relationship between type of solution and growth of *Dugesia dorotocephala* in the first 7 days.

At 0.009504533, the calculated P-value is lower than my alpha level of 0.05, meaning that there is less than a 5% chance that my experimental results were due to chance. Thus, I can reject the null hypothesis and accept the alternative hypothesis: There exists a statistically significant relationship between type of solution and growth of *Dugesia dorotocephala* in the next 7 days (between 7-14 days).

Notes and Qualitative Data:

· *Dugesia dorotocephala* moved a lot when being cut under the microscope due to light exposure. They are sensitive to light, hence the reason why they were kept in a dark room for the duration of the experiment.

· A white cloud formed at the end of the wound on day 3. This was the blastema meaning that cell division has started and regeneration is beginning.

DISCUSSION:

As depicted in data graphs, the rate of regeneration within the distilled vinegar and baking soda solutions is slower than normal. At the same time, the rate of regeneration in *Ocimum tenuiflorum* solution is quite faster than the normal solution, which means that its therapeutic properties do promote faster cell regeneration. Results observed are consistent between growth observations in the first 7 days and next 7 days (7–14-day period). The data graphs also illustrate that the growth of Planaria in the 7–14-day period is higher than the first 7 days across all solutions. This is expected and shows that growth accelerates with time elapsed. Results note that the average rate of growth in Distilled Vinegar (acidic) and Baking Soda (basic) solutions is less than half of normal growth – 0.29 and 0.20 mm over 0.61 mm normal growth. Use of *Ocimum tenuiflorum* as an additive accelerated growth of the first 7 days to an average of 182% over normal growth, 1.72 mm over 0.61 mm growth in normal solution. These results show potential for further research on use of *Ocimum tenuiflorum* in medicinal stem cell therapy.

Further research could include testing Planarian regeneration in other solution mixtures with ingredients known for their therapeutic and healing properties. This improvement would allow increased understanding if there are any more specific ingredients or mixtures that will give the fastest rates of regeneration. This can help physicians treat patients even faster and more effectively. Also, detailed study into the properties, structure, role and mechanics of neoblasts in Planaria regeneration and how certain stimulants accelerate and decelerate rate of regeneration would be valuable to the field of stem cells and regenerative medicine. This research can help scientists and physicians work better with stem cells and use the neoblast study to create successful stem cell therapies.

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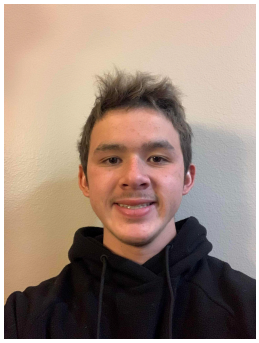

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The Effect that Diet and Exercise has on Dementia

ABSTRACT:

Dementia affects millions of people worldwide. Even so, there is not an established manner in which we can prevent or treat this medical disorder. PubMed was used as a database to search for and utilize research articles related to the topic. In this study we explore the effect between dementia and lifestyle changes such as diet and exercise. Multiple studies and reviews on

Pubmed were able to examine the effects and give hints to preventing dementia. It was determined that through changing diet with the addition of consistent exercise there was a demonstrable increase in cognitive function as well as a decrease in risk factors for dementia. It was also seen that employing certain lifestyle changes made a positive impact in delaying onset of dementia. The evidence is still growing in order to support and calculate the magnitude of effect of lifestyle changes.Additionally it is unclear as to which lifestyle changes are of most importance.

INTRODUCTION:

According to the Population Reference Bureau, as many as 12 million people in the United States alone are projected to have a form of dementia by the year 2040 [1]. Anybody over the age of 65 especially women are at risk for developing dementia and common symptoms of dementia are memory loss, mood changes, and difficulties with daily tasks. Although conditions such as dementia are so widespread, there is still currently no available cure. Methods to delay the onset of dementia in at-risk populations is an alternative focus for fighting the disease, rather than cure the disease. Lifestyle changes have been one of these alternative focuses and changes in diet and exercise have been researched to understand how effective it is in delaying dementia.

MATERIALS AND METHODS:

The criteria for researching and finding studies was by searching through the Pubmed database using keywords including “diet”, “exercise”, “dementia”, and “lifestyle”. Articles that had information on the effect of diet or exercise on dementia were included. Articles published before the year 2008 were omitted from the analysis process.

RESULTS:

The five articles found showed that a change in diet and adding exercise to their routine showed great improvement in cognitive scores when tested. Exercise was shown to have an improvement on insulin sensitivity, reduction in stress, and decreased inflammation. Receiving proper dietary advice proved to be beneficial in regards to executive functioning, processing speed, and memory all of which show better cognitive function. The results support the idea that cognitive ability is strengthened when lifestyle changes are introduced but more information is needed to make more definitive claims and recommendations.

DISCUSSION:

In 2009, Korczyn reviewed studies on how dementia could be prevented through changing lifestyle habits in the middle of someone’s life [2]. While dementia is more of a syndrome it seems to have many risk factors. Some of the risk factors include age, high blood pressure, diabetes, obesity, smoking, and low level education. It’s suggested that prevention is possible if risk factors are identified early and treated. Older-aged people are the most at risk but most of them do not smoke and are not overweight but the difference could lie in their particular lifestyle habits based on other factors like education. It’s acknowledged that dementia is a multifactorial disease with many triggers but positive lifestyle changes should be able to at least delay the onset of dementia.

Davis et al. (2021) reviewed articles on the ketogenic diet's effect on dementia prevention and treatment [3]. The review bases its investigation on the fact that the keto diet has been in use for treating other brain conditions like epilepsy. Benefits of the keto diet for fighting dementia are increased mitochondrial function, increase in insulin sensitivity, and weight loss, all of these are beneficial to one's health. Increasing insulin sensitivity helps decrease the risk of dementia since poor blood sugar is associated with risk of dementia. In the study of dementia, neuroinflammation is a contributor for dementia that is gaining widespread recognition in which the keto diet has been shown to be able to decrease.

Ngandu et al. (2015) concluded lifestyle changes were able to prevent cognitive decline in elderly people [4]. Their experimental design included giving the intervened group dietary advice, an exercise program, and computer based training for the mind, while the control group only received general health advice. The results showed that the intervention group had higher scores in all categories (executive functioning, processing speed, and memory) compared to the control group. This study was a breakthrough since it was the first long-term study that organized at-risk patients and allowed researchers to be able to start making inferences from the study.

Canevelli et al. (2016) reviewed eleven articles that have evidence for preventive measures for dementia [5]. The link between dementia and diet is ever growing based on evidence of cognitive decline correlating with low vitamin D concentrations. Supplementation of nutrients and adding exercise can be a way to increase brain function as many in the elderly group exhibited an increase in one area of cognitive performance.

Iuliano et al. (2019) studied how physical exercise affects preventing dementia. The basis of this study was many observational studies showing a reduction in the risk of cognitive decline when physical activity is introduced [6]. Physical inactivity is among one of the seven risk factors which are adjustable. After studying for 48 months the researchers came to the hypothesis that exercise's role in brain health is a positive one and can prevent dementia by eliminating obesity and cardiovascular issues. This hypothesis supports the original focus of the study, where it was surmised that exercise has a positive impact on preventing dementia.

CONCLUSION:

Lifestyle changes through diet and exercise in order to prevent dementia are promising due to its ability to reduce the amount of risk factors a person may experience throughout their life. These new lifestyle habits have the potential to increase cognitive function and physical health but more research on this particular subject is needed in order to see the effect it has in preventing dementia. After evaluating the mentioned studies, further research into risk factors of dementia will allow for more knowledge to be discovered in regards to preventing and possibly curing dementia.

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You Are What You Eat: A Look at the Connection Between Nutrition and Polycystic Ovarian Syndrome

ABSTRACT:

Polycystic ovarian syndrome (PCOS) is a hormonal disease that causes enlarged ovaries and the formation of small cysts on the ovaries' outer margins. PCOS can also cause infertility. The purpose of this study was to examine whether or not PCOS symptoms can be managed with diet and lifestyle changes. It was found that diet is an effective treatment option for PCOS symptoms. PCOS has a variety of effects, including on fertility, weight, and more. Diet and lifestyle can help people with PCOS take control of their hormones and remove these systems. Studies have shown that polycystic ovary syndrome (PCOS) can be managed with changes in food and lifestyle, but there is still no known treatment for the disorder.

INTRODUCTION:

Lemonade. Funnel cakes. Corn dogs. While these foods may happen to be found on every dream carnival's food truck menu, they are also examples of the foods women with Polycystic Ovarian Syndrome (PCOS) must avoid daily. Unfortunately, for many women, when it comes to what you eat, it's not just your waistline at stake. PCOS affects roughly 5 million women in the United States. This syndrome is a hormonal disorder causing enlarged ovaries with small cysts forming on the outer edges of the ovaries. The exact cause of PCOS is not known, however, it has shown a connection with abnormal hormone levels such as Androgens (like testosterone and androstenedione), Luteinizing hormone (LH), follicle-stimulating hormone (FSH), estrogen, progesterone, and insulin.

Currently, there is no complete treatment, but there are lifestyle changes that can help with the symptoms of PCOS. The cause of PCOS is not fully known yet however hormonal imbalances are one of the main causes along with lifestyle, and hereditary factors (2). PCOS requires a medical diagnosis and there many symptoms such as; abnormal menstruation, absence of menstruation, heavy menstruation, irregular menstruation, short or light menstruation, vaginal spotting, obesity, weight gain, infertility, depression, acne, hirsutism, loss of scalp hair, oily skin, or unwanted hair. PCOS leads to an increased risk for type 2 diabetes and more than half of women with PCOS develop type 2 diabetes. It is commonly recommended that people with PCOS help treat their condition with diet and exercise, despite the uphill battle women with PCOS face with their weight management. There are also a few prescribed treatments, including oral contraceptive pills, progesterone, and metformin. Many women with PCOS also struggle when trying to get pregnant, so they will use various advanced treatments including in vitro fertilization. Unfortunately, PCOS can be a difficult condition to diagnose and manage due to the imbalances of hormones within the body. There are many side effects of this condition, and women can start living with this condition around the start of puberty and go undiagnosed until they begin to try conceiving. Simply put, our hormone levels can fluctuate due to the food we eat. Can PCOS symptoms be managed with diet and lifestyle changes?

MATERIALS AND METHODS:

The PubMed database was used in order to search for and utilize research currently published on PCOS. Many of the articles and research I found were more current ranging from 2018-2022 and another more dated article from 2007. There were no articles used that were published before 2007. All articles chosen were written in English.

Keywords that were used in the search of the database include PCOS", "treatments", "diet", "microbiome", "type 2 diabetes", "hormone-balancing foods", "symptoms", "lifestyle", "nutrition" and "hormone".,

RESULTS:

Research has found that diet is directly correlated with the management of PCOS. A diet that can help manage the symptoms of PCOS includes fruits and vegetables with a low glycemic index (GI) and are typically non-starchy. PCOS is also directly related to your microbiome. Dietary restrictions have been shown to improve symptoms. The diet of someone with PCOS is very important to the management of the condition.

DISCUSSION:

If you are what you eat, to what extent is this true? Many diets have been attempted to help reduce the symptoms of PCOS [1]. Very few articles about diets and their connection with PCOS have been published to date. PCOS has been found to be manageable based on what you eat. The results did not surprise me because many people with other disorders have been able to manage and treat symptoms of other diseases. This data can be used in the future to find better treatments for people with PCOS. Very few articles about diets and their connection with PCOS have been published to date. Farshchi et al. (2007) shows how nutrition and diet affect PCOS symptoms [2]. An article done by (Last name of first author et al. (year)) concluded that foods such as artichokes, asparagus, bean sprouts, brussels sprouts, broccoli, cabbage, cauliflower, celery, cucumber, eggplant, mushrooms, onions, peppers, salad greens, spinach, tomato, turnips, zucchini, melons, berries like strawberries, raspberries, blackberries, and blueberries, as well as citrus fruits (150 mL of red wine per day), are all foods that are beneficial in reducing symptoms of people with PCOS [3]. A full analysis of patients who are finding success in managing their symptoms with diet and lifestyle changes could demonstrate a more exact cause for the lessening of symptoms. In a study done by (author), the dietary restrictions that were shown to be beneficial include; "Fat should be restricted to < or =30% of total calories with a low proportion of saturated fat[4]. In another article done by (author), it was concluded that a high intake of low GI carbohydrates contributes to dyslipidemia and weight gain and also stimulates hunger and carbohydrate craving" [5]. In a study done by (author), the microbiome was suggested to be incredibly important in aiding in symptom relief in PCOS, hosting bacteria that are important for digesting food [6]. It helps to eliminate any harmful bacteria, regulates our immune system, and is responsible for producing important vitamins needed for blood coagulation[7].

Currently, PCOS does not have a cure or a standard treatment of care apart from the management of symptoms. With increasing knowledge regarding the positive effect dietary changes can have on PCOS, more effective treatment plans will most certainly be on the horizon. The data discussed in this paper can be applied as preventative care and treatment for hormonal imbalances and other gynecological conditions.

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Effect Of Acute Sleep Deprivation On Motor And Cognitive Skills Across Age Groups

ABSTRACT:
Sleep deprivation is one of the leading causes of motor vehicle accidents and functional impairment [1]. Numerous studies have investigated the effects of limited sleep on driving and cognitive function, which include attention deficits, decision-making skills, hand-eye coordination, vigilance, and reaction time [2]. In this study, the effect of total sleep deprivation for a night on reaction time following a stimulus, verbal memory, and number memory was studied across subjects that ranged from 16 to 50 years old. The experiment was performed by comparing the results of the three parameters (reaction time, verbal memory, and number memory) before and after sleep deprivation. Those with sleep deprivation had a significant increase in reaction time ($p = .002$) and a significant decrease in verbal memory ($p = .038$). An overall decrease in number memory was observed but was not statistically significant. Ultimately, the increase in reaction time demonstrated in this experiment provides evidence to support a correlation between sleep deprivation and slower reflexes and decreased hand-eye coordination, which can manifest during motor vehicle operation. Additionally, a decrease in verbal memory can impair the absorption and recollection of information, a commonly used skill while driving. Future work should further examine the physiologic effects of sleep deprivation and other risk factors that may contribute to motor vehicle accidents.

INTRODUCTION:

Several studies have documented sleep deprivation as a major contributing factor for motor vehicle accidents [1, 3, 4]. These studies specifically focus on chronic sleep deprivation secondary to obstructive sleep apnea and have demonstrated a higher risk of accidents in patients with the condition [5]. However, there is limited literature examining the effects of acute sleep deprivation. Among those that do exist, there is an increased risk of lane departures and speed deviations in those with sleep deprivation.

Therefore, this study investigates the effect of total sleep deprivation for a night on parameters that affect daily performance. This includes reaction time, which is linked to reflexes during driving and sports [6], as well as verbal and number memory, which affect daily performance through educational activities and the recollection of information. These parameters comprise the majority of skills used during daily life and thus can be used as a proxy to measure an overall change in daily functioning.

MATERIALS AND METHODS:

40 subjects across ages 16 - 40 years old volunteered to participate in the study. The subjects were split into four distinct age groups (teenagers, 20-year-olds, 30-year-olds, and 40-year-olds). Reaction time, number memory, and verbal memory were tested through the "Human Benchmark" website [7] before and after total sleep deprivation for a night.

On this website, reaction time was tested by the amount of time needed to respond to a stimulus (a change in screen color) while number memory was judged by the number of consecutive numbers recalled. Verbal memory was judged by identifying a word that the participant had been previously shown. To eliminate bias, the subjects were tested on the same device at the same time of the day

To determine the significance of the results, first, the results for reaction time, verbal memory, and number memory following adequate sleep were used to calculate the mean and standard deviation. Using a paired z-test, the average results for each parameter after sleep deprivation were compared to the results before sleep deprivation.

RESULTS:

1. Reaction Time
   Reaction time showed a significant increase across all age groups after sleep deprivation ($p = .002$). Overall, teenagers were the most affected, demonstrating around a 36.67% increase in average reaction time. 20-year-olds showed a 34.34% increase, 30-year-olds showed a 20.33% increase, and 40-year-olds showed a 36.14% increase. On average,

reaction time increased by 31.87% after sleep deprivation.

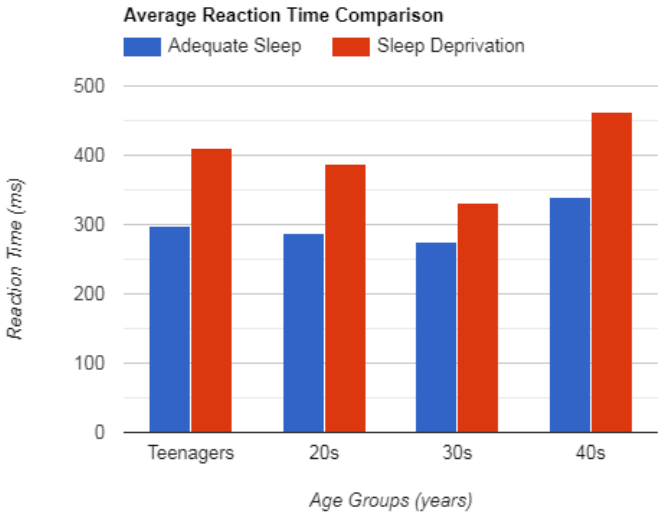

Figure 1. Reaction time before and after sleep deprivation

0. Verbal Memory

There was a significant decrease in verbal memory across all age groups ($p = .038$). Subjects in their 40s seem to be the most affected, with a 75.56% decrease. Teenagers showed a 26.47% decrease, 20-year-olds showed a 23.08% decrease, and 30-year-olds showed a 25.53% decrease. Overall, there was a 37.66% decrease in verbal memory across all age groups.

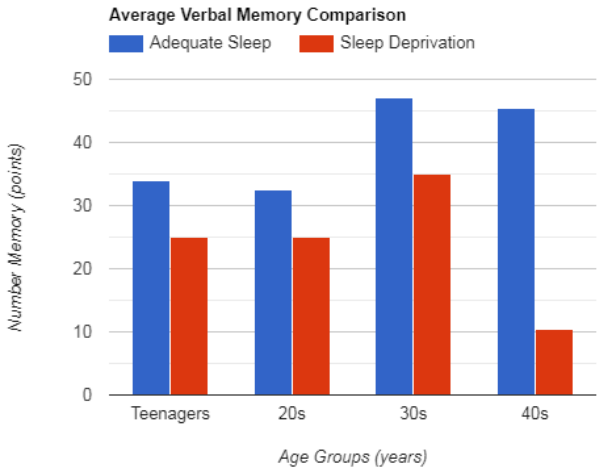

Figure 2. Average verbal memory before and after sleep deprivation

0. Number Memory

Though there is a decrease across all age groups, the results are not significant ($p = 0.34$). Teenagers showed a 15% decrease, 20-year-olds showed a 6.25% decrease, 30-year-olds

showed a 10% decrease, and 40-year-olds showed a 13.64% decrease. Overall, there was a 11.22% decrease in verbal memory after sleep deprivation across all age groups.

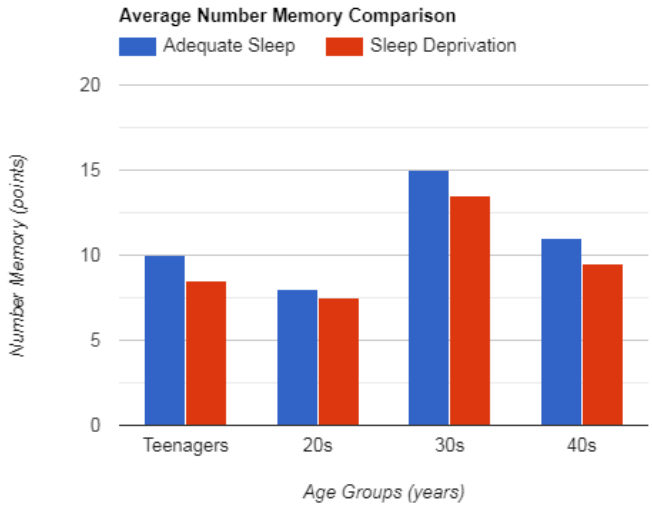

Figure 3. Number Memory before and after sleep deprivation

DISCUSSION:

Ultimately, the 40 participants included in this study showed a significant increase in reaction time and a significant decrease in verbal memory after sleep deprivation. While there was an overall decrease in number memory, the results were not significant. The increase in reaction time was most pronounced among teenagers and the decrease in verbal memory was most pronounced among subjects in their 40s. Such findings suggest that sleep is necessary for everyday functioning.

The pronounced increase in reaction time for teenagers can be linked to reaction time differences between adolescents and adults. Research has shown that, when evaluating risky traffic decisions, adults responded to such situations faster than adolescents [8]. Similarly, subjects in their 40s showed a noticeable decrease in verbal memory, which can be attributed to a sharp decline in memory and cognitive function with increasing age [9].

For these reasons, adequate sleep is essential for a healthy life. Sleep has two dimensions: quality and quantity [10]. Both factors are critical in maintaining a healthy life and to function optimally during the day. While there is no clear consensus on the time period needed for quality sleep, guidelines from the National Sleep Foundation recommend around 10 hours for children between 3 - 13 years-old, 9 hours for teenagers, and at least 8 hours for adults over a 24-hour period [11].

Additionally, the results of this study show an increase in reaction time to a stimulus across all age groups. Reaction time is an essential component of adjusting to challenges faced while driving, including decision-making during risky traffic decisions [8]. Additionally, there was a significant overall decrease in verbal memory, establishing a correlation to decreased cognitive function and the recollection/absorption of information [12]. While the effect of sleep deprivation on number memory was not significant, there was an overall decrease, suggesting a functional, rather than statistical, decline.

This research in this study, however, is subject to certain limitations. Statistical association was shown between sleep deprivation and reaction time/verbal memory, but causation cannot be proven. Additionally, the connection in this study between sleep deprivation and driving was made based on an online test, which are not necessarily connected to each other. Further studies should be conducted with a larger number of subjects and across a wider age group.
Overall, the findings from this study have important implications for drivers across all age groups. This study introduces a need for awareness on the effects of sleep deprivation, especially in teenagers and aging adults, and can hopefully be used to encourage a healthier sleep schedule.

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Cardiovascular Screening For Childhood Cancer Survivors

ABSTRACT:

Childhood cancer survivors are at increased risk of developing long-term cardiovascular complications due to different therapies received for cancer treatment. Regular cardiovascular screening is recommended for these survivors to diagnose early and prevent potential cardiac complications. This review article has explored the effectiveness of cardiovascular screening in childhood cancer survivors for detecting and preventing long-term cardiovascular complications. The review found cardiovascular screening effectively identifies potential complications, such as hypertension, high cholesterol, and impaired glucose tolerance. However, there is limited evidence on whether screening can prevent long-term cardiovascular disease. Childhood cancer survivors should receive regular cardiovascular screening, and clinicians should work with

survivors to develop personalized preventive measures to reduce the risk of long-term cardiovascular disease.

INTRODUCTION:

Some chemotherapy drugs and radiation therapy used to treat childhood cancers like leukemia (ALL and AML), lymphoma (Hodgkin and non-Hodgkin), brain and spinal cord tumors, neuroblastoma, Wilms tumor, and sarcomas can be cardiotoxic. Examples of such drugs include anthracyclines (e.g., doxorubicin), platinum-based chemotherapy drugs (e.g., cisplatin), and tyrosine kinase inhibitors (e.g., imatinib). Childhood cancer survivors (CCS) are at an increased risk of developing cardiovascular disease later in life due to these cancer treatments. According to Oeffinger et al. (2006), up to 73% of CCS experience at least one chronic health condition, including cardiovascular disease, in their lifetime [1]. Therefore, regular cardiovascular screening is recommended for CCS to mitigate this risk. The exact screening guidelines may vary depending on the individual survivor's age, cancer type, and treatments received [2]. Some general screening guidelines for CCS include annual blood pressure checks, lipid profile testing, and echocardiogram or other imaging studies to assess heart function [3]. Early detection and prevention through cardiovascular screening have significant potential benefits because they may allow clinicians to implement preventive measures, such as lifestyle changes and medication, to reduce the risk of long-term cardiovascular disease [4].

This review aims to assess the efficacy of cardiovascular screening in CCS for detecting and preventing long-term cardiovascular complications. This data can be used to educate healthcare providers and survivors about the importance of cardiovascular screening and the potential benefits of early detection and prevention.

MATERIALS AND METHODOLOGY: The research on "Cardiovascular screening for childhood cancer survivors" was conducted by reviewing published studies, reviews, and clinical guidelines obtained from databases such as ScienceDirect, PubMed, and Google Scholar. The research question was defined as "How effective is cardiovascular screening for childhood cancer survivors?" and specific search terms such as "cardiac complications" and "childhood cancer survivors" were used. Fifteen articles were obtained and evaluated based on value criteria, originality, timelines, and relevance to the research question.

The articles' discussions, conclusions, and recommendations were analyzed to identify a research gap and compare the results relevant to the study. The final results were recorded in the results section. The research methodology used in the studies focused on chronic health conditions and cardiac outcomes in CCS. The studies' well-presented results qualified them to be used in the research, and they offered valuable insights into the effectiveness of cardiovascular screening for CCS.

RESULTS:

A total of nine articles were found using the methods described above. The general trends were that CCS have an increased risk of developing chronic conditions, which could lead to early death. Therefore, the general recommendations were that CCS are to be screened annually using cardiomyopathy surveillance interventions to detect and monitor potential cardiovascular complications. In addition, the studies suggest monitoring, managing, and preventing long-term cardiovascular toxicity in young adults.

DISCUSSION:

Oeffinger *et al.* (2006) and Oeffinger *et al.* (2004) suggested that adult survivors of childhood cancer had an increased risk of developing various chronic conditions, including cardiovascular, psychological disorders, and musculoskeletal, and pulmonary diseases [1,6]. The studies also identified CCS had a greater susceptibility to premature mortality due to chronic conditions.

The findings from the articles by Mulrooney *et al.* (2016), Lipshultz *et al.*(2013), and Chow *et al.* (2015) suggest that survivors of childhood cancer had a higher likelihood of developing impaired cardiac function, arrhythmias, and conduction disorders, which could persist for many years even after treatment, necessitating the continuous monitoring[2,4,7].

The results from the articles by Armenian *et al.* (2015) and Armstrong *et al*. (2013) recommend particular cardiomyopathy surveillance interventions, including routine physical examinations, imaging studies, and laboratory tests for CCS[3,5]. Lastly, Armenian *et al.*(2015*)* recommend that CCS be given specific education and counseling to increase their awareness on the condition and help them manage it[3].

The findings from Hudson *et al.* (2013) further reinforced the fact that adult survivors of childhood cancer are prone to developing chronic conditions, cognitive and physical impairments, and reproductive health issues[8]. According to Mertens *et al.* (2008), "Among the CCSS cohort, 2821 (13.8%) 5-year survivors had died by the end of the follow-up period. The cause of death was obtained for 2534 individuals, with 57.5% of deaths attributed to recurrent disease"[9].

The literature review suggests that screening for cardiovascular complications is a practical approach to detecting and monitoring such issues in CCS, which can aid clinical practice. Routine screening is essential for identifying potential problems, and survivors should seek medical care regularly to detect any potential disorders that may affect their quality of life. Additionally, providing psychosocial follow-up care may help reduce the risks of long-term complications.

However, the limited available literature means that the review's findings are constrained. Additionally, most of the studies were observational, which only partially indicates the causes and effects of the problem. Therefore, further research is necessary to examine this clinical issue and develop a patient-centric approach to care that improves the survivors' quality of life. The research should use an appropriate methodology in conducting comprehensive studies. Ultimately, the findings can be applied to other research and clinical practice areas, such as screening high-risk populations for cardiac complications and providing psychosocial follow-up care for various patient groups.

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Expectations of an Electrocardiograph Technician

ABSTRACT:
This paper, through the use of research and background knowledge of the anatomical positions of the heart, highlights the importance of electrocardiograph (EKG) technicians and their specific roles and responsibilities to correctly perform tests that analyze the electrical impulses and state of a patient's heart.

Keywords: electrical, electrocardiograph, heart, patient

Expectations of an Electrocardiograph Technician

Providing quality healthcare to patients requires countless interactions, diagnoses, tests, and services every single day. Electrocardiographic technicians, as part of a patient's healthcare professional team, play a significant role by discovering electrical impulses of a patient's heart, using electrocardiography. This is one of the most critical diagnostic tools used by healthcare professionals in providing patients a detailed overview of any activity, whether good or bad, that is occurring inside their heart. This paper details the description, requirements, day-to-day life, science, reasons for conducting an EKG test, additional diagnostic tests, how to become a certified EKG technician, job opportunities, and the rights of EKG technicians. EKG technicians are a vital aspect of the healthcare setting and their roles and responsibilities are unique and designed to provide quality healthcare.

Description of an EKG Technician

An electrocardiograph technician (also known as an EKG tech or CET) is a healthcare professional who operates electrocardiograph machinery, typically during diagnostic tests or surgical procedures, to obtain the electrical impulses of a patient's heart and analyze it (Watson 2021). EKG techs are important to determine a patient's health since they are recording every small action the heart is making. If an EKG technician notices something wrong it is fairly easy and conclusive for a physician to diagnose the patient and get them started on treatment.

Requirements of an EKG Technician

An EKG technician must possess a variety of skills to perform successfully. It is imperative that an EKG technician is skilled with technology, able to use computers, and advanced EKG equipment to ensure equipment is always up and running. It will be very difficult for doctors to completely know how a patient's heart is functioning without an EKG tech that knows how to operate the advanced technological equipment. EKG techs must also have lots of stamina and be able to work in a fast-paced environment, since they tend to be moving from

patient-to-patient and set up the machine multiple times to record the patient's heartbeat without any room for errors. Another vital characteristic of an EKG tech is to be empathetic with patients and have the patience to soothe them through the EKG monitoring process in a way that prevents panic. Attention to detail is a crucial, necessary asset for an EKG technician to acquire. Each of the little waves and dips signify an essential rhythm and electrical impulse of the heart. Failure to recognize a miniscule detail in a patient's electrocardiograph can be fatal.

Day-to-day life of an EKG Technician

Every day, EKG technicians are expected to set up the machinery, confirms that the machinery is operating correctly, guide a patient through the diagnostic exam and/or stress test, record the heart waves of the patient, analyze the results, and interact with the patient and their physicians regarding the results (Swain 2018). While the actual job of an EKG tech is not highly stressful, the environment and conditions of patients in their surroundings is complex and taxing, which is why EKG technicians must be focused and grounded every day at work to ensure that patient results are completely accurate.

Scientific Aspects of Being an Electrocardiograph Technician

Science of Taking an EKG

Taking an EKG of the heart is a non-invasive procedure that involves placing electrodes, or electrical conductors, on to a patient (Watson 2021). These specific electrodes have small, sticky patches and are typically attached to each limb of the patient and across their chest wall, since these locations are where electrical impulses are used to make the heart beat and push blood to the body. After the placement of the electrodes, the EKG machine records the timing and strength of these electrical impulses as they move throughout the heart (Watson 2021). While recording the impulses, quick waves are shown across the screen, or printed on to paper. These waves determine how well a patient's heart is operating. The small wave in the beginning of the sequence is referred to as a "P wave" which represents the electricity from the upper chambers, or atria, of the heart as the electricity moves down to the lower chambers (Watson 2021). The next wave in the sequence is the "QRS" wave which records the speed and strength of the electricity when in the ventricles, or bottom chambers, of the heart (Watson 2021). The last wave, known as a "T wave" represents the heart as it recovers. These three waves shown in an EKG precisely depict how electricity is moving throughout the body, providing healthcare professionals with knowledge on what is happening inside their patient's body and reasoning as to why.

Why an EKG is Conducted

EKG technicians perform electrocardiographs on patients with a variety of issues. Doctors may refer patients to an EKG tech if they are having tachycardia or bradycardia, an irregular heart rhythm heard through a stethoscope, potential damage to the heart after a heart attack, poor blood flow to the heart due to blocked or narrowing arteries, symptoms of an abnormal heart rhythm (known as arrhythmia), palpitations of the heart, or any symptoms associated with poor heart health such as chest pain, shortness of breath, fatigue, hard time exercising, and constant dizziness (Watson 2021). Each of these heart conditions can be confirmed through looking at an EKG and potential reasons why they are occurring can also be concluded by looking at the electrical activity of the heart, explaining why an EKG test is a highly used diagnostic tool to further improve the treatment of our patients.

Additional Diagnostic Tests and Tools Utilized

In addition to the standard EKG, where electrodes record the electrical activity of the heart, EKG technicians perform multiple other tests and experiments to determine whether a patient's heart is functioning properly. EKG technicians conduct stress tests, where an electrocardiograph monitor is used to record a patient's baseline heart rate and blood pressure both before and during exercise to see if there are certain circumstances, like heavy physical activity, where the heart is susceptible to struggle (Swain 2018). Scientists have also invented a new way of listening to the heart, called an Audicor biomarker. This new technological device, which is designed to be a mix of electrocardiography and phonocardiography, where the left ventricle is enlarged to be able to clearly hear the heart, giving doctors a cost-efficient, confident way of diagnosing patients with heart failure (Vijayasimha 2017). Holter monitoring is another popular test used by EKG technicians. Holter monitoring, unlike an EKG, records a patient's heartbeat for at least 24 hours (Dinsmoor 2018). Patients wear these monitors while performing daily duties, typically being worn around the waist or over the shoulder, while the monitor continues to record and save the electrical activity of the heart, so healthcare professionals have easy access for their patient's vital signs.

How to Become a Certified Electrocardiograph Technician

EKG Certification

The State of Texas requires the following from an aspiring EKG technician to officially become certified: high school diploma or a GED, a successful completion of an EKG training course, conduct at least 10 EKGs, and pass the EKG tech exam with a score of 80 or above. This certification needs to be renewed every two years with the technician gaining experience and passing the certification test again.

Job Opportunities for EKG Technicians

EKG technicians tend to work in many healthcare settings, due to their job of quickly determining whether a patient's heart is functioning properly. EKG technicians can work in a doctor's office, an outpatient clinic (where patients do not have to stay overnight, like urgent care clinics, primary care clinics, and community health centers), in a hospital's surgical unit or cardio unit, and/or labs (Watson 2021). Each of these places requires a skilled EKG technician that is able to swiftly determine if a patient's heart needs a specific treatment or if it can withstand treatment plans. EKG technicians can also choose to advance to different healthcare positions, such as a medical lab technician who uses medical equipment to interpret fluids and tissue samples, since their analytical skills from looking at electrocardiographs would help them thrive in fast-paced, perceptive careers.

Rights of an EKG Technician

EKG technicians are tasked to perform an electrocardiograph and properly relay results to both patients and their healthcare providers, while following the Healthcare Insurance Portability and Accountability Act. EKG techs have the right to provide a summary of the results to the patient's cardiologist or physician (Watson 2021), who can then talk to their patient about next steps or a conclusive diagnosis. EKG techs also have the right to immediately contact staff members for further action if they see a potentially life-threatening result on the EKG, since any amount of time wasted is time for the patient to further deteriorate.

On a daily basis, EKG technicians perform a numerous amount of tests and show a wide range of skills. Without their knowledge on how to correctly operate machinery, analyze results,

and relay information accurately, healthcare professionals would not be able to confidently diagnose and treat a patient with heart issues. It is evident that EKG technicians, based on their unique roles and responsibilities, are a vital part of healthcare and determine the exact state of the heart, helping physicians provide quality healthcare.

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INTRODUCTION:

Calciphylaxis is a rare kidney disease characterized by calcifying blood arterioles and capillaries in the dermis and subcutaneous tissue. Throughout this literature review, Calciphylaxis, as well as its different components and effects, will be thoroughly explored to form a better understanding of the disease and its prevention and treatment.

METHODS:

To research this rare disease, a variety of sources were utilized, including PubMed, the database of the National Institute of Medicine, the open access publisher MDPI, as well as a thorough analysis of independent research articles written by medical professionals and the academic community. Research paper publication dates were narrowed down to the last year to maximize the currentness and reliability of the information and access to the full text so a full content analysis could be made. Keywords when searching for relevant articles included: “Calciphylaxis”, “Calciphylaxis symptoms”, “Calciphylaxis surgery”, “Calciphylaxis treatment”, and “Calcinosis Cutis calciphylaxis”.

RESULTS:

Calciphylaxis manifests as a severe dermatological condition as well as through thrombosis of the subcutaneous microcirculation and abnormal quantities of different blood components. It is also referred to as “calcific uremic arteriolopathy”, and is commonly seen in patients diagnosed with end-stage renal failure and those on dialysis. Although too rare to diagnose certain demographics as having a higher risk of the disease, it is prevalently seen in Caucasian women and those with obesity.

Symptoms

Calciphylaxis is typically prominent in patients who already have other severe kidney issues, so there may be several symptoms that overlap between pre-existing conditions. A few symptoms of calciphylaxis include:

Skin lesions- Calciphylaxis causes painful purple skin lesions to emerge. These lesions can molt or blister, and often rapidly progress to open skin sores or ulcers. The sensitive nature of these lesions means that infection can easily occur, and worsen the situation.

Skin necrosis- Calciphylaxis can also result in dead skin tissue (skin necrosis), which will form black, scaly patches on the skin. Skin necrosis has a quick onset and the effects may worsen on an hourly basis, although it can be treated with surgery or antibiotics.

Ischemic ulcers- Arterial ulcers or Ischemic ulcers can start to form on the skin as a result of calciphylaxis and are slow-healing wounds that are a result of poor blood flow to the lower extremities, therefore ischemic wounds typically appear on the legs and feet. The lack of oxygen can cause tissue to become damaged or even die, necessitating skin therapy treatment and wound care.

Calciphylaxis not only results in dermatological and cardiological conditions, but can also cause sudden weight loss as

Diagnosis

Diagnoses are usually made when these symptoms are observed. Still, a proper diagnosis also consists of a blood test, in which parathyroid hormone and calcium x phosphate product levels are often increased.

Treatment

There is currently no approved treatment for calciphylaxis, as it is a very rare condition and it has a high morbidity rate, estimated to be a 50 percent chance of 6-month survival. The best care for this disease is wound treatment (properly treating skin lesions and necrosis), analgesia, and reducing exposure to risk factors, as well as maintaining a healthy quality of life. That being said, several medications are used to either treat Calciphylaxis directly or to attempt to reduce the symptoms of other underlying diseases. These treatments include corticosteroids, iron therapy, and Warfarin.

How Calciphylaxis Arises

Although Calciphylaxis is usually seen in patients with end-stage renal failure, it has been observed in patients with little to no renal failure. Since it is a rare disorder, there is not adequate research to determine causes and prevention, but there are certain situations where it has consistently arisen according to research studies.

Post-Surgery Calciphylaxis Onslaught

Kidney transplant:

Calciphylaxis has been observed to develop after certain conditions of kidney transplantation surgeries, according to the Clinical Kidney Journal. The paper stated that after a review of international literature and data search over the past 50 years, it was shown that Calciphylaxis was developed in patients who had a long dialysis vintage (over 24 months) and had moderate graft dysfunction. The research suggests that Calciphylaxis may appear as a result of uraemic-related risk factors, or even other underlying issues caused by re-transplantations. Additionally, skin lesions were peripheral in this cohort, contrasting with the hemodialysis cohort, whose skin lesions were concentrated on.

Common Comorbidities:

As calciphylaxis emerges in the late stages of a kidney disorder, it is often accompanied by kidney and liver disease, but several other comorbidities are obesity, since the additional adipose tissue can further reduce blood flow, hypoalbuminemia, as well as autoimmune disorders such as rheumatoid arthritis and lupus. Additionally, Calciphylaxis is linked to an increased risk of developing cardiovascular problems such as heart attacks or strokes.

DISCUSSION:

Calciphylaxis has presented itself as a rare life-threatening disease that impairs blood component levels, as well as internal and external health, causing a severe decrease in not only patients' quality of life but also their life expectancy. Although Calciphylaxis is most prevalent in patients with end-stage renal disease, recent studies have characterized the disease as a multifaceted etiology, including risk factors such as failed kidney transplants or

retransplantations and bariatric surgery. Understanding the risk factors of Calciphylaxis is extremely important in prevention as well as treatment, as it can give insight into the severity of the condition as well as the type of treatments or medication needed.

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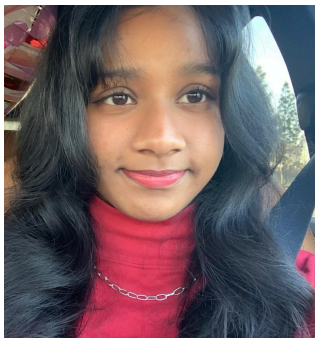

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The Effects of Processed Food on Human Health and its Relation with Cancer

ABSTRACT:

The primary purpose of this study is to evaluate and investigate the correlation of ultra-processed food with cancers. The consumption of ultra-processed foods (UPFs) is suspected to be significantly correlated with an increased risk of cancer in individuals today. After utilizing qualitative data gathered from peer-reviewed articles from PubMed, the results show that cancer was significantly correlated with the consumption of UPFs. The increased consumption of UPFs is statistically proven to be linked with causing cancers in site-specific and reproductive organs. Eating UPFs can also result in further complications in people with previous medical and mental health issues. It is recommended that to cut back on the harm the overconsumption of UPFs has done, people should invest more in locally grown nutrient-dense foods, such as fruits and nuts.

INTRODUCTION:

The development of biotechnology, such as genetically-modified organisms (GMOs) products and gene manipulation/cloning, has significantly improved the diet of human beings. Likewise, with increasing technology, there has been significant dispersion of ultra-processed foods (UPFs) targeting areas with less food production. However, the nutritional composition of UPFs is poorer. UPFs are composed of added sugars and offer less fiber as compared to whole foods. Global dietary patterns have affected the usage of food processing and the quality of the food that is produced through industrial processes. Cancer is suspected to be correlated with UPFs as cancer development rates are increasing along with the production of UPFs. Thus, the global burden of cancer is continuously rising as the incident increase is expected to cause an increase from 19.3 million individuals to 28.4 million individuals by 2040 [1]. This investigation will evaluate how processed food is correlated with the deterioration of human health and functions as they increase the incidence of cancer production.

MATERIALS AND METHODS:

The utilization of secondary resources through qualitative data research was conducted for the research through a literature review in PubMed. Keywords searched for this research paper include “UPFs”, “cancer”, “processed foods”, and “dietary patterns”. Only sources that included information about the link between UPFs and cancers were applied. Inclusion criteria were that the source had to be from at least 2018, so articles dated 2017 and before were excluded.

RESULTS:

Six sources were found in PubMed, and all were deemed authentic and peer-reviewed. All studies showed a distinct link between UPF consumption and the risk of reproductive and site-specific cancers. The studies conducted experiments, some with follow-ups, that displayed how individuals that consumed UPFs were more likely to experience a higher risk of cancer. The studies with follow-ups claimed that the risk of reproductive cancer, such as breast and ovarian cancer, significantly increased in individuals who involved UPFs in their diet.

DISCUSSION:

Chang et. al (2023) performed a cohort study to investigate how UPFs affect incidences of common site-specific cancers. They found that the hazard ratio estimator for gastrointestinal cancer was considered a borderline statistic as it significantly impacted that the comorbidities increased with the utilization of the UPF diet [1]. The consumption of highly processed foods also pointed to challenges for people who had previously had physiological and physical health issues like depression or hypertension.

A cohort study by Diallo et. al (2018) shows how individuals with UPF consumption had a higher percentage of reproductive cancer development as compared to individuals with a regular diet [2]. The UPF consumption and cancer incidence were correlated significantly out of the total of 15 nine-to-one incident cancer cases that were followed up and evaluated. The results showed how individuals that consumed processed red meat were associated with risks of breast and

prostate cancer as compared to the control groups. There is also evidence that shows how processed red meat involves carcinogenesis.

An investigation done by English et al. (2021) showed a study comprising 152 observational studies and one randomized clinical trial [3]. A total of 53 studies came from the US and included adults and older persons (aged 17–84 at baseline). The majority of studies had low to moderate risks of bias and findings were remarkably consistent across investigations. Findings revealed that increased consumption of fish, vegetables, fruits, legumes, nuts, whole grains, and unsaturated vegetable oils was related to a lower risk of all-cause mortality in the age group 17-84 years. The systemic review ultimately claimed that individuals that consumed less processed foods had a lower risk of all-cause mortality and lowered risk of developing cancer.
In a randomized controlled trial performed by Fiolet et al. (2018), the overall cancer mortality increased significantly as the breast cancer ratio increased from a 10% point increment through the subjects that consumed UPFs compared to those who did not [4]. Participants filled out a series of five questionnaires that asked about sociodemographic and lifestyle factors, anthropometry, health status, dietary intakes, and psychical activity. Every six months participants (n=104,980) were asked to complete a set of three dietary records that were distributed at random over a two-week period. The outcome ultimately showed UPF intake was associated with risk for cancers as 2,228 first-event cases of cancer were diagnosed and verified throughout a follow-up of five years, including 739 breast cancers (264 premenopausal, 475 postmenopausal), 281 prostate cancers, and 153 colorectal cancers. The diagnoses of cancer were involved with the consumption of sugary-processed foods and drinks during the initial study.

Lastly, a large prospective cohort investigation done by Dicken and Batterham (2021) indicated that the comprehensive assessment of the association of UPF consumption was related to cancer [5]. The investigation's results showed how head and neck cancer increased by a 10% ratio, breast cancer increased by 16%, and ovarian cancer was indicated to be increasing by 30% in individuals above the age of 40 along with the increased intake of UPFs. The association was estimated to be based on dual factors of socioeconomic behavior and dietary factors, in which UPFs played a very important role.

Through these findings, it is reasonable to suggest that the appropriate initial approach to this dilemma is to reduce the overuse of UPFs and increase the utilization of a GMO diet that is more advantageous and healthy and has a lower risk of cancerous development among human beings. For instance, promoting a diet of only eating locally grown foods and raising awareness around the detrimental effects of consuming processed foods are both methods that could reduce societies' dependency on processed foods. Dependence on locally produced food has drawbacks, such as countries that are not as agriculturally developed not being able to produce high yields of food, forcing developing countries to rely on UPFs made in foreign factories. One possible solution that could help alleviate this problem is developing a budget in which developing countries would receive more money for farming and appropriate biotechnological and agricultural products, such as genetically modified plants that produce at high yields and are resistant to harsh conditions, in order to enhance access to wholesome and locally grown foods.

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Behavioral Characteristics Of Brachyponera Chinensis And Impact On Native Ant Population

ABSTRACT:

Invasive species incursions can be detrimental to biodiversity and ecosystems, depending on the biology and behavior of the invader. Ants are among the most successful invasive organisms in the world. Invasive ant species invade varied environmental areas or ecosystems as a result often of human activity. The invasive ant species disrupt the natural balance within an ecosystem and compete with native ant populations for resources. *Brachyponera chinensis* (*B.*

chinensis) , also known as the Asian needle ant, is unique in its adaptive ability to invade intact forests and habitats with healthy native ant populations. Gaining knowledge regarding behavioral characteristics observed of *B. chinensis* colonizing areas of a deciduous forest in Conover, North Carolina helps to determine strategies of management. *B. chinensis* invasion was chronicled by identifying, measuring, and examining their presence in leaf litter, decaying wood, under human refuse, and rock structures. Information gained to identify behaviors of *B. chinensis* such as polydomy and the occurrence of native ant species around invasive colonies, informs current understanding in efforts to protect biodiversity.

INTRODUCTION:

Biological invasion is not only a threat to biodiversity but also leads to enormous economic and ecological costs (Wang et al., 2021; Siddiqui et al., 2021; Suehiro et al., 2017; Allen, 2017; Warren et al., 2015). Identifying traits of invasive ants that aid to facilitate establishment into new environments and successful invasions of ecosystems represents an important environmental issue (Waters et al., 2022; Allen, 2017; Murata et al., 2017). Many ant species can take advantage of the resources of a particular area by expanding out between numerous spatially separated but socially connected nests by practicing polydomy (Allen, 2017 Murata et al., 2017). Polydomy is a characteristic common to many invasive ant species. To determine if *B. chinensis* ants are polydomous, an investigation was conducted to test nest spatial organization and aggression displayed between one-on-one aggression assays for workers collected from different nests of *B. chinensis*. An individual ant was considered aggressive when showing signs of aggressive behavior, such as single or multiple bites, open mandibles, and prolonged antennation. The purpose of the current research is to identify behavioral characteristics of *B. chinensis* populations in Conover, North Carolina to determine the extent of species polydomy and impact on native ant population abundance. *B. chinensis* can possibly deplete natural resources within an ecosystem, causing a decline in native ant populations and nest sites. Furthering understanding of these traits adds to the learning of invasive organismal biology and may affect the creation of management techniques for the invasive *B. chinensis*.

RESULTS:

Observations were made of *B. chinensis* inhabiting a deciduous forest in Conover, North Carolina, over a timeframe from December 2022 to February 2023. Nest sites of all ant species were identified within the experimental plot area of 625m^2 to distinguish between native, *B. chinensis*, or other (Fig. 1). One native ant nest was observed of *Camponotus castaneus*. Four nests of *B. chinensis* were identified. No other ant species were discovered. The targeted ant species (*B. chinensis*) was first identified using its common morphological characteristics. Worker size varied from approximately 4.0 mm to 5.0 mm, the average worker size being 4.5 mm and uniformly black with brown mandibles and orange-brown legs (Fig. 2). The size of queens averaged 6.0 mm but ranging from 5.0 mm to 7.0 mm and are dark brown to black in color. Specimens were identified microscopically, and nests of the targeted species were observed to have consistent and near equal populations. The nest of the native *C. castaneus* was spatially separated from other nests identified and the population appeared healthy. The presence of *B. chinensis* colonies seemed to deter native ant populations as determined by the absence of native ants and the one spatially separate nest; *B. chinensis* observed replaced native ant populations. Workers originating from the same experimental plot, but different nest locations did not display aggression in four times four aggression assays, suggesting that *B. chinensis* are a

polydomous ant species and therefore having the benefits of efficient resource utilization and decreased extinction risk.

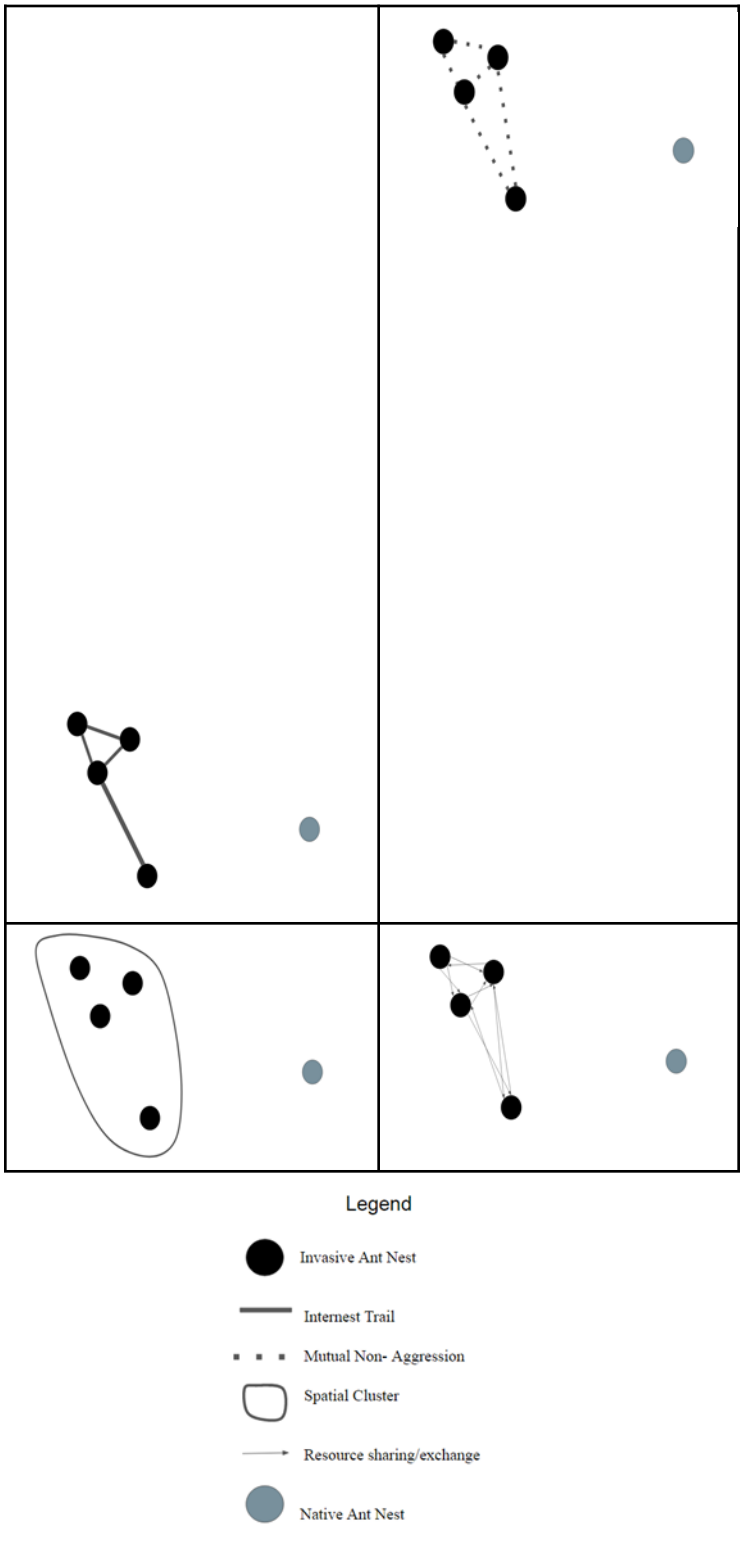

Fig. 1.

Fig. 2.

DISCUSSION:

Invasive species such as *B. chinensis* can be detrimental to biodiversity and native ecosystems, subject to the behavioral characteristics of the introduced species. Invasive ants have several common characteristics, polydomy is a characteristic common to many invasive ant species. Polydomy benefits may range from territorial dominance, to decreased predation. The multiple *B. chinensis* nests observed were connected socially. This was determined by conducting one-on-one aggression assays. The social connection between nests allowed for dispersed nest spatial arrangement to best utilize available resources and guard against extinction. These observations illuminate the polydomous behavior of *B. chinensis*. Conducting genetic testing on ants from the different nests would aid to confirm findings. The presence of invasive *B. chinensis* seems to have displaced native ant populations as illuminated by the absence of native ant nests. Information to quantify the ecological impact as a result of the displacement of native ants is lacking. Further research is needed to arrive at management solutions to guard against biodiversity loss resulting from *B. chinensis* on native ant populations.

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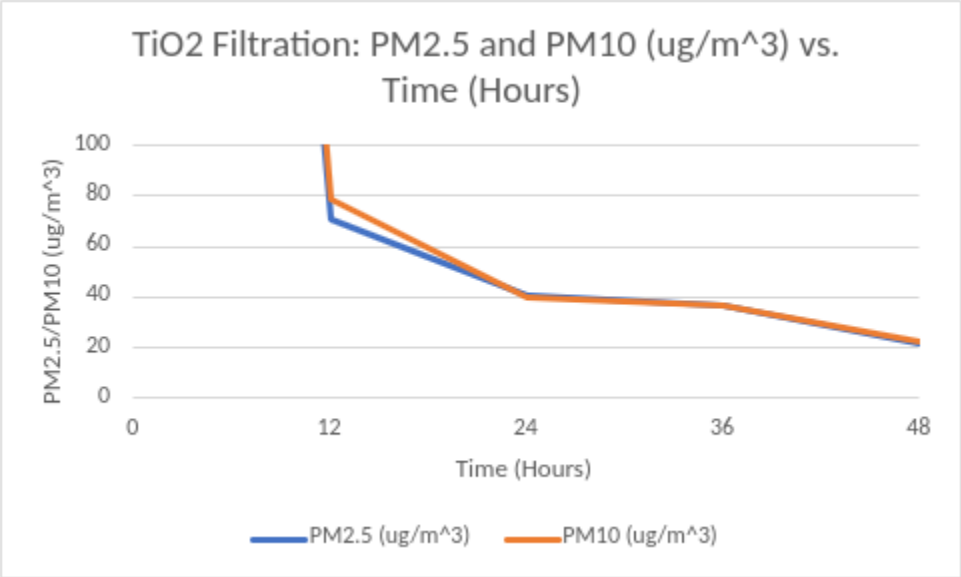

Figure 1.2 - Graph of ZnO Filtration of PM2.5 and PM10 over a 48-hour period: PM2.5 and PM10 (ug/m^3) vs. Time (Hours).

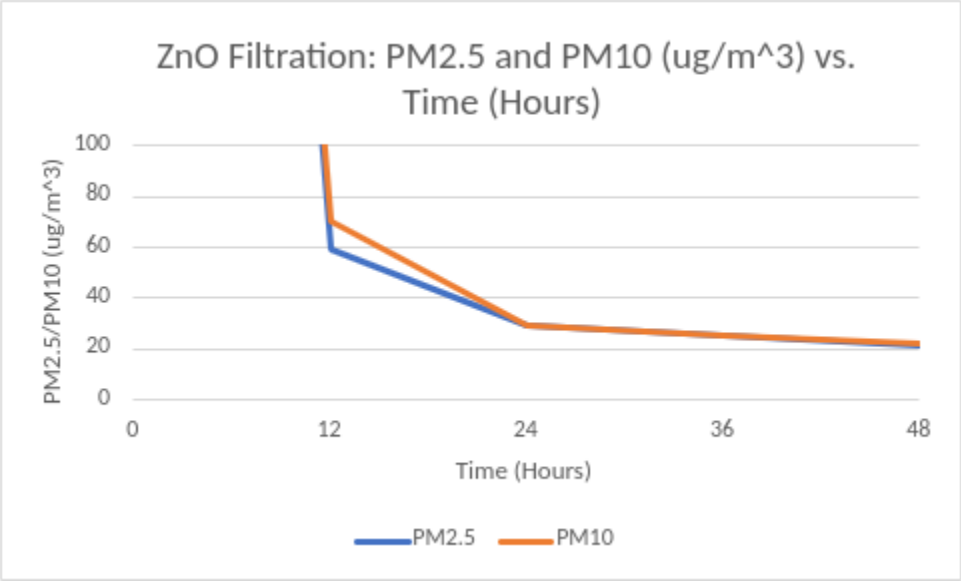

Figure 1.3 - Graph of Gelatin Filtration of PM2.5 and PM10 over a 48-hour period: PM2.5 and PM10 (ug/m^3) vs. Time (Hours).

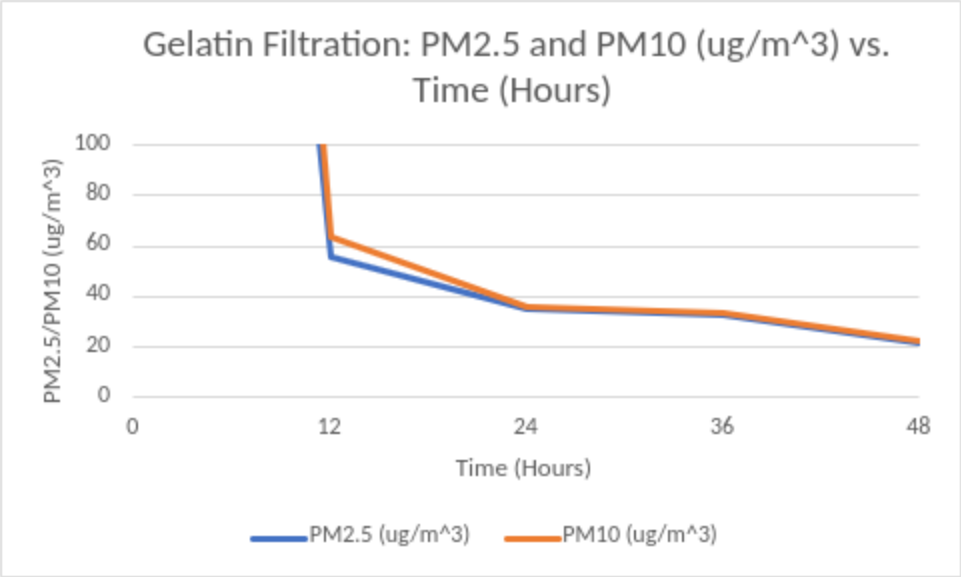

Figure 1.4 - Graph of Percentage Removal of PM2.5 and PM10 from polymers ZnO, TiO2, and Gelatin (%).

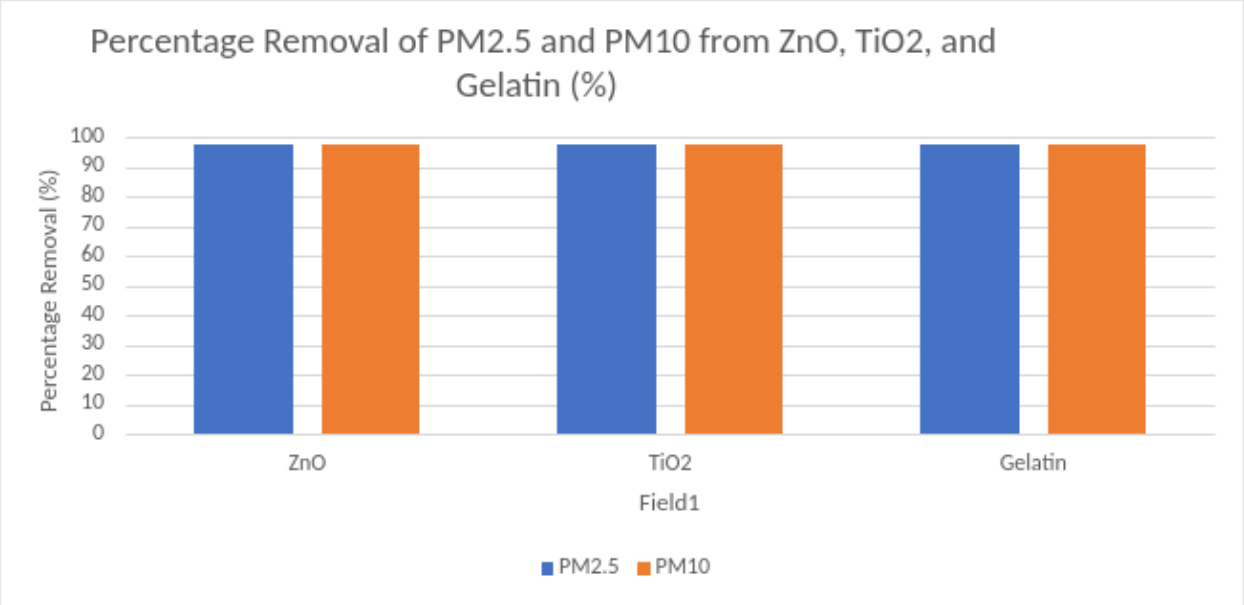

Figure 1.5 - Experimental Setup. The three containers each contain a different polymer: ZnO (left), TiO2 (middle), Gelatin (right).

Figure 1.6 - Experimental Setup. The three containers each contain one MF filter sponge soaking in the polymer.

Figure 1.7 - Experimental Setup. The airtight container contains one lit incense stick.

Figure 1.8 - Experimental Setup. The three airtight containers each contain one MF filter sponge after being soaked in a different polymer and labeled with the designated polymer: ZnO (left), TiO2 (middle), Gelatin (right).

Table 1.1 - ZnO Filtration: Table of concentrations of PM2.5 and PM10 over a 48-hour period.

Time (Hours)	PM2.5 (ug/m^3)	PM10 (ug/m^3)
0	>999.9	>999.9
12	59.3	70.6
24	29	29.5
36	25.4	25.5
48	21.1	22.1

Table 1.2 - TiO2 Filtration: Table of concentrations of PM2.5 and PM10 over a 48-hour period.

Time (Hours)	PM2.5 (ug/m^3)	PM10 (ug/m^3)
0	939.9	>999.9
12	70.5	78.5
24	40.4	40.1
36	36.5	36.8
48	21.4	22.2

Table 1.3 - Gelatin Filtration: Table of concentrations of PM2.5 and PM10 over a 48-hour period.

Time (Hours)	PM2.5 (ug/m^3)	PM10 (ug/m^3)
0	832.5	>999.9
12	55.4	63.6
24	35.5	36
36	33.1	33.3
48	21.8	22.6

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Impact Of Mental Health On Refugees

ABSTRACT:

The increasing number of internationally displaced people and asylum seekers, referred to as "refugees" in this paper, creates a rise in many health issues, including mental health. Depression, anxiety, post-traumatic stress disorder (PTSD), and other psychiatric conditions have been found in both children and adult refugees in various regions in the world. Prior studies found on the National Library of Medicine website (NCBI) were examined to conduct this analysis, and the search indicated that many refugees are not cognizant of the symptoms of mental health or do not seek care until conditions are exacerbated. A review of the literature demonstrated that refugees with mental-health issues can lead to a higher likelihood of their children showing similar symptoms. Additional assistance needs to be provided in understanding mental health and destigmatizing it.

INTRODUCTION:

The past few decades have seen a rise in the number of refugees and displaced people in the world, largely due to recent political conflicts and natural disasters taking place in countries such as Sudan, Afghanistan, and Ukraine. The United Nations High Commissioner for Refugees (UNHCR) reports that as of 2022, more than 103 million people have been forcibly displaced from their home countries—and this number is on the rise [6]. With this drastic increase in refugee populations comes significant health issues that have considerable impacts not only on refugees but on residents of host countries as well. These include communicable diseases, chronic issues, and mental health disorders [7]. This paper investigates the relation between refugees and mental health, such as post-traumatic stress disorder (PTSD), depression, and general anxiety.

Possible stressors that contribute to poor mental health include leaving home possibly for the first time, death of family members, and political unrest. Additional troubles include economic hardships, stress, and difficulty assimilating to the host country's culture. While all of these factors lead to serious mental health conditions, many hesitate to seek help because of financial instability, lack of gravity for psychological well-being, or fear of the stigma in society surrounding mental-health.

MATERIALS AND METHODS:

Analysis of several prior studies conducted with refugees in various host countries, including Australia, Turkey, and the United States was reviewed. Studies were found using the National Library of Medicine (NCBI) and Pubmed, with additional articles published by the United Nations and the United States government used for foundational knowledge. Keywords for obtaining articles include "refugee," "mental health," and "single study." The criteria for inclusion were: articles published from 2018-2023; articles primarily discussing mental health disorders; and articles demonstrating studies performed by authors.

RESULTS:

This analysis encompasses information from five publications and United Nations and US government websites. The publications all focused primarily on emotion disorders, rather than neurodegenerative or chronic mental conditions. While every study acknowledged that refugee populations do have more mental health issues, there was no conclusion on whether or not they were consistently higher than those of the respective host countries. It is also unclear if mental health conditions formed after moving to the host country or before.

DISCUSSION:

The studies revealed poor mental health conditions, including depression, PTSD, and prolonged grief in refugees, and were generally at higher rates than the population of their respective host countries.

In a study performed by Byrant et al, out of 2210 caregivers and children refugees in Australia who answered a questionnaire about their mental health, 110 caregivers and 178 children's responses were closely examined; 37% of this group reported prolonged grief disorder. Interestingly, caregivers' grief had a direct correlation to their children's mental health [1].

Other sources corroborate this data such as a self-reported questionnaire in Bhutanese refugees in the Midwestern region of the United States, given by Maleku et al. Almost 45% of the refugees report having mental health symptoms, but interestingly, 25% of the pool did not understand what negative mental health warning signs are [2].

In the refugees screened by Magwood et al, the most commonly found issues were PTSD and depression, with anxiety, trauma, and other mental health conditions also reported in considerable numbers [4]. In addition, 42% of Syrian children living as refugees in Turkey scored 19 or higher on the Depression Scale for Children, and 65% of them scored 40 or higher on the UCLA Loneliness Scale.

One study offered a contrasting perspective. Mazumdar et al conducted a data analysis in 2021 regarding hospital usage in Australia, finding that the refugee population is 17% more likely to use hospitals for specific stress disorders, such as PTSD and anxiety, but less likely than the host Australian population to use the hospital for physical health issues [3].

As shown by the data, refugees have considerable rates of mental health issues, including depression, PTSD, and loneliness. Mental health conditions in the family or community increased the chances of other relatives also showing symptoms. While Mazumdar et al did show that refugees were less likely to use hospitals for other health issues, this is likely attributed to financial barriers to access hospital resources. Additionally, the large number of people who were unsure if they had mental health symptoms suggests that refugees underutilize healthcare resources due to lack of recognition of mental health signs.

Another possible consideration is the stigma that surrounds mental health in the refugee's home country may contribute to a lack of education on mental health disorders. Because it is difficult for the United States to improve education in the refugee's home country, it is imperative that engaging courses be included in their preferred language upon arrival to the United States. However, it is not only the refugee's responsibility to understand mental health; permanent residents of the United States should also undergo mental health training so that the stigma around it is removed and everybody feels more comfortable accessing mental health resources.

Another barrier that could cause these mental health issues is a lack of cultural community in a host country, resulting in refugees feeling isolated after experiencing harrowing challenges. To improve these conditions, refugees should meet with a US resident originally of their home country who speaks the refugee's language. Refugees should also be encouraged to join cultural groups, or meet regularly with the person they met upon arrival to the United States.

This experiment was not only beneficial in understanding the relation between refugees and mental health, but also investigating the societal causes of this negative correlation. With these findings, more advocacy to create a welcoming, positive community and access to healthcare could be beneficial to providing refugees better resources to overcome these mental health conditions.

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The Impact of Sedentary Behavior on Human Health and Prevention of Sedentary Time

ABSTRACT:

The goal of this research paper is to examine the effects of sedentary behavior on human health and well-being. This is a literature review conducted by analyzing several different articles which were carefully chosen according to specific inclusion criteria. The results show the effects of prolonged sitting on cardiovascular health, mental health, obesity, and other such diseases. Furthermore, due to the decreasing amount of physical activity during work hours, sedentary behavior has become more prevalent in this technologically advanced society. These studies are aimed towards reaching proper solutions on effectively reducing sedentary behavior. This paper suggests and strongly recommends that reducing sedentary behavior and increasing physical activity levels should be a priority in order for people to live healthy and illness free lifestyles.

INTRODUCTION:

Sedentary behavior, long periods of sitting or lying down with a lack of physical activity, has become more and more common in society today. The advancements in technology are one of the main causes of people living more sedentary lives. With everyone being able to access everything at the tip of their fingers, they're experiencing a severe lack of movement. The question we introduce in this research is whether or not this increase in sedentary behavior

warrants further attention because of potential negative effects on human health? The WHO recommends at least 60 minutes of medium to vigorous exercise a day [1], but most people are not meeting that requirement on a day to day basis. This issue has become more prevalent in the past few decades with the rise of technology. The goal of this research paper is to define sedentary behavior, its negative effects on human health and how we can prevent this serious health issue from becoming more prevalent. It is important that we understand sedentary behavior, its effects and how we can solve this issue of lack of physical activity.

METHODS:

In order to find the articles for this literature review paper, the PubMed database was used. PubMed has one of the largest databases of medical and scientific research articles in the world and it is also a credible source. There were several specific keywords that were used to narrow down the list of articles in the database to be used for this research : "sedentary behavior", "cardiovascular disease", "mental health", "physical activity", "obesity", "mortality." Keep in mind that all these words were used with "sedentary behavior." Each of these words were chosen carefully in order to best fit the literature review. "Cardiovascular disease", "obesity", and "mortality" were all chosen as the goal of this paper is to discern how sedentary behavior affects each of these categories. Sedentary behavior does not only have a physical impact on the body, it also has a mental impact. That is why "mental health" was used as a keyword in this research paper. Other inclusion criteria included articles which showed correlation between sedentary behavior and its negative effects on a person's overall well being. Preferably, articles with graphs which specifically highlighted any such correlations found through their research. A total of five articles were used during the writing of this paper. Each paper was chosen based on the criteria and keywords mentioned above.

RESULTS:

All five of the articles used in this review agreed that there is an increased risk of cardiovascular disease (CVD), and other heart related problems such as coronary heart diseases (CHD) associated with prolonged periods of sedentary behavior. Another effect of sedentary behavior is that it increases the risk of insulin resistance and it also was shown to cause impaired glucose metabolism. Research has shown that in the past few decades sedentary behavior has become ubiquitous in the workplace. This increase in sedentary behavior occurred drastically over the past 5 decades and shows a decrease in occupation related energy expenditure. Detrimental effects of sedentary behavior and increased screen time include depression, anxiety, stress, and other such mental health issues. Beyond this, due to lack of Physical inactivity (PI), many adolescents are becoming obese as they are consuming more calories than they burn. Specific physical activity guidelines have been set through careful study and it requires at least 60 minutes of exercise a day . Other studies in the article show that physical activity can help reduce and or prevent the negative health effects of sedentary behavior. Overall, studies presented in this paper all seem to encourage physical activity in order to prevent obesity, CVD, and mental health problems that may be caused by prolonged periods of sedentary time.

DISCUSSION:

The study conducted by Lavie et al. (2019), investigated the effects of sedentary behavior on cardiovascular disease (CVD) risk factors and how physical exercise could have an effect of reducing such risks [1]. The findings suggest that sedentary behavior is closely associated with increased risk of CVD, such as stroke and heart failure. The results show that Physical Inactivity (PI) directly affects the ability of the cardiovascular system to function properly, thus increasing the risks of CVD. Specifically in regards to coronary heart disease and other metabolic syndromes than may occur as an effect of prolonged sedentary behavior. These results were expected as sedentary behavior promotes an unhealthy lifestyle which will cause health complications for people who adhere to such a lifestyle.

One study conducted by Bailey (2021) investigated the increase in sedentary behavior in the workplace and the impact that this increased period of inactivity has on the health of people [2]. The author points out that as society develops and becomes more modern, sedentary behavior also becomes more common. A study mentioned by the author shows that there has been a significant decrease in "occupation-related energy expenditure from 1960-2008." For example, according to one of the studies reviewed by Gonzalez-Gross and Meléndez (2013) , in the United States, there has been a significant decrease in physical activity at work over the last five decades [3]. This means that there has been an increase in sedentary time, or time spent physically inactive. Another study researched by Bailey (2021) shows that university officer workers spend "79% of their working day seated" and spend up to "9.8 hours of sitting across the total walking day." This highlights the drastic increase in sedentary behavior in the workplace over the past few decades. As Bailey (2021) and Erin Hoare et al. (2016) mention, sedentary behavior does not only have physical complications, but also mental health complications [2,4]. These mental health complications include detrimental effects on mental health by causing an increase in depression and anxiety. In this modern time, adolescents are able to access technology more and easily, thus increasing their sedentary time and decreasing their physical activity time. Both of these studies show that this will only lead to future health complications, so there must be research conducted on how to effectively reduce sedentary times in people, especially adolescents.

The studies examined by Gonzalez-Gross and Meléndez (2013) highlight an important link between increased sedentary behavior and increased obesity rates [3]. Over 25% of people currently living in America are facing the issue of obesity. According to a study done by the World Health Organization (WHO), a large percentage of adults and adolescents do not meet the recommended duration for physical activity that have been provided in the previous WHO guideline [5]. The WHO has researched this increase in sedentary behavior and provided new and improved guidelines for physical activity. These guidelines emphasize the "frequency, intensity, duration, and types of physical activity" required to obtain health benefits and greatly reduce health risks. Studies have shown that an average of 60 minutes of just moderate daily exercise can provide many benefits, but other health benefits can be achieved through more physical activity. The relationship between exposure to increased screen time and sedentary behavior is strong and the WHO recommends less screen time usage and increased physical activity. With more and more people not exercising at least 60 minutes a day, they are becoming more prone to illnesses and cardiovascular related health complications. The WHO's new guidelines put a strong emphasis on the required minimum amount of physical activity for each age group of people.

Over the last few decades, the increase in sedentary time has been growing at astonishing rates. If this continues, many people will face health complications that could have been easily prevented by simple means of exercise. Studies into prevention and awareness of sedentary behavior need to be conducted in order to stop the sedentary epidemic that the world is currently facing right now. With everything being available at the tip of our hands courtesy to our smartphones, we have become less physically active and are more inclined to spending long periods of time inactive. The only way this sedentary epidemic can be stopped is through awareness and prevention that need to occur sooner rather than later.

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Analysis Of Significant Gene Markers Found In The Hippocampus Of Individuals With Alzheimer's Disease

ABSTRACT:

Alzheimer's disease (AD) is a neurodegenerative disease that has a substantial impact on individuals' functioning and quality of life. The role of gene expression in the etiology of the disease is a rising area of investigation. In this study I conducted a secondary analysis using a dataset of genetic markers from the National Institute of Health GEO2R database to investigate the prevalence of gene expression in a sample of individuals with Alzheimer's Disease. I identified five genes with the highest percent of gene expression in individuals with Alzheimer's Disease compared to a sample of healthy controls. The purpose of this study was to identify primary genetic markers in individuals with Alzheimer's Disease and highlight the need for further research regarding the role of these particular genes in Alzheimer's Disease pathology.

INTRODUCTION:

Alzheimer's disease (AD) is a neurodegenerative disease with variable onset and presentation that impacts 6.7 million people nationally[1]. This prevalence warrants the need for further research to better understand and address the impact of the disease. In healthy individuals, the brain consists of neurons which function to transport information to muscles and organs in the body to perform certain tasks. To understand this paper's premise, it is important to understand the scientific nature of Alzheimer's disease.

Neurons' unique characteristics consist of their ability to communicate with one another, metabolize and consume high levels of oxygen, and repair themselves[2]. In Alzheimer's disease, neurons are not lost by number but rather lose their function causing significant damage to neuronal connections. Other effects of Alzheimer's disease are amyloid plaques in the brain, neurofibrillary tangles, and inflammation[2]. The etiology of this disease is unknown which is why increased research is required.

This paper focuses on the impact of Alzheimer's disease on the hippocampus. This brain region, known for its seahorse-shape, supports memory, learning, navigation, and the perception of space[3]. This region is linked to Alzheimer's disease due to memory loss being a primary feature of Alzheimer's disease.

In particular, I looked at gene expression in brain tissue of individuals with Alzheimer's disease versus healthy controls. Gene expression is the process in which the gene is used to produce end products and protein[4]. It informs us about the genes within the tissue and it can be used to diagnose diseases, such as Alzheimer's disease[5]. I will be investigating the top genetic markers of Alzheimer's disease between individuals with Alzheimer's disease and a control group. The goal of this paper is to identify the top five gene markers found in individuals with Alzheimer's disease compared to the control group.

METHODS:
GEO2R is an interactive web tool sponsored by the National Institute of Health that compares two groups in a GEO dataset in order to identify genes that are differentially expressed across experimental conditions (GEO2R). To identify the top five genetic markers, I used a bioinformatic analysis tool to conduct a secondary data analysis of publicly available dataset GSE48350. This specific dataset contains data from four brain regions, collected from 80 AD and 173 healthy brains. The data for this investigation will originate from the hippocampus in 19 AD and 43 control brains.

RESULTS:
Sample demographic characteristics can be seen in Table 1 below. Data analysis showed significant differences in specific gene expression between individuals with Alzheimer's Disease compared to Healthy Controls (Figure 1). Furthermore, Table 2 identifies functions of the genes with highest expression in the sample of individuals with Alzheimer's Disease.

Table 1. Sample Demographics

	Alzheimer's Disease (N=19)	**Healthy Control (N=43)**
Gender (% male)	52.6	53.5
Age (years)		
20-39	0	10
40-59	0	8
60-79	7	9
80+	12	16
Average Age (years)	83	62

There was a relatively even distribution between sex for both Alzheimer's Disease (52.6% male) and Healthy Control (53.5% male) samples. The average age of individuals with Alzheimer's Disease (83 years) was higher than those in the Healthy Control (62 years) sample.

Figure 1. Average Gene Expression in Individuals with Alzheimer's Disease vs. Healthy Control

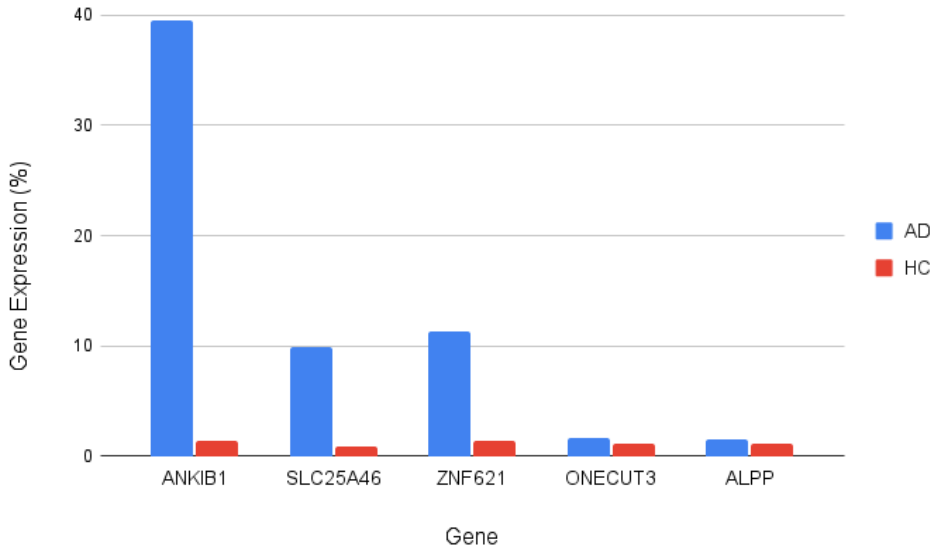

Figure 1 displays five genes with the highest percent of gene expression in individuals with Alzheimer's Disease. There was statistical significance in the percent of gene expression in the hippocampus of individuals with AD compared to healthy controls as followed: ANKIB1 ($p=4.18e^{-44}$), SLC25A46 ($p=3.63e^{-32}$), ZNF621 ($p=1.05e^{-30}$), ONECUT3 ($p=2.25e^{-14}$), and ALPP ($p=5.23e^{-13}$).

Table 2. Top Five Genes expressed in Alzheimer's Disease Patients

No.	Gene	Full Name	Function
1	ANKIB1	Ankyrin Repeat And IBR Domain Containing 1	Predicted to enable ubiquitin conjugating enzyme binding activity and ubiquitin protein ligase activity
2	SLC25A46	Solute Carrier Family 25 Member 46	Encodes a mitochondrial solute carrier protein family member
3	ZNF621	Zinc Finger Protein 621	Predicted to enable DNA-binding transcription factor activity, RNA polymerase II-specific and RNA polymerase II cis-regulatory region sequence-specific DNA binding activity
4	ONECUT3	One Cut Homeobox 3	Enables sequence-specific double-stranded DNA binding activity
5	ALPP	Alkaline Phosphatase	Protein encoded by this gene is an alkaline phosphatase, a metalloenzyme that catalyzes the hydrolysis of phosphoric acid monoesters

Reference: Gene Card: The Human Gene Database[6]

Table 2 displays the top five genes in individuals with Alzheimer's Disease and their related functions.

DISCUSSION:

Previous research shows that 10.7% of individuals above the age of 65 are diagnosed with Alzheimer's Disease nationally.[1] The prevalence of this diagnosis suggests the need to further research on the etiology of the disease. This paper investigated the significant gene markers found in individuals with Alzheimer's Disease through secondary analysis of an existing publicly available dataset (GSE48350) on the National Institute of Health's GEO2R database. The results display a higher expression of the following genes ANKIB1, SLCA46, ZNF61, ONECUT3, and ALPP (Figure 1) in individuals with Alzheimer's Disease compared to Healthy Controls, ANKIB1 showing the highest difference. ANKIB1 enables the ubiquitin conjugating enzyme which degrades protein into short peptide fragments for recycling[7]. The increase of ANKIB1 is correlated to the increase of protein degradation which could explain the brain damage displayed in individuals with Alzheimer's Disease. A next step could be investigating the specific role ANKIB1 plays in the development of Alzheimer's Disease. It is important to acknowledge the limitations of this study including the small sample size and the difference in average age between individuals with Alzheimer's Disease and the Healthy Control sample. Overall, my results support the need for further investigation of the role these five genes play in Alzheimer's Disease pathology.

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Treating Alzheimer's Through the Modification of Drugs Using Artificial Intelligence

ABSTRACT:

Background: Genome-wide association studies (GWAS), a method that helps scientists identify genes associated with a particular trait, have identified various susceptibility loci for Alzheimer's disease (AD). However, there has been limited success in utilizing GWAS and multi-omics data (the data generated from genome, proteome, transcriptome, metabolome, and epigenome) to identify high-confidence AD risk genes (ARGs) and druggable targets that can lead to the development of new therapies for AD patients.
Objective: This study aims to review and summarize the current literature on attempting to treat Alzheimer's Disease through the modification of drugs using artificial intelligence.
Methods: I searched "neuroscience", "artificial intelligence", "Alzheimer's", "drugs" in PubMed to identify relevant studies to review.
Conclusion: In the case of Alzheimer's, AI can help identify new drug candidates, predict disease progression, and optimize treatments for individual patients based on their unique genetic and lifestyle factors.

INTRODUCTION:

The use of artificial intelligence in drug discovery and development has emerged as a promising approach to identify new drug targets and optimize existing drug treatments. One application of this approach is in the treatment of Alzheimer's disease, a neurodegenerative disease that has been the focus of much research. Genome-wide association studies (GWAS) have identified

numerous genetic variants associated with Alzheimer's, but translating this genetic information into new treatments has proven challenging. However, by integrating GWAS data with multi-omics data and protein-protein interaction networks using artificial intelligence (AI) based approaches, researchers have identified new potential drug targets for Alzheimer's and repurposed existing drugs for the treatment of the disease. In particular, the use of network-based AI frameworks has allowed for the identification of high-confidence Alzheimer's risk genes and druggable targets, which can guide the development of new therapeutics for patients. This approach has opened up new avenues for drug development and personalized medicine, as researchers can now identify potential drug targets based on genetic and molecular data, and use artificial intelligence algorithms to predict the efficacy of various compounds for specific diseases. By modifying drug treatments using AI-based approaches, researchers are hopeful that they can improve outcomes for patients suffering from Alzheimer's Disease.

METHODS:

Using PubMed, I searched a vast database of published research articles related to medicine and healthcare, including studies on the modification of drugs using artificial intelligence. The search terms used included "neuroscience", "artificial intelligence", "drugs", "Alzheimer's". Once the relevant studies were identified, I compared the differences and similarities in each study. By analyzing these differences, I identified key areas where AI-based drug modification could improve the current treatments for Alzheimer's disease. Additionally, I observed how each study builds upon the previous ones, leading to an accumulation of knowledge that drives new discoveries and treatments.

RESULTS:

Fang et al. (2022) discuss an artificial intelligence-based framework that was developed to integrate multi-omics data and human protein-protein interactome networks to identify drug targets impacted by GWAS-identified variants in Alzheimer's disease (AD). The study identified 103 ARGs validated by various levels of pathobiological evidence in AD and found that pioglitazone, febuxostat, and atenolol are significantly associated with decreased risk of AD compared to matched control populations. In some experiments it was shown that pioglitazone downregulated glycogen synthase kinase 3 beta (GSK3β) and cyclin-dependent kinase (CDK5) in human microglia cells, supporting its potential mechanism of action in AD.

Cummings et al. (2022) discuss the current landscape of AD clinical trials and drug development. As of January 25, 2022, there were 143 agents in 172 clinical trials for AD, with disease-modifying therapies representing the majority of the agents in trials. The pipeline includes repurposed drugs approved for other indications, and a total of 50,575 participants are needed to fulfill recruitment requirements for all currently active clinical trials.

Battista et al. (2020) report on the results of a meta-analysis that assessed the effectiveness of machine learning when applied to neuropsychological measures for automatic classification of Alzheimer's disease (AD) patients. The analysis found that machine learning can successfully classify patients, with higher specificity as a screening tool rather than a prognostic tool. It can also extract relevant categories of neuropsychological tests that maximize the classification accuracy. Although a high level of heterogeneity was observed in the studies analyzed, the

results suggest that machine learning can be used as a useful tool in the diagnosis and screening of AD.

The three experiments provide an overview of current research and drug development efforts in the field of Alzheimer's disease. Fang et al. (2022) highlight the role of artificial intelligence in modifying existing drugs to improve their efficacy in treating AD. Cummings et al. (2022) provide an update on the number and types of agents in clinical trials for AD, with disease-modifying therapies comprising the majority of agents in the pipeline. It also notes that a significant proportion of candidate agents in the pipeline are repurposed drugs approved for other indications. Finally, Battista et al. (2020) discuss the potential of ML as a diagnostic tool for AD. By combining these findings, it becomes clear that a multi-faceted approach that incorporates AI and machine learning technologies alongside traditional drug development efforts may hold the key to effectively treating and managing Alzheimer's disease in the future.

DISCUSSION:

The introduction of artificial intelligence (AI) in neuroscience signifies a new era of understanding and treating brain-related disorders. With its ability to process and analyze vast amounts of data quickly and accurately, AI can provide insights into complex brain functions and help develop new treatments for diseases such as Alzheimer's, Parkinson's, and depression. AI can also help in predicting and diagnosing diseases at an early stage, which can lead to faster patient treatment and better patient outcomes. This is especially important in medicine, where early detection and treatment can save lives and improve the quality of life for patients. By applying machine learning algorithms to data from genome-wide association studies, researchers have already identified several potential drug targets for Alzheimer's, and have even repurposed existing drugs like pioglitazone, febuxostat, and atenolol to reduce the risk of Alzheimer's in high-risk populations.

Personalized medicine can also use AI in order to model treatment plans according to an individual's genetic and physiological makeup. It can also help in drug discovery by identifying potential targets for new drugs, reducing the time and cost involved in the drug development process. Everyone should care about the impact of AI in medicine, from healthcare providers to patients and their families as it has the potential to revolutionize healthcare, making it more effective, efficient, and accessible for everyone. With further research, it is possible that personalized drug treatments developed using artificial intelligence could become a cornerstone of Alzheimer's therapy, providing patients with more effective and targeted treatments that can significantly improve their quality of life.

CONCLUSION:

Artificial intelligence (AI) has the potential to revolutionize the medical field by providing new ways to diagnose and treat various diseases, including Alzheimer's. AI algorithms can analyze large amounts of complex medical data, including genetic information, medical images, and electronic health records, to identify patterns and develop personalized treatment plans. By analyzing large amounts of data and identifying patterns, AI can identify potential new drug targets and optimize existing drugs to better target the disease. This approach can help reduce the time and cost of drug development while also improving treatment efficacy and patient outcomes. In the case of Alzheimer's, AI can help identify new drug candidates, predict disease

progression, and optimize treatments for individual patients based on their unique genetic and lifestyle factors.

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Agricultural Problems In India

ABSTRACT:

In India there is currently a large population that is relying on rural farming and is also a huge factor for its economy. The possible problems that are talked about in this paper are the lack of education for the majority of the rural society and also the lack of connection between the retail outlet and farms because of slow transportation and lack of storage units. In this study, we conducted a literature review of agricultural issues in India and potential solutions to possibly mitigate such issues. A possible solution that was found through this literature review is that the increase of government involvement by providing subsidies for farmers will help with the

problems stated. This solution will help the rural farmers to become more aware of the new information around them and make better decisions and new marketing opportunities.

INTRODUCTION:

Approximately 58% of the population of India is reliant on agriculture as a main source of livelihood and 70% of rural households rely on agriculture, which accounts for 20% of India's GDP (Thapliyal). With such a large portion of the population relying on agriculture, there are many problems that the country of India faces annually. First, accessibility of knowledge and lack of education pose a major issue for the rural society in India. More specifically, the vast majority of the information that the rural population receives about agriculture is through the state government, with only about 41% of that information disseminated to farmers (Krishna and Naik). Additionally, the connection between the farms and the retail outlet is inefficient, in that slow transportation and lack of storage units result in a loss of profits for the small farmers (Kumar). Because farming in India contributes to the majority of its economic growth, these problems need to be solved to ensure a significant increase in India's GDP (Kumar). Therefore, this paper aims to determine methods in which to improve the lives of rural farmers in India and, ultimately, increase the country's economic growth.

Lack of accessibility to knowledge

Among the factors that cause problems for farmers in India including soil degradation, poor seed quality, and inadequate crop rotation, a lack of education is perhaps the most pressing of all of these (Thapliyal). According to Gopal Naik, a professor of Economic and Social sciences in the Indian Institute of Management, this lack of information for farmers is affecting crop growth (Naik). Naik points out that the Indian population is unaware of technological development in agriculture and notes that approximately 6% of farmers have access to extension agents and only 20% of the farmers are practicing progressive farming, people who are moving to perfection of farming with advanced technology and condition of farming (Naik). Manisha Thapliyal, a researcher at the Plant Herbal Research institute, also acknowledges the "knowledge gap" that India has compared to other countries focused on farming, especially when it comes to technology. She also notes that the invention of precision farming will increase the quality of agricultural products tremendously, but the rural farmers won't grasp the concept because of the current knowledge shortage. Thapliyal implies that the solution for this type of problem is to spread awareness of new technology for the small farmers through India to achieve results, which Naik also agrees with. Siriginidi Subba Rao, a principal researcher at the Central Leather Research institute, states that India is 72.22% rural, and in some major areas like Bihar which is 89.53% rural, there is an enormous lack of technology. This deficit is summed into 3 reasons: not being aware of technology, a lack of facilities to hold such technology, and finally the lack of education to use it (Rao). Additionally, Dr. Mukesh Kumar, a Ph.D NET in the Department of Economics at Maharshi Dayanand University, agrees that both market information and knowledge of agriculture goes hand in hand. He states "Market information (demand, production and prices) plays a vital role in the functioning of the whole market, by harmonizing the competitive marketing process." This statement provides evidence for the fact that knowledge about the market in general may play an important role in what farmers should grow to make the most amount of profit. Kumar also acknowledges that urban farmers tend to have a larger knowledge base compared to the rural farmers, which both Thapliyal and Naik agree with.

Nonetheless, Kumar focuses on a market approach, while Naik and Thapliyal want to increase the flow of information to the rural farmers.

Problems in agricultural marketing

Although knowledge about agriculture is important, so is the marketing process, which are the steps between the harvesting and the sale of the agriculture products and explaining the marketing process that leads to the success of these small farmers (Kumar). The research conducted by Dr. S. Jerome, an assistant professor in the Department of Commerce at St. Joseph's College, aims to identify the specific problems that rural farmers face (Jerome). Researchers interviewed over 100 farmers, which were split into groups: urban, semi-urban, and rural. The studies revealed that 56% of the respondents agreed with the statement that vehicle rentals are not affordable for farmers and 60% agree with the view that highway toll booth charges are too high for farmers (Jerome). Therefore, transportation clearly plays for rural farmers in India and many farmers are concerned with it. Moreover, Dr. Mukesh Kumar agrees that the lack of proper transportation in rural areas is a problem, but he also acknowledges that there is a lack in storage units across India, especially in rural villages. He notes that 15-30% of the produce is damaged each year, either by rats or rain due to the absence of proper storage facilities (Kumar). This demonstrates the importance of proper food storage and how the businesses of both the stores and the farms are affected by a lack of storage facilities in rural villages in India. Kumar implies that this is hurting the agricultural market in a negative way and he hopes to prompt governmental action to improve the conditions of rural farming and improve the Indian economy (Kumar).

Solution: government policies

Despite the lack of knowledge, transportation, and storage unit issues for the rural farmers in India, these can potentially be solved through governmental policy changes To this end, Dr. S. Jerome also asked the farmers opinions on if the government was supporting the 100 farmers (Jerome). Approximately 74% of the farmers in the study reported that the government was not supporting them (Jerome). Thus, the farmers seek the help of the government to create better opportunities in agriculture, especially in spreading knowledge. For example, India could follow in the footsteps of other countries in implementing a subsidy program. A study was conducted by the Middle East and Central Asia Department, which is run by the international monetary funds that helps with financial assistance with governments, where 22 countries in the Middle East and North Africa underwent subsidy reforms and the majority of countries yielded positive economic growth, increased communication with the rural population, and obtained a stronger presence within their government (Sdralevich). Therefore, subsidy reforms can potentially help to educate the rural farmers and improve the inefficient transportation and storage facilities, to ultimately help the rural farmers to thrive. The Indian government started to increase the amount of subsidies yearly starting from 2003. The subsidies allowed farmers to prepare for poorweather, attain storage so that they could store the food after harvest, and have easy access to the market which overall boosted the economy (Kumar). Ultimately, if India is able to implement a subsidy system, increase knowledge, and enhance technology, the country can potentially mitigate such agricultural issues and possibly help those living in poverty.

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The Effect of The Number of Drops Hydrochloric Acid on The Number of Coacervates Formed

INTRODUCTION:

The Earth's first atmosphere had little to no oxygen and was thick with water vapor, along with compounds released by volcanic eruptions, such as nitrogen and its oxides, carbon dioxide, methane, ammonia, and hydrogen (Zahnle, Schaefer, & Fegley, 2010). There was intense UV radiation, along with frequent lightning strikes and meteorite impacts on the Earth's surface (Mamatova, 2021). This input of energy caused chemical reactions capable of creating compounds based on hydrogen, carbon and nitrogen that would eventually form organic molecules (Zahnle, Schaefer, & Fegley, 2010). In the 1920's, Alexander Oparin and J.B.S Haldane predicted that life could have risen through a series of inorganic chemical reactions. They proposed that common gasses in early Earth's atmosphere combined to form simple inorganic chemicals, and that these in turn combined to form complex molecules. This hypothesis, tested by Haldane and Oparin, mixed different solutions of organic macromolecules under specific conditions in a lab eventually leading to the formation of coacervates. Coacervates are microscopic, spontaneously formed lipid molecule aggregates that may have constituted the earliest forms of life (Seal et al., 2022). They are significant because, according to the Oparin-Heldane hypothesis, they took a part in playing a major role in cell evolution. When observed, these coacervates resembled circular objects enclosed by a selectively permeable membrane (Kumar, Steele, & Wickramasinghe, 2020).

The Oparin-Heldane hypothesis eventually stimulated the experiment done by scientists Stanley Miller and Harold Urey in 1953. These two scientists tested the idea that amino acids could have risen on early earth through simple chemical reactions. Water was used as the primitive sea and was heated to evaporate into a flask with different gasses, such as methane, ammonia, and hydrogen. The chamber was then sparked, simulating the lightning storms in the early atmosphere. The resulting gas was then collected and condensed into a liquid. Once observed, Miller and Urey found that the water had turned a foggy brown (Kumar, Steele, & Wickramasinghe, 2020). The objective of their investigation was to decipher if organic molecules needed for life could be formed from inorganic components. Since then, this experiment has been replicated many times.

This study aims to test the reproducibility of the Miller-Urey model using gum arabic, a carbohydrate molecule, and gelatin, a protein macromolecule. The purpose of this experiment was to study the origin of life and to determine if coacervates could be formed in a similar setting to that of Miller and Urey. Collectively, it was hypothesized that if the pH levels of the solution increased, then the amount of coacervates formed would also increase, because the more acidic a solution is the more coacervates should form. Ultimately, this relates to the underlying question of how life on earth first originated and if inorganic chemicals were the basis of the complex molecules being studied today.

MATERIALS AND METHODS:

For this experiment, the materials used include: the gum arabic solution, a capped tube of gelatin solution, five microscope slides, five coverslips, a pipet, 0.1 M hydrochloric acid, pH paper, a graduated cylinder, and a microscope.

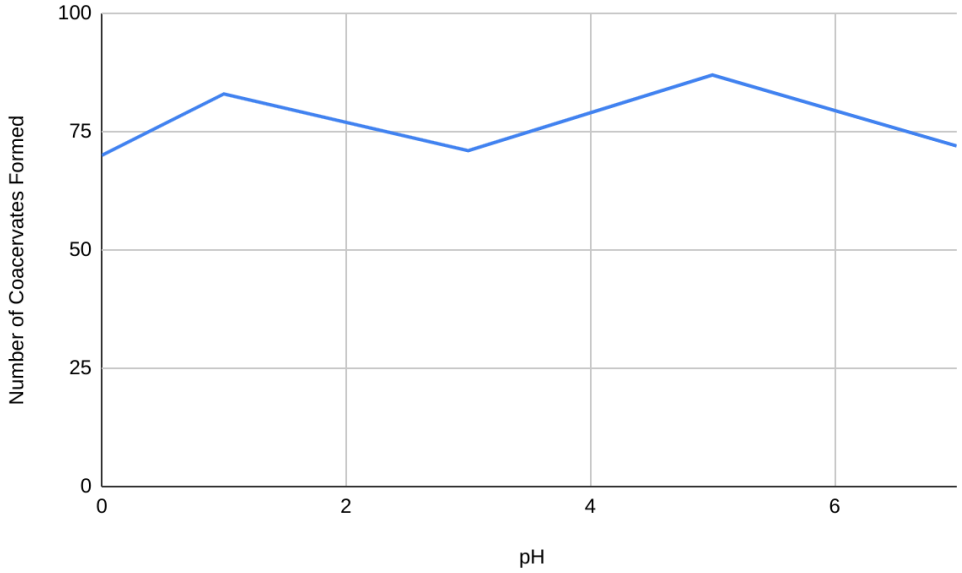
To prepare the control sample, 4 mL of the gum arabic solution was measured in the graduated cylinder. Once measured, the gum arabic solution was poured into the glass tube with the gelatin, and inverted to mix. After the fluid was properly inverted and mixed, observations were made. Next, the pH of the solution was found by taking the pipet and dipping it into the mixture, and then touching the pipet to the pH paper. Once the pH paper dried, the pH of the

solution was recorded. Then, 2 drops of the solution were dropped onto a microscope slide and a coverslip was placed on top. Once the microscope slide was properly prepared, the slide was observed and examined at 40x power. While observing the microscope slide, the number of coacervates was counted and recorded.

To gradually increase pH of the solution, 1 drop of 0.1 M hydrochloric acid was added to the glass tube and inverted to mix the solution. After that, the pH was measured and the solution was once again observed under the microscope. The number of coacervates in the new mixture was recorded. I then proceed to increase the pH by adding 2 drops of 0.1 M hydrochloric acid to the tube. The solution was properly inverted and mixed, the pH was measured, and the number of coacervates was recorded by observation under a microscope. This process was repeated two more times.

DATA AND RESULTS:

Graph 1: The Effect of pH on Number of Coacervates Formed



Graph 1 depicts how the varying pH levels on the pH scale affected the number of coacervates formed when observed under a microscope. This can be seen numerically in Table 1, column 4: number of coacervates formed.

Table 1: The Effect of the Number of Drops of HCl added on the Number of Coacervates Formed.

Number of drops HCl added	pH	[H]	Number of coacervates formed	Observation of solution
0	5	10^8	70 (medium)	Cloudy, floated to the top
1	4.5	10^-8	83 (tiny)	Cloudy, bubbles
3	5	10^8	74 (tiny)	Foggy
5	5.5	10^-9	87 (tiny)	Almost opaque, consistent

7	5.5	10^-9	72 (medium)	Bubbles, semi cloudy

Table 1 shows the results of our experiment including the number of coacervates formed and the observation of the solution with varying amounts of HCl.

Sample Calculations:
pH=-log[H]
10^-pH

H=10^-5mol/ mL
* expressed in mol/L
H=$\frac{[10^{-5}]}{1000}$
$H = 10^{-8}$

As seen in Graph 1, the independent variable is the pH level and the dependent variable is the number of coacervates that formed. The control group was the original solution that had zero drops of HCl added to it, and throughout the experiment this was what was used as a standard of comparison. Furthermore, the constant in this experiment was the drops of HCl being added to the mixture. Throughout the experiment this was the only solution being added to the mixture and what varied was the number of drops that were added. This experiment was replicated a total of 5 times to gain more reliability in the results.

When comparing the control to sample 1, there was a significant increase in coacervates formed, showing that as the pH level decreased, the number of coacervates increased. However, Graph 1 shows that regardless of the pH level, the number of coacervates vary. This varied data may be due to human error and possible inaccurate observations of the formed coacervates under microscope. Using the formula pH=-log[H], H can be isolated to represent the molar ion concentration.

DISCUSSION:

Throughout this experiment, coacervates were generated from a solution of gum arabic and gelatin. We learned that these aggregates were made up of organic macromolecules with selectively permeable membranes that may be found in living organisms. It was hypothesized that if the pH levels increase, then the amount of coacervates formed would also increase because the more acidic a solution is, the more coacervates should form. The data collected does not support the hypothesis because the amount of coacervates formed varied, even though the pH levels increased consistently. In some cases, it was observed that as the pH decreased, the number of coacervates increased. The human error in the experiment consisted of not mixing the solution completely. Another human error was that each set (set consists of change in pH) of coacervates were only counted once. The suggestions for improvement reside within the errors. The gum arabic and gelatin solution should've been mixed better and more thoroughly. Instead of inverting the tube only two or three times, it should have been mixed well enough so that the gum arabic and gelatin were thoroughly combined. Another suggestion for improvement is that each coacervate slide should've been counted three times instead of one. Since it was only counted once, there is a possibility that the data collected is incorrect. By having more

observations of the same slide, the accuracy of the data could have been improved. Some questions that can signal further investigations could be what would happen if there were more drops of HCl added to the gelatin. Additionally, what would happen to the HCl drops and the gelatin heated before and after being mixed together?

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What Demographic Of Students Are Most Likely To Voluntarily Visit A School Psychologist?

ABSTRACT:
There is a growing mental health epidemic in the adolescent population. There are certain demographic groups more at risk for mental disorders than others. Research has shown adolescents need mental health support from professionals. One such professional that has shown to have a positive outcome are school psychologists. The goal of this study is to investigate what demographic of students is most likely to voluntarily visit a school psychologist. A thirteen question survey collecting demographic information and willingness to go to a school psychologist was administered to a random sample of about 400 students. The form received 213 student responses at which point it was closed. Results were analyzed by finding how much percent of each demographic were willing to go to a school psychologist. This study showed that out of the full student population that was surveyed 48% of students were willing to go to a school psychologist. The study also found that certain demographics (ex: freshmen, black, pansexual, etc.) are more likely and others (ex: male, questioning, etc) are least likely to voluntarily go to a school psychologist. This study also found that an overwhelming majority of students would not go to a school counselor yet a lot of them would go to a school psychologist. Findings like these clearly outline the importance of school psychologists. Past research has shown that there are certain groups more at risk for mental health issues than others, this study investigates whether those demographic of students would willingly go to a school psychologist. One of the implications of this study findings is to help school boards to decide how much resources to allocate to school psychologists. This study was only conducted at one school and may need to be replicated at other schools with larger and more diverse sample sizes as well in order to get more generalizable results.

INTRODUCTION:
There is a rising issue of mental health disorders within the teen population. To cite the CDC, “more than 1 in 3 high school students had experienced persistent feelings of sadness or hopelessness” and “approximately 1 in 6 youth reported making a suicide plan in the past year”(CDC, 2023). This issue is one that must be addressed in order to both save lives and ensure the success of Gen Z (born 1995 - 2010*)*. Schools, being the place where teens spend most of their waking hours, can be a big contributor to the mental health of their students. Schools can have both a negative and positive impact on their students’ mental health. Many students who need help, do not get the mental health resources that they need for many reasons. So in order to help their students one thing that schools can implement is a school psychologist that can help the students who need it the most. However, the question is, who needs it most? That is the question this research study hopes to answer, asking: **What demographic of students are most likely to voluntarily visit a school psychologist?**

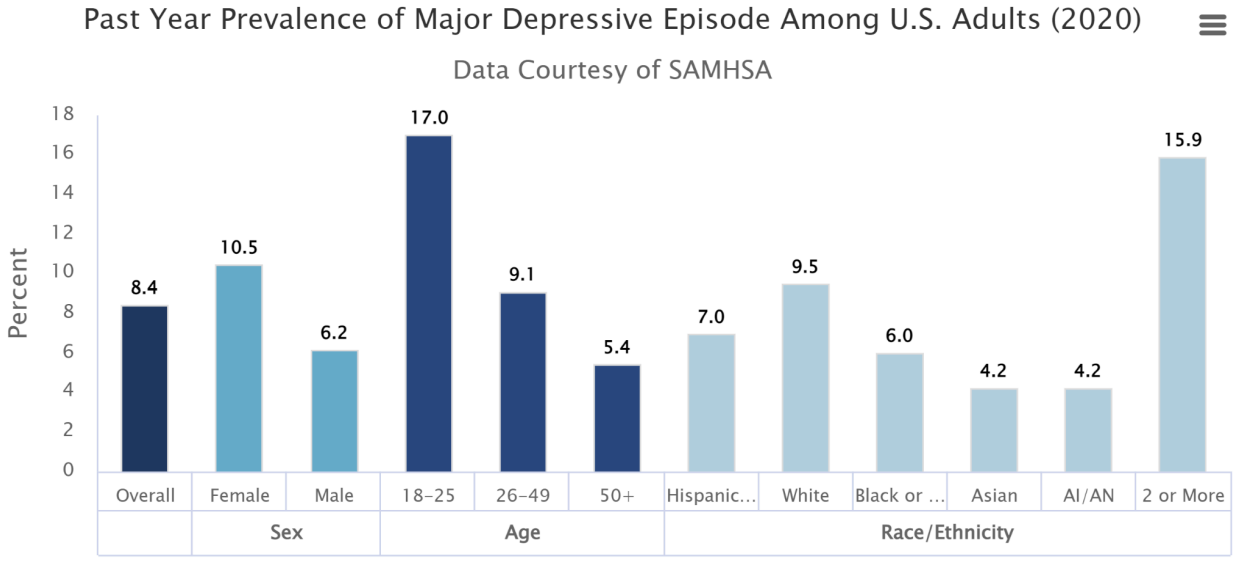
LITERATURE REVIEW:
POV 1: Certain demographic groups are more mentally at risk than others

A recent study (*Major Depression*, n.d.) conducted by SAMHSA (Substance Abuse and Mental Health Services Administration), a government run state agency, showed the demographic of people with major depressive disorder (graph shown below). The section of this study that is most important to this research study was the one with adolescents and the prevalence of Major Depressive Episodes. The information was obtained through a survey. The questions "were adapted from the depression module in the National Comorbidity Survey Replication (NCS-R)". They took into account their gender, age, and race/ethnicity. It showed

that the prevalence of major depressive episodes "was higher among adolescent females (25.2%) compared to males (9.2%)" and was "highest among adolescents reporting two or more races (29.9%)". The data also reported that major depressive disorder was most prevalent in adolescents aged 16-17. They made a categorical bar graph from this data. The study was taken from a random sample of teens both living in households and group quarters. The study did not take into account people who have no fixed address. This may slightly alter results because it takes mental hospitals out of the picture. This source leaves a lot of gaps to be researched. Primarily, the only demographics they proposed were age, gender, and race/ethnicity. The study did not take into account other factors such as sexual orientation, socio-economic status, immigration status, and more. These are all factors that affect adolescent mental health. The study, while providing good information, only shows that there is a problem and leaves a gap in proposing possible solutions. The study shows what demographic of adolescents have the issue. This research fills this gap by finding what demographic of students would be more likely to accept a form of solution through a school psychologist.

Figure 1: Shows how prevalent major depressive episodes are within different demographic groups for adolescents (data collected by SAMHSA) (*Major Depression*, n.d.)

This 2021 article ("Breaking the Cycle of Silence Around Black Mental Health," 2021) starts off by giving a case study of a shooting that happened in a middle school playground, followed by the discussion that happened in the therapy session afterwards. The kids felt like they didn't need the therapy because "nobody died". The article states that "the normalization of trauma is far too common among black youth" and this is because "one in every three black children in the United States has been exposed to two to eight adverse childhood experiences". Even though this is the case, black individuals (especially youth) are less likely to receive mental health support. Schools can play a huge role in helping these youth, yet much of the time the school does not even have enough funding or resources for adequate school counselors or psychologists. If they do have sufficient resources, oftentimes black students are discriminated against on the basis of race. The article then discussed how it's important to teach black students emotional awareness so they feel more comfortable talking about their feelings with a trusted adult. There are many non-profits that already provide services in economically disadvantaged schools to marginalized communities. Then the article talks about how "schools can't do it alone" and how it's important to provide this support outside of school as well. This article provides a prime example of how certain demographic groups are more marginalized and mental health compromised than others. Although the article implies that many of these black students



would benefit from therapy the author does not cite any sources saying that school psychologists would be beneficial to these students nor does it talk about any sources that would show whether or not these black students would go to therapy on a voluntary basis.

This 2015 academic paper ("Multiyear Study Investigates Stress in IB and AP Students", 2015) is a meta-analysis study that talks about the mental health of AP and IB students. The authors discuss how since these students do so well in school they are overlooked when looking for "at-risk" groups. A study done in 2004 highlighted that " the higher pressure academic environment produced increased levels of stress, caused increased mental health problems and reduced happiness, fewer friendships, and disengagement from school". This inspired the authors of this article to start a curriculum of teaching healthy coping mechanisms. They proposed that having interventions would be helpful to students. This source shows how some students may be overlooked and yet still need mental health resources. My study looks at students like this (for example those who take AP classes). This source states the issue but does not propose a specific solution. Through my research I hope to find if implementing a school psychologist is something that these AP and IB students are willing to take advantage of.

POV 2: School Psychologist fill important roles

This study (national association of school psychologists, 2021) is a meta-analysis study taken by the national association of school psychologists, a credible professional organization. It describes a list of ways school psychologists improve student and school outcomes. These improvements are measured in studies through improvement in academic performance, decrease in dropout rate, decrease in aggressive behavior and much more. The article starts with the author describing what school psychologists do stating that "School psychologists work with students, educators, and families to support the academic achievement, positive behavior, and mental wellness of all students, especially those who struggle with barriers to learning" . Then the article gives five categories in which school psychologists help students including: "Improved Instruction and Learning, Supporting Healthy, Successful Students, Creating Safe, Positive School Climates and Strengthening Family–School Partnerships' '. This information argues just how essential school psychologists are in maintaining a healthy and happy school environment. This study outlines many studies proving that school psychologists help students. What is not mentioned in this study is what type of students these school psychologists help and who would benefit from them the most. It also does not take into account whether students would visit a school psychologist on a voluntary basis.

This article (School psychologist vs. school counselor: Which career is your calling? [Infographic], 2022) published by the University of Massachusetts, compares school psychologists with school counselors. This source very clearly states the difference between school counselors and school psychologists which in turn highlights the need for both school counselors and school psychologists. This source also highlights how school psychologists only work with kids that have diagnosed mental health problems. It states both school counselors and school psychologists work with students in schools helping them reach their greatest potential. Given this, they both fill very different roles. While school counselors work with everyone, school psychologists "serve students who may qualify for special services, identifying issues holding them back from success". School psychologists do things such as "administering psychological tests, helping develop individualized education plans, and collaborating with

teachers on behavior modification techniques". School counselors on the other hand "counsel students regarding personal,social or behavioral problems, prepare students for future educational and professional endeavors, discuss students' progress with parents and teachers". This shows that there is a difference between the two professionals. Although there are many studies out there describing whether or not students would take advantage of a school counselor there are not many studies outlining whether students would voluntarily visit a school psychologist. Since my study focuses on school psychologists instead of counselors, it fills that gap in academic research.

This study (Auger et al., 2018) is an observational study that investigated "students' attitude towards school counselors". More specifically, it focuses on what barriers and stigma stops students from reaching out for help from school counselors. This study used the survey method and surveyed 3,584 students from 11 different schools. The study is structured to include demographic information such as student race/ethnicity, gender and age how it impacts willingness to seek help. It is also structured to find the reasons behind why students are hesitant to seek help from school counselors. It finds 3 main barriers including lack of trust that counselors would maintain confidentiality, fear of judgment from peers and feeling that the counselor is a stranger. The study also found weather demographic differences made a difference in willingness to seek counseling from school counselors. It turned out that minority students and older adolescents were less likely to seek help from school counselors. While this study focuses on the attitude of students towards seeking help from school counselors and why, it does not talk anything about school psychologists. It is known that both school counselors and school psychologists have very distinct and important roles to play. School counselors help all the students at school with both academic as well as emotional needs, but school psychologists are more focused on comprehensive mental health care services to specific sets of students who are struggling.

MATERIALS AND METHODS:

Rationale

It is widely established that adolescents are most at risk for mental health disorders (*Major Depression*, n.d.). Having prior background knowledge in the adolescent mental health crisis, I researched a possible solution in the form of a school psychologist. To get a more thorough background into this field I researched past research papers in this field. Key phrases I used when searching for research papers were "school psychologists", "mental health compromised demographics", "demographics and willingness to see a school counselor", "adolescents seeking mental health support" and more. I analyzed for credibility by finding where the source came from and the author. If the source came from a reputable journal or established health organization I deemed it credible enough to use. To check for relevance I made sure none of the sources were written before the year 2000. This study analyzed whether or not students would voluntarily visit a school psychologist, by definition, voluntary means done by one's own choice. In order to find what demographic of students are most likely to visit school psychologists I used a survey. Whether or not students would use a school psychologist is an opinion question and therefore I felt that the survey method would be the best approach to answering this question.

Creating survey

Using my research question I created survey questions. I took into account different demographics which would play a role in whether or not students would voluntarily seek help from a school psychologist. The demographics I chose were grade level, ethnicity, sexuality, gender, religion, immigration status, political leaning, diagnosed mental health disorders and number of AP classes. For many of these demographics I found studies that supported that some groups were more mental health marginalized than others. A demographic factor I would have liked to add was socio-economic status. I did not add this because as a high school student I had no means to get this information. I also surveyed how mentally supported students currently felt, and if school counselors are meeting their mental health needs. I did this by asking whether or not they felt supported mentally and educationally at our school, if they felt like they could talk through their mental health issues with their school counselors and whether or not they had someone to talk about their mental health issues with. Lastly, the final question I asked was whether or not these students would visit a school psychologist. Then I submitted an application to get approval from my IRB.

Using an administrative software called "Google Forms" I made a google form with the consent forms and questions. I programmed the form in a way that if students chose the minor option they were led to the minor consent forms and if they chose the adult option they were led to the adult consent forms. The questions were then asked in the following format.

1. What grade are you in?
A) Freshman
B) Sophomore
C) Junior
D) Senior

2. What's your ethnicity
A) White
B) Hispanic/Latino
C) Black
D) Asian
E) Multicultural
F) Native American
G) Pacific Islander
H) Middle Eastern
I) Other…

3. What sexuality do you identify with?
A) Straight
B) Lesbian
C) Gay
D) Bisexual
E) Pansexual
F) Queer
G) On the Asexual/Aromantic scale
H) Questioning

4. What gender do you identify with?
A) Female
B) Male
C) Non-Binary
D) Gender Fluid
E) Transgender
F) Other…

5. What's your religion?
A) Christianity
B) Islam
C) Judaism
D) Hinduism
E) Buddhism
F) Non-Religious
G) Other…

6. Are you or your parents immigrants?
A) I'm am a first generation immigrant
B) My parent/s are immigrant/s
C) Neither my parent nor I am an immigrant
D) Other…

7. What is your political leaning?
A) Republican
B) Democratic
C) Independent party
D) None/ I don't know
E) Other…

8. Do you have a diagnosed mental health disorder?
A) Yes
B) No
C) Other…

9. How many AP classes do you take?
A) 0
B) 1
C) 2
D) 3
E) 4
F) 5
G) 6
H) 7
I) Other…

10. Do you feel mentally and educationally supported at this school?
A) Yes
B) No

11. Do you feel like you can work through your mental health issues with your school counselor?
A) Yes
B) No

12. Do you have someone you can truly talk about all your mental health issues with?
A) Yes
B) No

13. If available to anyone would you go to a school psychologist (therapist)?
A) Yes

No

Sampling methods

I decided to only survey the students who attend Mcneil High School, which is a public school. In order to get a random sample of all the students at my high school I used simple random sampling. Simple random sampling is when an experimenter picks a random sample of people from a full population. To obtain a list of the full population (all the students that go to Mcneil High School) I emailed the yearbook teacher, who had a full numbered list of all the students that attend McNeil High School. In the email I clearly outlined my study, confidentiality policies, and why I needed the list. Then, to pick a random sample from the full population I used a random number generator. I picked out a random sample of 400 students. This gave me a good sample size, giving me enough room for attrition rate.

Data Collection

From the list of 400 students, I grouped students by their eighth period class and went to their classes (if they didn't have an eighth period I would go to their fourth period class during my off-period). During my visit I informed both the adults and minors of my study. I asked if they would like to fill out a 7 minute survey on whether or not they would visit a school psychologist. Adults were asked to fill out the survey on my computer. For the minors I informed them that there is a google form in their email and asked them to fill out the form at home after getting parental consent. Going in person and informing the students of the survey reduced the bias of students who don't check their school email.

Three weeks after sending out the form I closed it to respondents. I received 213 responses to my survey. This was a good amount of people to get unbiased results and enough people to be able to analyze data.

RESULTS AND DATA ANALYSIS:

Overall, about 48% (n=213) of students said they would go to a school psychologist and about 52% of students said that they would not voluntarily visit a school psychologist.

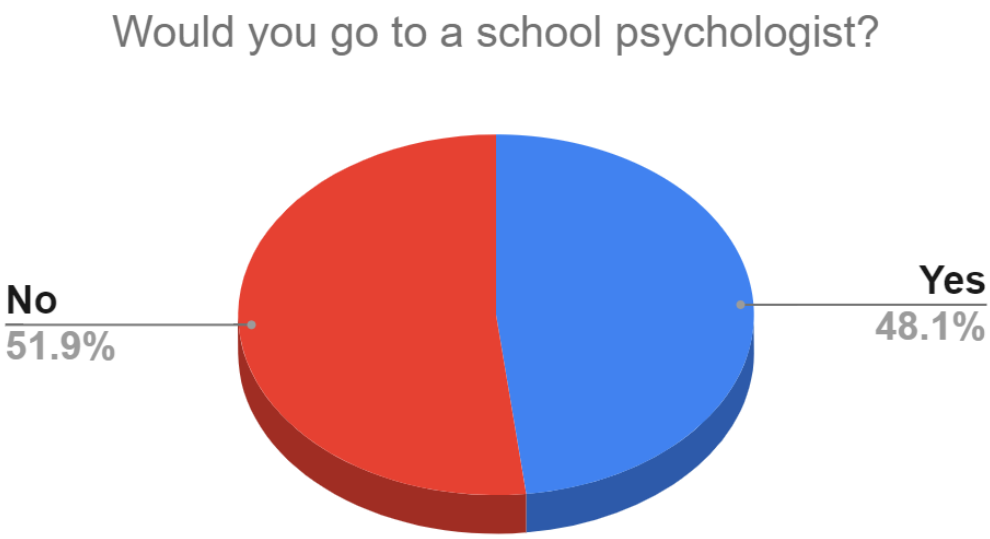


Figure 2a

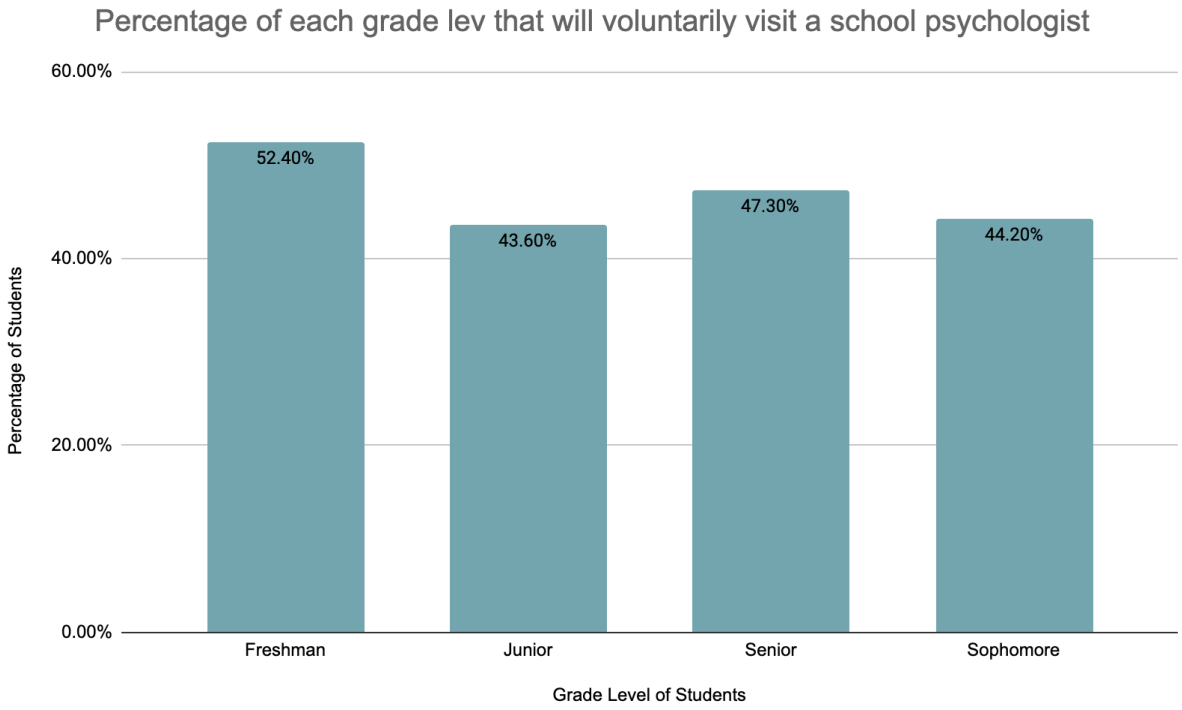


Figure 2b

52% of freshmen (n=48), 42% seniors (n=58), 47% of sophomores (n=53) and 45% of juniors (n=54) would go to a school psychologist if offered to them. Freshmen are most likely to go to a

school psychologist. While freshmen seem to be a bit more willing then the rest of the grade levels, all grade levels showed a generally similar interest in going to a school psychologist.

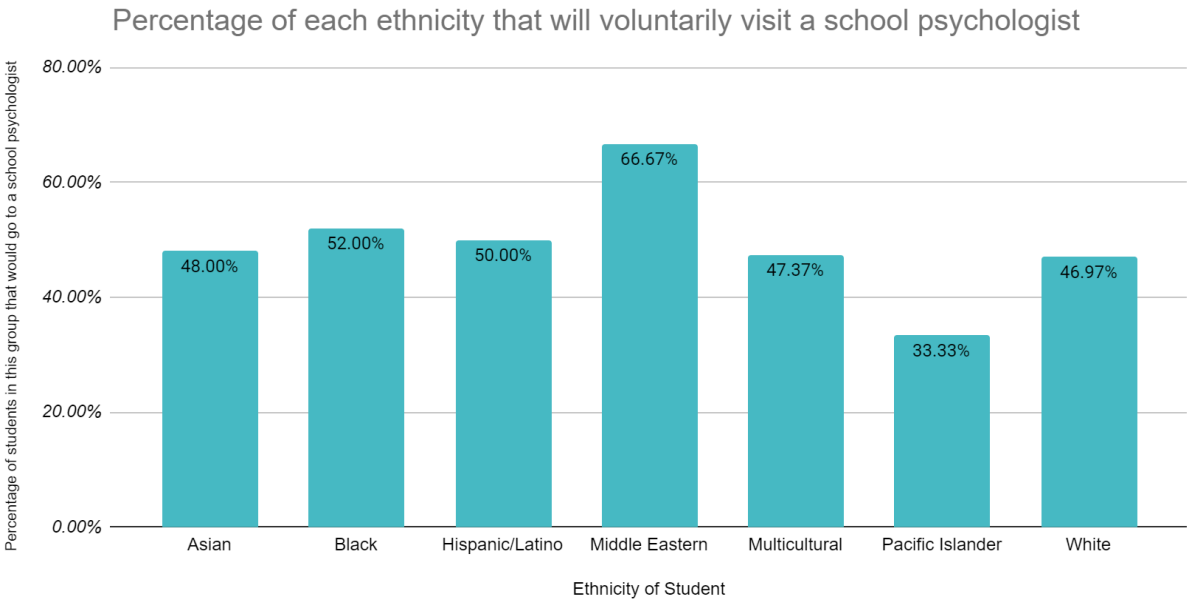
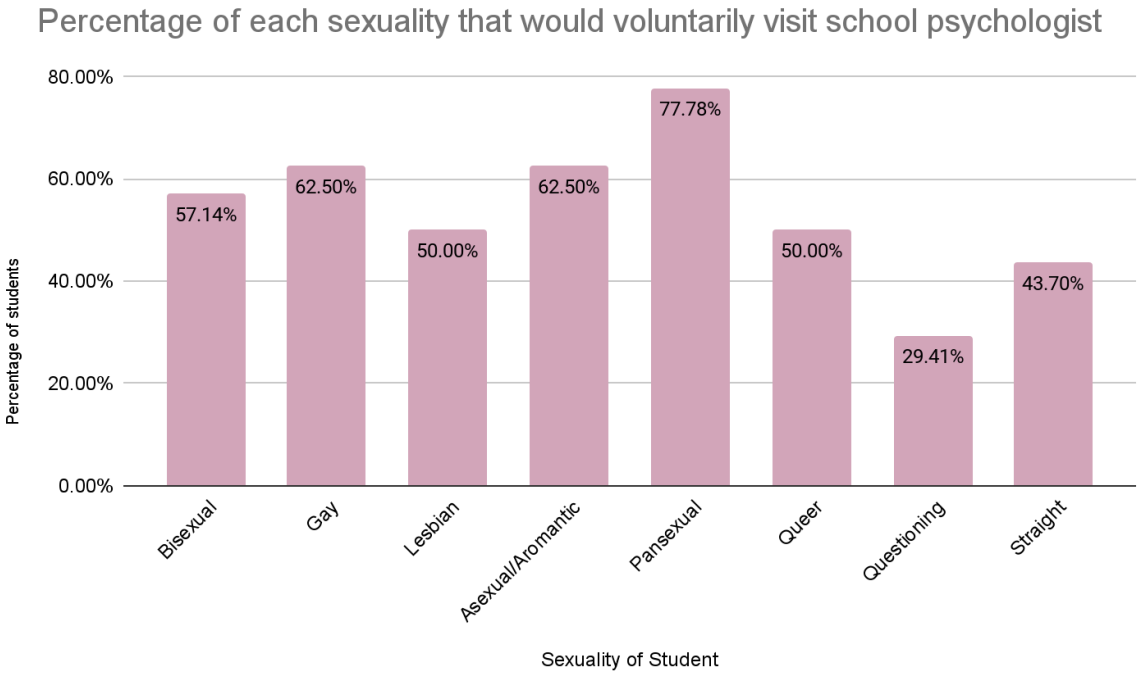


Figure 3

Looking at the graph above, there does not seem to be much of a difference in the percentage of students of different ethnicities to visit a school psychologist. There were less than 4 middle eastern and pacific islander students which is why they seem like outliers in the graph, therefore they don't have enough people in the sample to be counted as a significant result.



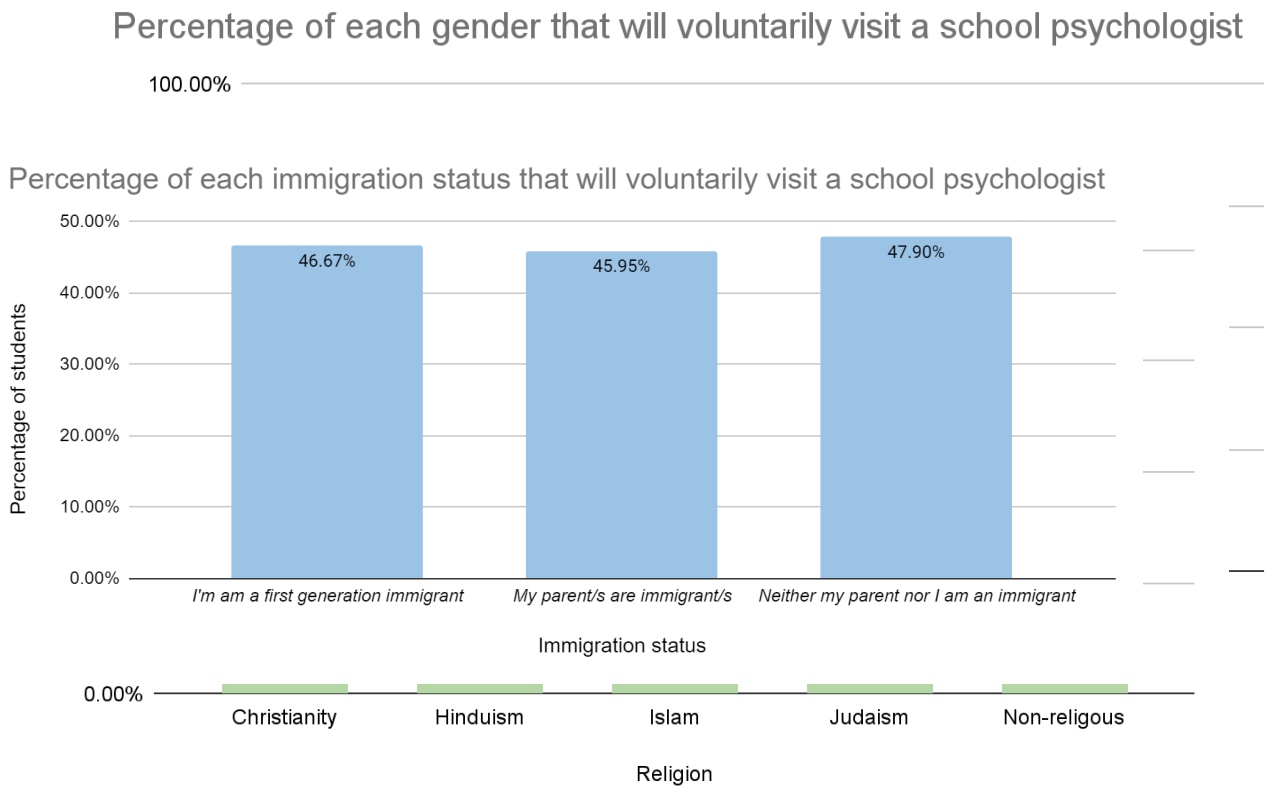


Figure 4
Questioning people seem least likely and pansexual people seem the most likely to voluntarily visit a school psychologist. The difference in interest to visit a school psychologist between the different sexualities is high. This may lead to show that sexuality may have an influence on whether or not students would visit a school psychologist.

Figure 1

Figure 5
51% of females (n=130), 60% of gender fluid (n=5), 33% of males (n=65), 66% of non-binary (n=6) and 85% of transgender (n=7) said that they would voluntarily visit a school psychologist. Agenderous genders (transgender, non-binary, gender fluid) seem the most likely to visit a school psychologist. Out of cisgendered people more females seem willing to visit a school psychologist as compared to males. This difference can be explained by psychological research that states that while women usually turn to others when presented with stress, men turn inward (Taylor, 2006).

Figure 6
About 44% of christian students (n=90), 47% of non-religious students (n=70), 36% of hindu students (n=24), 75% of Jewish students(n=4), and 50% of muslim students (n=8) are willing to visit a school psychologist. There were other religions that students have put down but because there were not enough students for those religions (less than four students per religion) it was not included in the data analysis.
Figure 7

About 47% of people who are first generation immigrants (n=17), 46% people whose parents are immigrants (n=75) and 48% of people who neither themselves nor their parents are immigrants (n=121) are willing to visit a school psychologist. There is not much difference between the three groups, leading me to conclude that students' immigration status does not have much correlation with weather or not they would voluntarily visit a school psychologist.

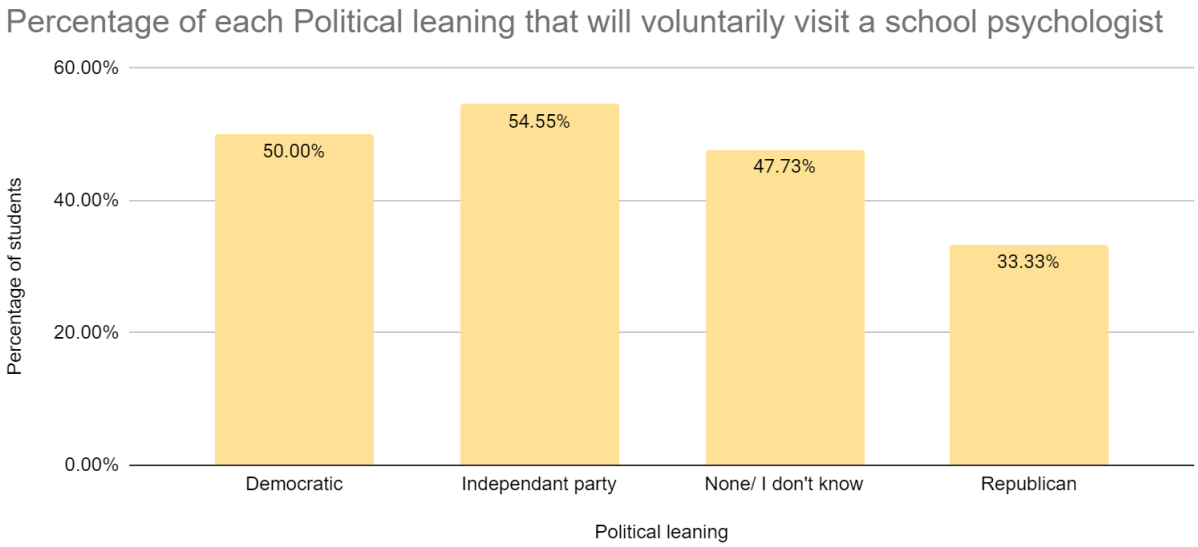


Figure 8

About 50% of democrat students (n=91), 55% of independent party students (n=11), 33% of republican students (n=15), 60% of leftist students (n=5) and 48% of undecided students (n=88) would voluntarily visit a school psychologist. While students with republican views seem to be a bit less willing than the rest of the students, the students leaning towards other political parties (independent, none, democratic) showed a generally similar interest in going to a school psychologist.

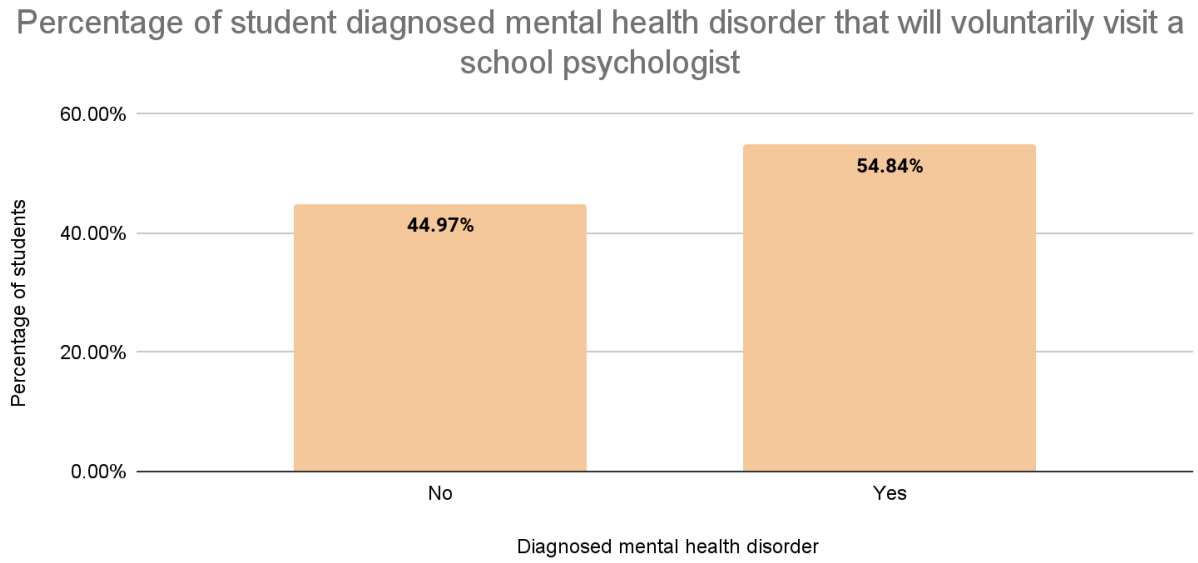


Figure 9
About 55% of people who have a diagnosed mental health disorder (n=62) and 45% of people who don't have a mental health disorder (n=151) would go to a school psychologist on a voluntary basis.

In my opinion, the "number of AP classes" question was worded in a complicated way resulting in a lot of people not being able to interpret the meaning of the question correctly. Given the data it is hard to draw a correlation between AP classes and willingness to visit a school psychologist.

When the survey was taken, results showed that 56% of all respondents did not feel mentally and educationally supported at this school. 45% of those who didn't feel supported and 52% of those that did feel supported would voluntarily visit a school psychologist. This may show that if students don't trust the schools resources in the first place they are less likely to trust school psychologists

When asked, an overwhelming majority of 84% of students said they do not feel like they can work through their mental health issues with their school counselor. Out of those students who do not feel comfortable with talking to a school counselor, 46% are willing to go to a school psychologist. For those students who do feel like they can go to their school counselor 57% said they would also go to a school psychologist.

When asked if they had someone to talk to about their mental health issues, about 63% of respondents said they did. Out of those respondents that said they did about 41% of them said they would go to a school psychologist. Of the remaining 37% who did not have someone to talk to, 61% of them said they would go to a school psychologist.

Freshmen are the most likely grade level, middle eastern is the most likely ethnicity, pansexual is the most likely sexuality, transgender is the most likely gender, jews are the most likely religious

group, independent party is the most likey party, and people with diagnosed mental disorders are most likely to voluntarily visit a school psychologist.

For pansexual, jewish, and transgender individuals a majority of the students (over 70% of all the students in that group) would go to a school psychologist meaning these were the demographics most likely to voluntarily visit a school psychologist.

VALIDITY AND RELIABILITY:

I checked my reliability using four measures: participant error, participant bias, researcher error and researcher bias.

In order to reduce participant error the survey clearly worded and stated the questions. A question that was not worded correctly was the question asking students about the number of AP classes they take. The survey did not clearly state that students must respond with the number of classes they take this year. This led students to believe that they must respond with the number of AP classes they have taken throughout their entire high school career. Another way to reduce participant error in the future when repeating this study is to not add an 'other' response where students can fill in their own answer to a question. This caused too many outlier responses.

In order to reduce participant bias I picked a random sample out of my school population. I also took students outside their classroom to answer the survey questions, which prevented participants from changing their answers in fear of their peers seeing their answers. I also did not ask students questions verbally, this avoided the bias of them not saying their true answer due to the fear of others overhearing.

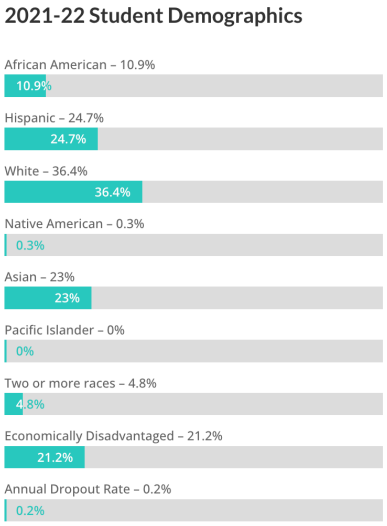
My research avoided researcher error by having my analysis be completely quantitative. This reduces the bias of my opinion hindering the finding of the results, as I did not rely on qualitative analysis.

In order to avoid researcher bias the survey was conducted in a google form format rather than verbally. This way students felt like they were talking to the form rather than me, the researcher. This was important because I attend McNeil high school and some of the students were classmates of mine. They may feel uncomfortable answering questions like these directly to my face. I also took a random sample which avoids researcher bias of me picking a biased sample.

Validity was checked using three measures including construct validity, internal validity and external validity. This study directly answers the question what demographic of students are most likely to voluntarily visit a school psychologist. The survey takes demographic information and compares it against how many students of that demographic would go to a school psychologist. The other way this study could be done is using an observational study where a school psychologist would have been placed in a school and the school psychologist would note the demographics of each student that voluntarily visited them. While this may have provided a bit more accuracy, as a high school student this was not within my abilities given the constraints of resources.

The study was designed to establish a correlational relationship between demographic and likelihood of going to a school psychologist rather than a causal relationship between the two and hence it has a low internal validity.

External validity was maintained by choosing a large sample size. Although the random sample was taken at only one school, in my opinion my school has a good amount of diversity which allowed me to get a large and diverse random sample. When checked against official demographic records the demographic of students in this study reflected the students that go to Mcneil High School. Add school google graph



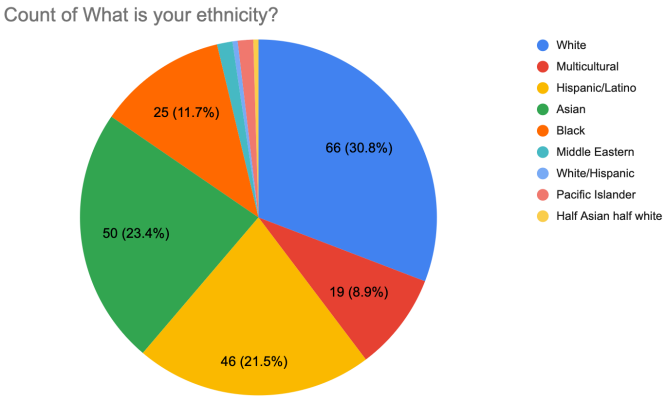


Figure 10a **Figure 10b**

Figure 10a shows population race demographics taken from the official Mcneil High School website and figure 10b shows race distribution of students who filled out the survey. Comparing the two demonstrates external validity by showing that the sample chosen reflects population of school

DISCUSSION, IMPLICATIONS AND FUTURE RESEARCH:

This study implies that school psychologists would be a better alternative for students to go to about mental health issues than school counselors. An overwhelming majority of 84% of students felt they could not talk to a school counselor, but there were a lot of students (48%) saying that they would go to a school psychologist. This shows that school psychologists may be a more desirable option for students to talk about their mental health. In fact, about half of those who would not go to a school counselor said they would go to a school psychologist, showing the vital role the school psychologists can play in providing mental health resources for students.

As of the 2020-2021 school year, in Texas (where this study was conducted) on an average there is about one school psychologist per every 2500 students (NASP, 2021). Through the research done by this study we can see that about half of the student body would voluntarily visit a school psychologist. This means that the current number of school psychologists isn't enough to meet

the needs of the students (assuming there are around about 1500-2500 students going to a certain high school). Currently students can only go to a school psychologist if they either already have a mental disorder diagnosis or are referred to by a teacher. The problem with this is, as stated in the literature review, certain students may get overlooked whether it be because they perform well in school or other demographic factors. This way if students can voluntarily visit a school psychologist then those factors are accounted for.

This research study also adds to existing research in the field. As established in the literature review there are certain demographic groups more at risk for mental health issues(*Major Depression*, n.d.). My study finds whether these same groups would reach out for help if offered to them (in the form of a school psychologist). That study showed that females and people of multicultural ethnicity were the demographic group with the most prevalence of major depressive disorder. My study showed that females (who are more at risk) were more likely to accept support than males.

Now that this study has established the importance of a school psychologist, future studies can aim to find a way to implement them better into schools. This means implementing more of them and making them more available to students. Implementing school psychologists means finding government funding for those school psychologists. Future research can focus on where this funding can come from and how to legally acquire that funding.

Another interesting result that was found during this study was there was a majority (63%) of students who said they had someone to truly talk about their mental health issues with. A future study that could come from this result is, who are they talking to? Are these students talking to people who will give them healthy coping mechanisms or people who will give them unhealthy coping mechanisms?

Another question that is still to be answered is what prevents students from visiting a school psychologist. Half of the students that answered the survey claimed that they would not visit a school psychologist if presented with one. This creates the question of why. What barriers are preventing students from visiting a school psychologist, are there any barriers to preventing them or do they simply don't feel like they need one?

Along with that another interesting finding was the discrepancy in willingness to see school psychologists based on gender, more particularly cisgendered males and females. Based on this finding further research could investigate what barriers prevent high school males from seeking mental health support and how schools can assist in removing those barriers.

Lastly, while this study focused on student opinions on school psychologists there is no opinion taken on how parents/guardians feel about a school psychologist. Future research can focus on how parents/guardians feel about school psychologists, and how they feel about students being able to reach out to a psychologist without their consent first.

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