The University of Texas at Austin
McCombs School of Business

UT Austin Boot Camps

Pregnancy Related Mortality

The data we are looking at is specific to California in the years of 2019-2021 with limitations.

Project Overview

Project Name	Pregnancy Related Mortality
Project Members	Divya Anup and Meera Vanmali

Team Members

Divya Anup

Meera Vanmali

Project Summary

The United States has the highest pregnancy-related mortality rate among developed countries, making it a critical public health issue. This project focuses on analyzing and visualizing data obtained from the California Public Health Department regarding pregnancy-related mortality from the years 2019-2021. Our objective was to identify and visualize key factors contributing to maternal deaths to better understand this issue and inform potential interventions. In addition, the World Health Organization (WHO) was utilized as a resource. The pregnancy-related mortality data shown in this data is the number of pregnancy related deaths per 100,000 live births.

We utilized Python, specifically within a Jupyter Notebook environment, to analyze the dataset. For our visualizations we utilized matplotlib. The dataset contained detailed information on various factors associated with pregnancy-related mortality. The data set was very large so our analysis focused on only the following factors:

- **Age:** The age groups of the women who passed away.
- **Type of Insurance:** The type of health insurance (public or private) they were under.
- **Race:** The racial demographics of the deceased.
- **Cause of Death:** The medical or health complications leading to death.
- **Gestational Week:** The specific week of pregnancy during which the deaths occurred.
- **Body Mass Index (BMI):** The BMI categories of the deceased.

Research Questions

Age: How does the age of pregnant women correlate with pregnancy-related mortality rates in California from 2019-2021?

Type of Insurance: What is the impact of the type of health insurance (public vs. private) on pregnancy-related mortality rates in California during the same period?

Race: How do pregnancy-related mortality rates vary among different racial groups in California from 2019-2021?

Cause of Death: What are the most common causes of pregnancy-related deaths in California from 2019-2021?

Gestational Week: During which gestational weeks do the highest rates of pregnancy-related mortality occur in California?

Body Mass Index (BMI): How does the Body Mass Index (BMI) of pregnant women influence pregnancy-related mortality rates in California, and are there specific BMI categories that are more at risk?

Dataset to be used and other Resources:

[California Department of Public Health]

[World Health Organization - Maternal Mortality]

[U.S. Center for Disease Control & Prevention]

Project Breakdown

- Topic discussions
- Searching for data that fit our topic
- Data fetching/rewatching of lectures
- Import file to Jupyter notebook and begin data analysis
- Utilize Matplotlib for visualizations of factors
- Testing variations of different codes
- Hypothesis Test using T test on BMI
- Data summary
- Create documentation of project analysis
- Create PowerPoint presentation of visualizations and data
- Delivering the presentation
- Uploading of all relevant material to gitlab

Research Methodology

The objective of this study was to analyze maternal mortality rates in California from 2019-2021 by examining various influencing factors, including age, gestational period, race, type of insurance, Body Mass Index (BMI), and cause of death. Due to limited access to comprehensive datasets and fewer research studies in women's health compared to other areas, this research focused specifically on California to derive insights into maternal mortality trends. The study utilized publicly available data from the California Public Health Department related to pregnancy-related mortality. The dataset covered a three-year period (2019-2021) to provide a focused view of recent trends.

The analysis employed descriptive statistics and hypothesis testing, including an independent samples t-test, to compare mortality rates between Obese III (BMI 40+) and Underweight/Normal Weight (BMI < 25). Visualizations such as bar graphs, pie charts, and line graphs were used to present the data, allowing for clear comparisons across different categories and trends over time. The study was conducted collaboratively by team members who communicated regularly to determine which factors to analyze and how to interpret the data. Findings were guided by specific research questions, revealing significant trends and disparities in maternal mortality. For instance, the t-test results indicated a statistically significant higher mortality rate for Obese III compared to

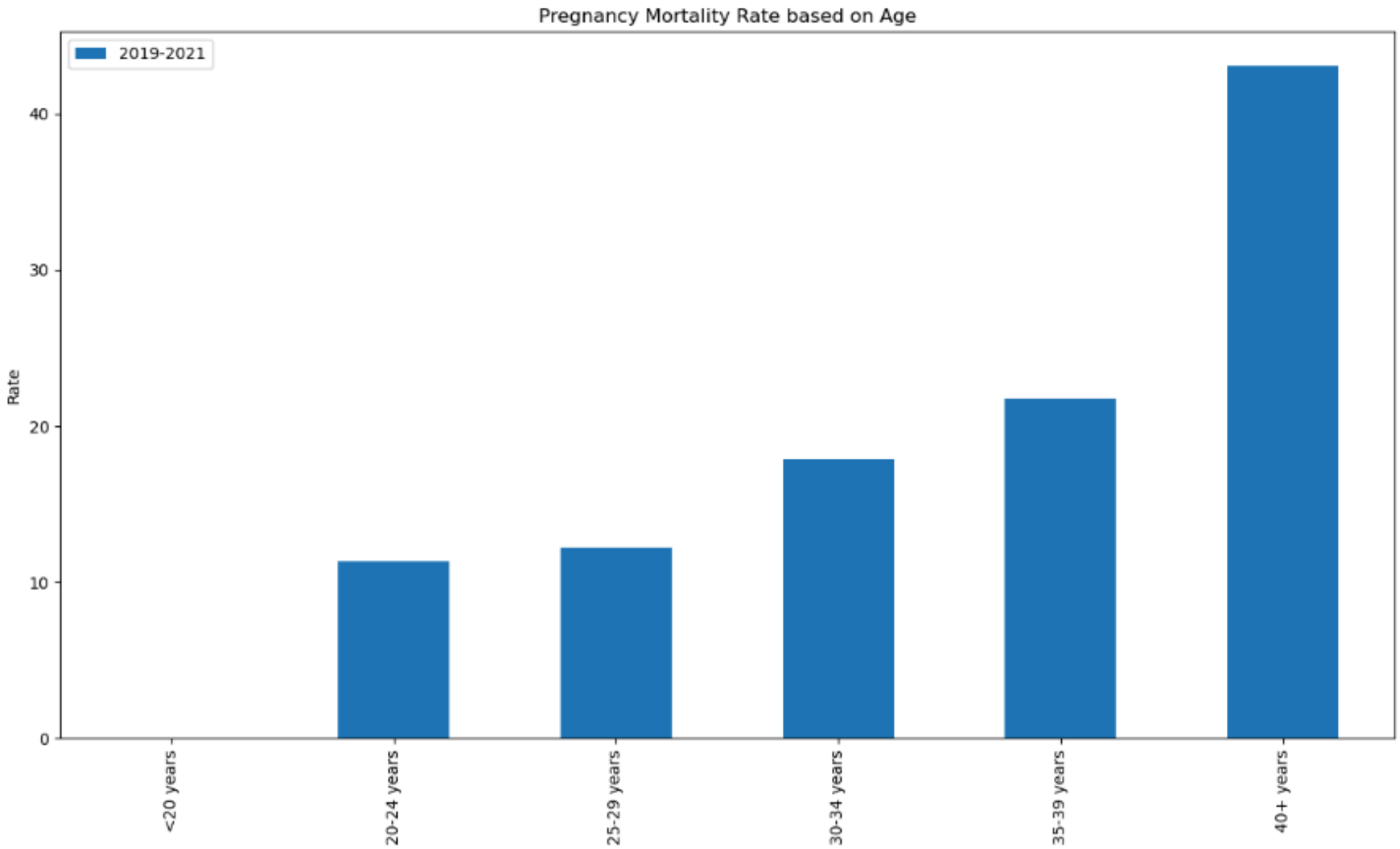
Underweight/Normal Weight individuals. The results highlighted that certain factors, such as higher BMI and specific gestational periods, are associated with increased mortality risks.

However, the research acknowledges its limitations, including the focus on California and the three-year dataset, which may restrict the generalizability of the findings. The results are intended to provide insights into maternal mortality trends and should not be used as clinical guidelines or medical references. The study underscores the need for continued research and expanded datasets to enhance understanding and address maternal health disparities more effectively.

Research Questions Answered

Age: How does the age of pregnant women correlate with pregnancy-related mortality rates in California from 2019-2021?

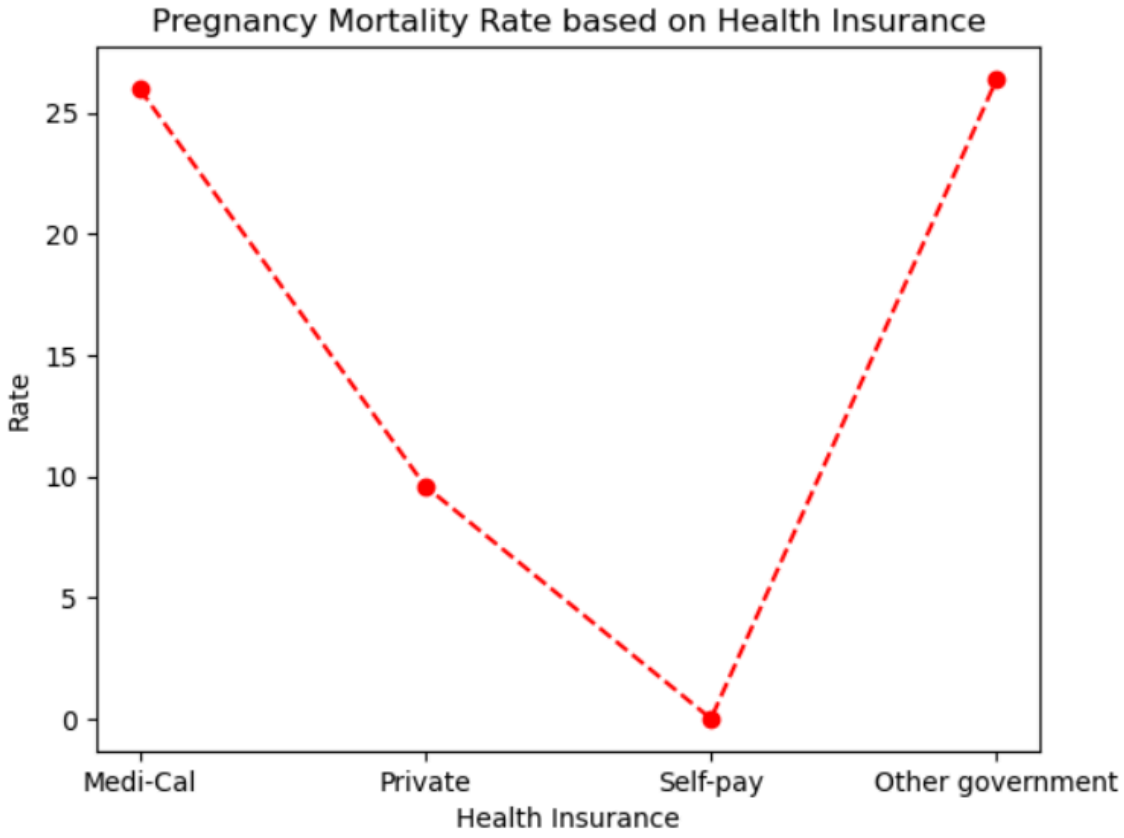
Data revealed that women aged 40 and above had significantly higher rates of pregnancy-related mortality. Mortality rate in this age group was substantially higher compared to younger age groups. Data indicated a noticeable increase in mortality rates starting at age 30. The trend suggests a progressive rise in risk with advancing maternal age beyond 30. Women in the 20-29 age range exhibited average mortality rates. This age group showed the most favorable outcomes in terms of pregnancy-related mortality.



Type of Insurance: What is the impact of the type of health insurance (public vs. private) on

pregnancy-related mortality rates in California during the same period?

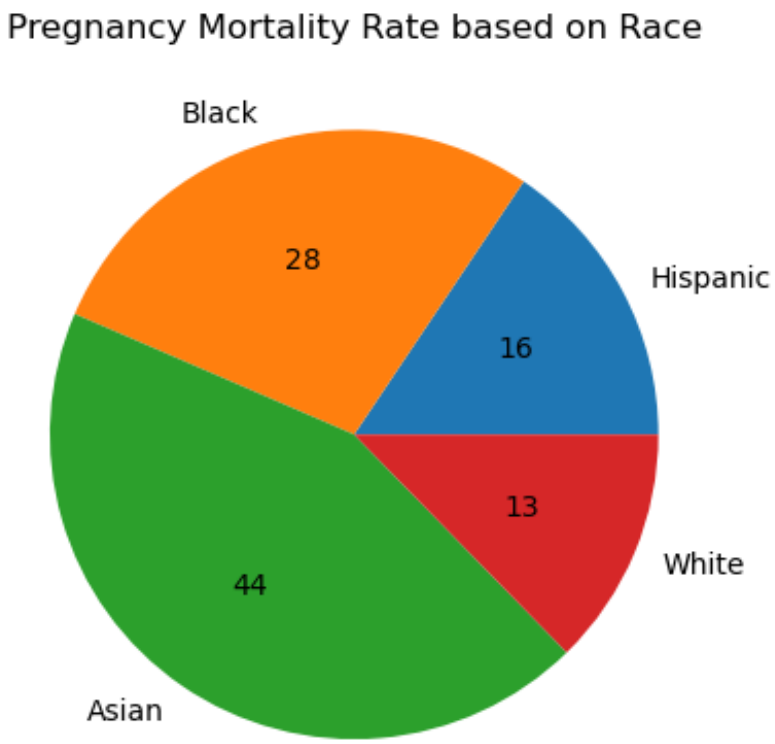
Women covered by Medi-Cal and other government insurance programs exhibited the highest pregnancy-related mortality rates in California. Their rate was greater than 25%. This disparity may be attributed to factors such as limited access to high-quality prenatal care, lower socioeconomic status, and potential disparities in healthcare services. Women with private health insurance had notably lower pregnancy-related mortality rates, approximately around 10%. This lower rate could be linked to better access to comprehensive prenatal care, higher socioeconomic status, and more consistent healthcare services. In contrast, women who self-paid for their healthcare services showed the lowest pregnancy-related mortality rates, possibly due to higher income levels, the ability to afford high-quality healthcare, and more personalized care options. However, it's important to note limitations in data capture regarding self-payments, which may not fully reflect the complete picture of maternal health outcomes.



Race: How do pregnancy-related mortality rates vary among different racial groups in California from 2019-2021?

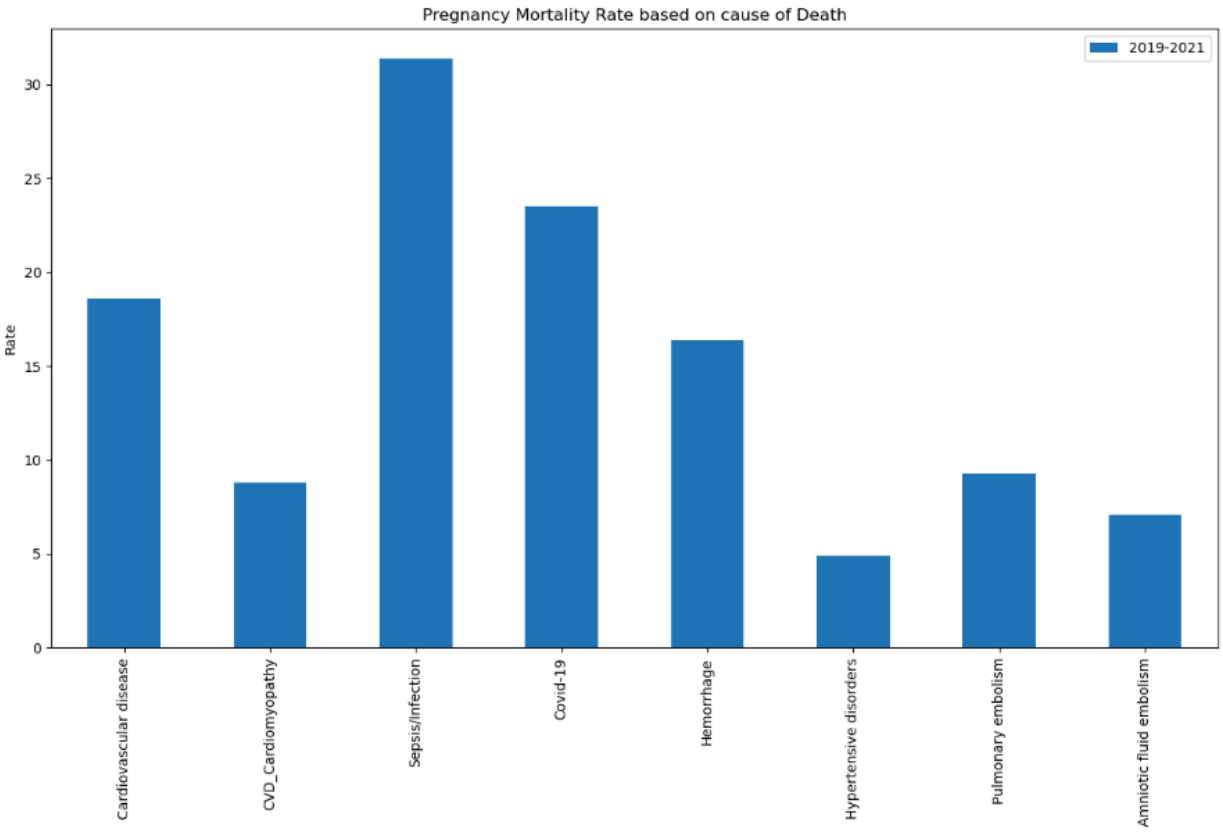
Pregnancy-related mortality rates in California varied significantly across racial groups. Asian women experienced the highest rates at 44%, which may stem from cultural and language barriers impacting healthcare access, differing health-seeking behaviors. Following closely, Black women reported the second highest rates at 28%, attributed to factors including healthcare discrimination, higher prevalence of chronic conditions, socioeconomic disparities, and implicit biases in medical care.

Hispanic women had mortality rates lower than those of Black women but higher than those of White women. White women recorded the lowest pregnancy-related mortality rates during this period.



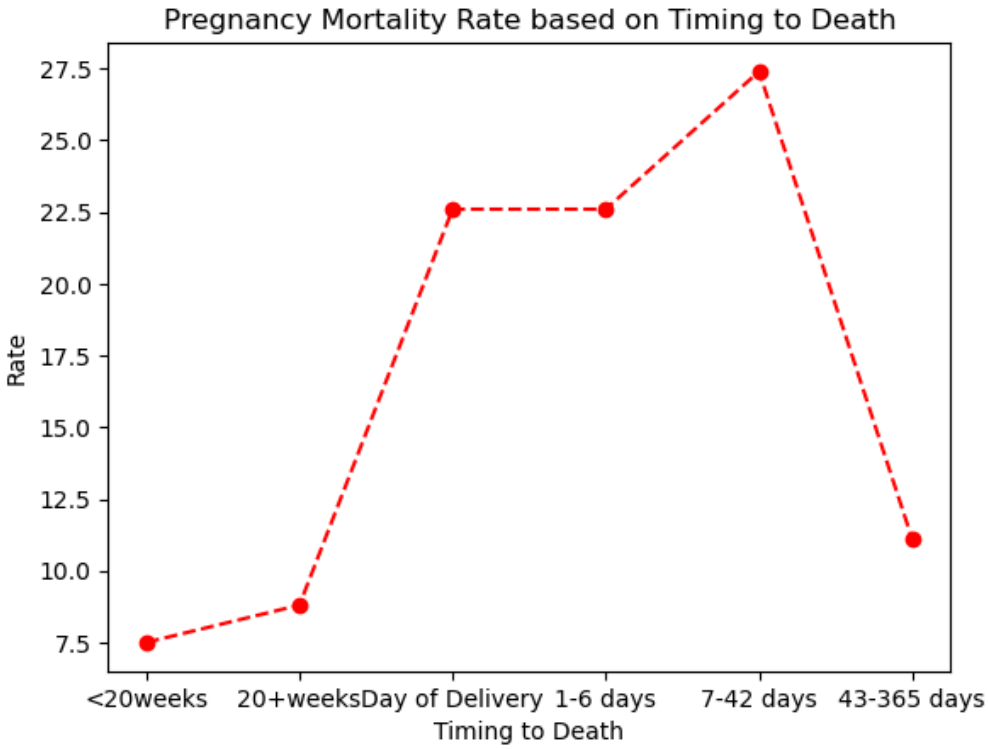
Cause of Death: What are the most common causes of pregnancy-related deaths in California from 2019-2021?

From 2019 to 2021, sepsis and infections emerged as the predominant causes of pregnancy-related deaths in California, surpassing other factors. The impact of undiagnosed cases of COVID-19 and its variants potentially contributed to this rise, with COVID-19 itself becoming the second most common cause of these deaths. The period saw notable shifts in mortality trends compared to previous years, where cardiovascular diseases and hemorrhages held similar positions as the third and fourth leading causes of maternal mortality. In addition, conditions such as hypertension exhibited lower mortality rates, approximately 5%, while pulmonary embolism, amniotic fluid embolism, and cardiomyopathy were in the 7-10% range. Before this period, cardiovascular diseases had dominated from 2017-2018, underscoring the significant impact of the pandemic on mortality patterns, particularly with the sharp increase in sepsis and infections, likely influenced by challenges in testing and clarifying causes of death early in the pandemic.



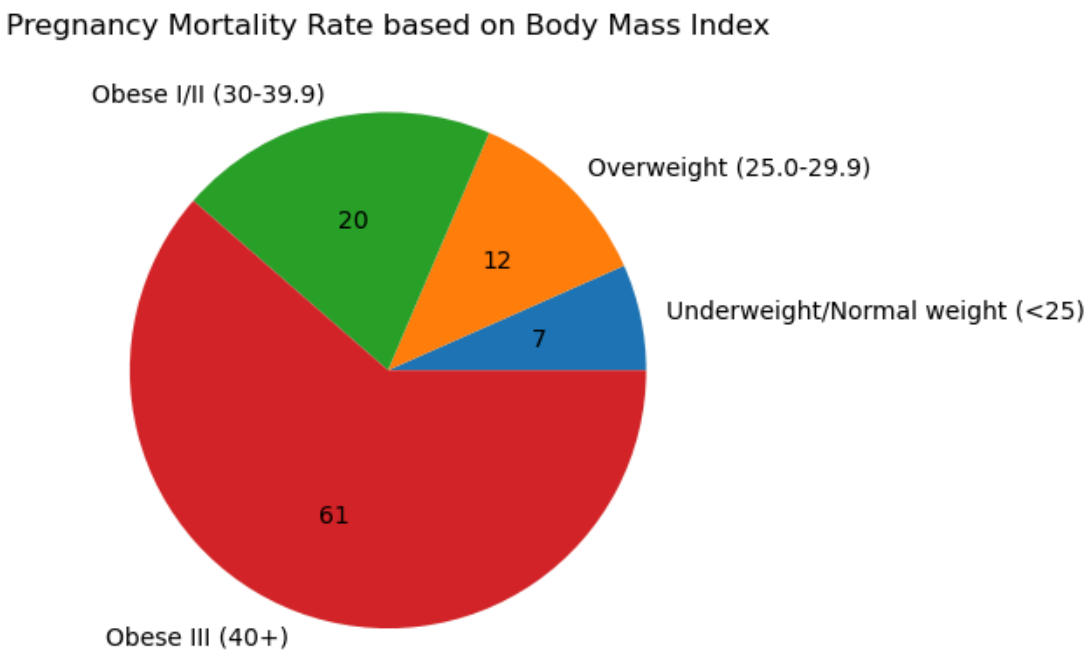
Gestational Week: During which gestational weeks do the highest rates of pregnancy-related mortality occur in California?

In California, pregnancy-related mortality rates show a notable increase after 20 weeks of gestation, with a significant spike observed at the time of delivery. The most rise, reaching 27.5%, occurs between 7 and 42 days postpartum. This period marks a critical phase where complications from pre-existing conditions may exacerbate mortality risks. Rates subsequently decrease to 11% after 43 days postpartum but remain a concern for up to a year post-delivery. These statistical trends highlight the important periods during pregnancy and postpartum where maternal health outcomes are particularly critical.



Body Mass Index (BMI): How does the Body Mass Index (BMI) of pregnant women influence pregnancy-related mortality rates in California, and are there specific BMI categories that are more at risk?

The Body Mass Index (BMI) of pregnant women plays a significant role in influencing pregnancy-related mortality rates in California. Analysis reveals that women classified as Obese III (BMI 40 and above) exhibited the highest mortality rates at 61%. Those in the Obese I and II categories (BMI 30.0-39.9) faced a reduced but still elevated risk at 20% compared to normal weight individuals. Women categorized as overweight (BMI 25.0-29.9) experienced lower mortality rates than the obese groups but remained at increased risk compared to those with normal BMI, with rates around 30%. Conversely, women classified as underweight or in the normal weight range (BMI < 25) demonstrated the lowest pregnancy-related mortality rates at 7%. These findings underscore the critical impact of BMI categories on maternal health outcomes, highlighting higher risks associated with higher BMI classifications and relatively lower risks for underweight and normal-weight individuals.



Hypothesis Tests Preformed

T-Statistic Test - Body Mass Index

To compare pregnancy-related mortality rates between women classified as Obese III (BMI 40+) and those categorized as Underweight or Normal Weight (BMI < 25), we conducted an independent samples t-test. The test yielded a t-statistic of 7.82 and a p-value of 1.659, indicating a highly significant difference between the two groups. Specifically, the pregnancy-related mortality rate for women in the Obese III category was found to be 453.73% higher compared to those in the Underweight/Normal Weight category. This statistical analysis confirms that the difference in mortality rates observed is unlikely to have occurred by chance. Therefore, we conclude that there is a significant association between higher BMI (Obese III) and increased pregnancy-related mortality rates in California during the specified period.

Pearson Correlation Analysis - Age

To assess the relationship between age and maternal mortality rates, we conducted a Pearson correlation analysis, yielding a correlation coefficient of 0.969. This indicates a very strong positive correlation between age and maternal mortality rates in California. The associated p-value of 0.031 suggests that this correlation is statistically significant at the 5% significance level, indicating that the observed relationship between age and mortality rates is unlikely to have occurred by chance. In practical terms, as maternal age increases, there tends to be a corresponding increase in maternal mortality rates. This finding underscores the importance of age as a factor influencing maternal health outcomes, highlighting the need for targeted healthcare interventions and policies to be aimed at older mothers to mitigate these risks effectively.

Conclusion

In this study analyzing maternal mortality rates in California from 2019 to 2021, several critical factors including age, gestational period, race, type of insurance, BMI, and cause of death were examined to uncover significant disparities and risk factors influencing maternal health outcomes in the state. Advanced maternal age, particularly beyond 40, emerged as a substantial risk factor, necessitating targeted healthcare strategies for older mothers. Differences in insurance coverage were stark, with women reliant on Medi-Cal and government insurance experiencing markedly higher mortality rates compared to those with private insurance, highlighting socioeconomic and access-to-care challenges. High BMI, notably Obese III (BMI 40+), correlated strongly with increased mortality rates, emphasizing the critical role of BMI management in maternal health. Leading causes of death included sepsis and infections, compounded by challenges such as undiagnosed COVID-19 cases. These findings underscore the dynamic interplay of health, socioeconomic, and systemic factors influencing maternal mortality in California. However, it's important to acknowledge limitations in this analysis, including the focus on a specific time period and geographical area which may limit generalizability. Additionally, the dataset's completeness and accuracy can impact the interpretation of findings. Addressing these limitations and continuing research efforts are essential for developing targeted interventions and policies to reduce maternal mortality rates and improve overall maternal health outcomes nationwide.

About the Data

The pregnancy-related mortality ratio shown in these reports is the number of pregnancy related deaths per 100,000 live births.

> For example: when looking at the code in the Numerator column that number is per 100,000 live births. In 2019-2021 Covid-19 was reported to kill 53,000 women out of the 226,000 live births. Denominators include all live births to California resident mothers/parents giving birth.
>
> Rate is being calculated by = 53,000/226,000=.0235 = 23.5%

Year	Category	Subcategory	Numerator	Denominator	Rate
2019-2021	Cause of Death	Covid-19	53	226.0	23.5
2019-2021	Cause of Death	Other infection	18	226.0	8
2019-2021	Cause of Death	Hemorrhage	37	226.0	16.4
2019-2021	Cause of Death	Hypertensive disorders	11	226.0	4.9
2019-2021	Cause of Death	Pulmonary embolism	21	226.0	9.3
2019-2021	Cause of Death	Amniotic fluid embolism	16	226.0	7.1
2019-2021	Cause of Death	Cerebrovascular accident		226.0	
2019-2021	Cause of Death	Anesthesia complications		226.0	
2019-2021	Cause of Death	Other	19	226.0	8.4
2019-2021	Cause of Death	Undetermined		226.0	

- Obtain data on maternal mortality rates in California from 2019-2021.
- Import the data into Jupyter using Python libraries like Pandas (import pandas as pd).
- Data Exploration and Initial Inspection:
  - Display the header of the dataset (df.head())
- Data Cleaning and Preprocessing:
  - Data Cleaning and Preprocessing: Handle missing data by imputation or removal, based on the context of the analysis (df.dropna())
  - Convert data types as necessary
  - Ensure consistency and correctness of data
- Data Analysis and Visualization:
  - Create visualizations using Matplotlib to explore relationships and distributions:
  - Bar charts for categorical variables like age and cause of death.
  - Pie charts for race and body mass index.
  - Line graph for insurance and timing of death.
- Data Slicing and Subsetting:
  - Slice the data to focus on the years 2019-2021
  - Subset the data based on factors of interest (age, race, insurance, BMI, gestational period, cause of death)

Limitations

The analysis of pregnancy-related mortality rates from 2019 to 2021 in California is constrained by many limitations that impact the interpretation and generalizability of findings. The dataset spans only three years, limiting the ability to capture long-term trends or fluctuations in mortality rates over broader time frames. The focus solely on California restricts insights to this geographic area, potentially overlooking variations in maternal health outcomes across different states or regions of

the United States. Additionally, the dataset may not fully account for all pregnancy-related deaths, as underreporting or misclassification issues, particularly concerning conditions like COVID-19, could affect the accuracy of mortality rate estimates.

The dataset lacks detailed information on socioeconomic status, environmental factors, or other potential determinants of health that could influence maternal mortality rates. This hinders a comprehensive understanding of the multifaceted factors contributing to maternal health disparities. Additionally, the influence of COVID-19 on pregnancy-related mortality rates is complex and may be confounded by varying stages of the pandemic and differing healthcare responses over the study period.

Lastly, the data does not specifically mention pre-existing conditions among the individuals studied, which could significantly impact maternal health outcomes. These limitations underscore the need for caution when interpreting the findings and highlight the necessity for more extensive and inclusive datasets that encompass broader demographic and contextual factors. Addressing these limitations would enhance the accuracy and applicability of future maternal health research and improve maternal health outcomes nationwide.

Disclaimer: The information presented in this analysis of maternal mortality rates in California from 2019-2021 is intended solely for educational purposes as part of a class assignment. It should not be construed or used as medical advice, clinical guidance, or as a reference for medical decisions. The analysis and findings are based on publicly available data and are not intended to substitute professional medical judgment or expertise. Individuals seeking medical advice or information related to maternal health should consult qualified healthcare professionals or authoritative sources. This educational exercise aims to enhance understanding of data analysis techniques and maternal health trends within an academic context, and caution should be exercised in applying these findings beyond educational or research purposes.

Resources

In our project on maternal mortality rates in California from 2019 to 2021, we received guidance from our instructors, Travis Hopkins, and TA Kian Layson. They provided crucial direction and feedback that helped shape our analysis and interpretations. Alongside their assistance, we utilized resources such as reviewing lectures, watching YouTube tutorials, and engaging with coding forums to enhance our understanding of Python programming and statistical analysis techniques.

Moreover, incorporating AI tools into our workflow facilitated efficient data preprocessing and exploratory analysis tasks. Throughout the project, we actively incorporated feedback from our instructors to refine and improve our approach. This process help us in our analysis to be thorough and well-informed, maintaining academic integrity by properly attributing all sources and in efforts to ensure our work was original and referenced. By integrating these diverse resources and insights, we

achieved a comprehensive examination of maternal health trends in California, contributing to a meaningful exploration of the topic.