Socioeconomic and Health Determinants of Maternal Outcomes: A County-Level Analysis for Pregnancy Support Services

Background and Objectives

Maternal health is a critical factor that influences the well-being of both mothers and their new-borns. However, disparities in access to healthcare, socioeconomic resources, and support services can significantly impact pregnancy outcomes across different regions. This project focuses on identifying counties where pregnant women face higher risks due to factors like poor maternal health, limited prenatal care, and economic hardships.

Utilizing key metrics such as pre-pregnancy BMI, average birth weight, prenatal care access, and socioeconomic indicators like income levels and employment rates, this project seeks to pinpoint areas where support is most needed. The goal is to guide interventions to help develop targeted support programs that improve maternal care and pregnancy outcomes in underserved communities, ensuring healthier pregnancies and stronger maternal health services.

This project serves as a foundational step toward developing a business aimed at providing holistic and tailored support services to pregnant women, ensuring that they receive the necessary care and assistance to foster healthier pregnancies and, by extension, healthier communities.

These are the key areas that provide insights and recommendations:

- Maternal Health Metrics Analysis:
  Examination of factors influencing pregnancy outcomes like maternal pre-pregnancy BMI, average birth weight, and access to prenatal care. Identifying health and trends like low birth weight helps target regions needing improved healthcare services and maternal support.
- Health and Socioeconomic Correlations:
  Examining how health metrics and socioeconomic conditions interact to affect birth outcomes. These correlations can provide insights into regions which may need improvements.

The raw files for this project can be accessed here

The project dashboard and Excel worksheet for further and general analysis can be accessed here

The SQL queries utilized in extracting and loading data can be accessed here

The SQL queries utilized in preparing, organizing the data can be accessed here

The SQL queries utilized in merging and formatting the main analysis table can be accessed here

Targeted SQL queries utilized in answering business questions can be accessed here

A PDF file on this Executive Summary can be accessed here

Data Structure

This report on Socioeconomic and Health Determinants on Maternal Outcome, focuses on analysis made on a dataset of two tables merged into one: county_natality.csv and FIPS_socioeconomic.csv.

The final merged and cleaned table Merged_Natality_FIPS.csv which was utilized for the main SQL and Excel Analysis consists of a total row count of 1,722. Its schema is shown below.

Merged Natality FIPS	
Year	Date
County_of_Residence	String
State_of_Residence	String
County_of_Residence FIPS	Int
Births	Int
Ave_Age_of_Mother	Float
Ave_OE_Gestational_Age_Wks	Float
Ave_LMP_Gestational_Age_Wks	Float
Ave_Birth_weight_gms	Float

Ave_Pre_pregnancy_BMI	Float
Ave_Number_of_Prenatal_Wks	Float
Net_earnings_by_place_of_residence	Float
Percapita_personal_income	Float
Population	Int
Wage_and_salary_employment	Float
Earnings_per_job_avg	Float
Personal_income	Float
Total_employment	Float

Before starting the analysis, various quality control checks were performed to ensure data integrity and to familiarize ourselves with the datasets. The SQL queries used for inspection and quality checks are available here

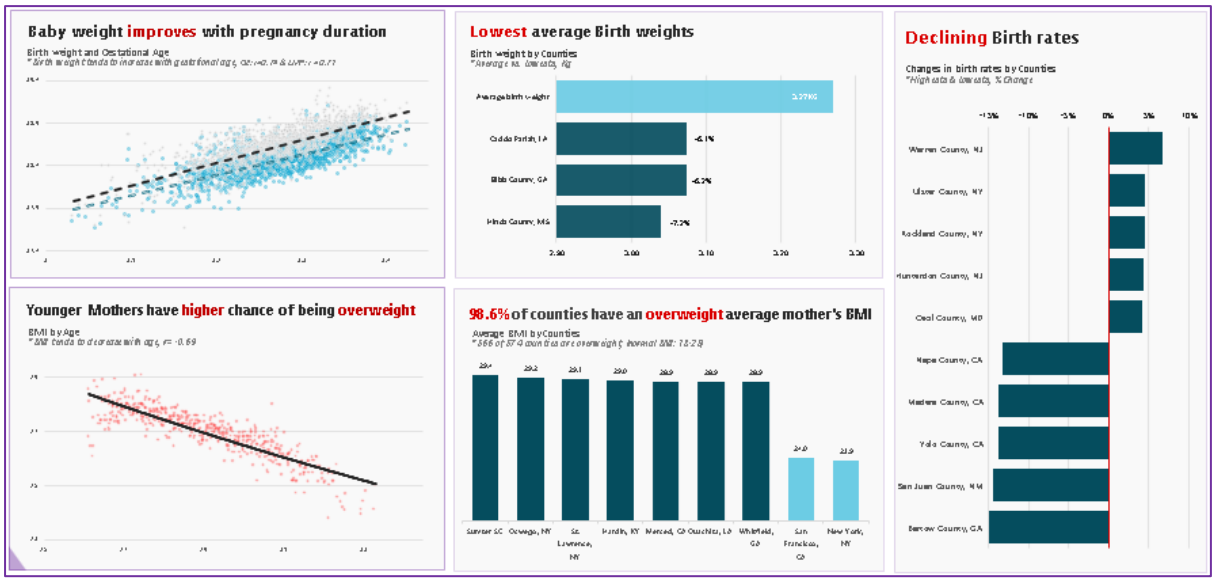
The SQL queries employed to integrate the various datasets and ensure that the resulting table is structured for comprehensive analysis can be found here

Executive Summary

Overview of findings

Findings reveals that maternal health outcomes, such as pre-pregnancy BMI and birth weight, are primarily influenced by gestational age and maternal age, with socioeconomic factors play a secondary role. While wealthier counties tend to have lower BMI levels, socioeconomic factors show only minor correlations with birth weight. Gestational age consistently emerges as the strongest determinant of birth weight. Prenatal care access also varies across counties, and while its influence on birth weight is moderate, improving healthcare infrastructure and education in lower-income areas is essential for better outcomes. Overall, gestational factors and healthcare access are key drivers of maternal and infant health, with economic conditions plays a supporting role. These insights can inform targeted strategies to enhance maternal health and improve birth outcomes.

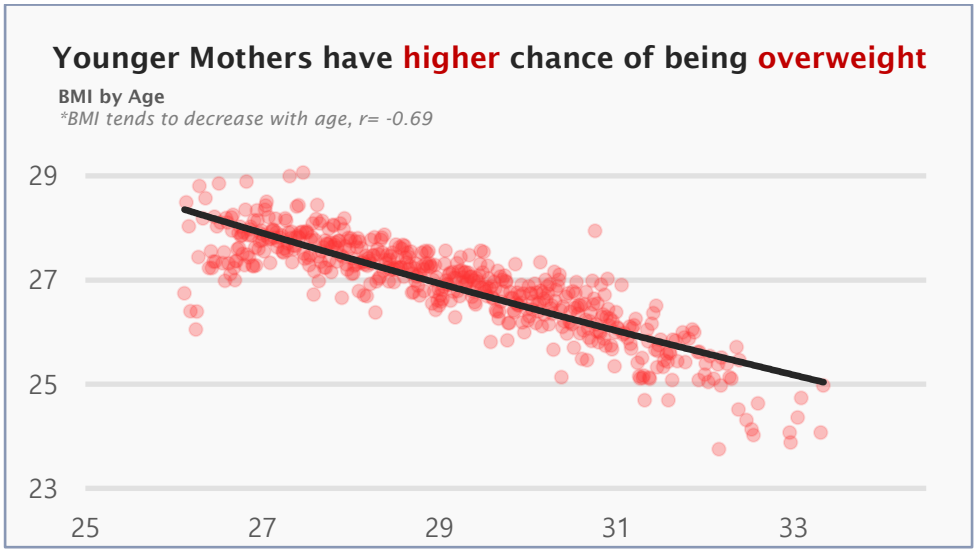
Below is an Overview from the Excel Dashboard. Which can be fully accessed here



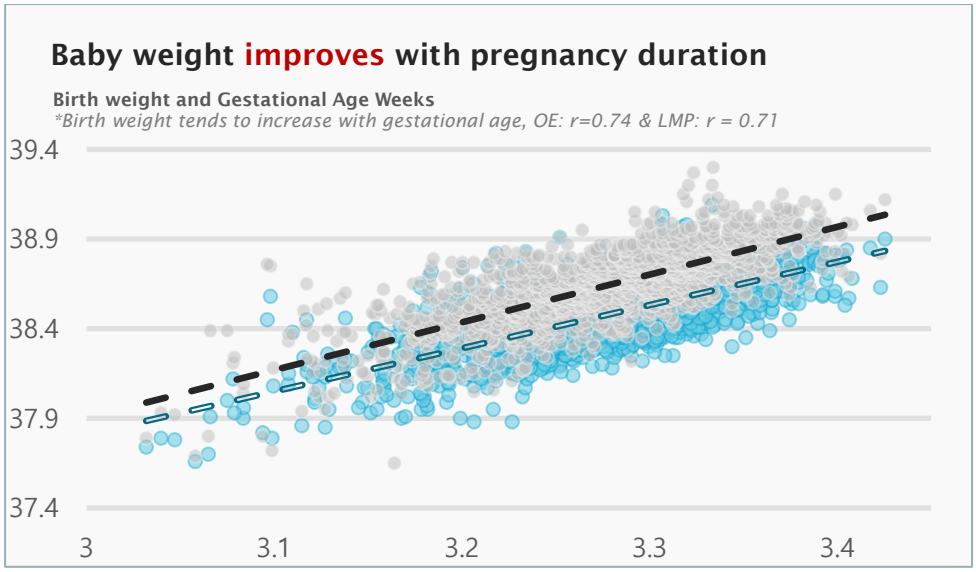
1. Maternal Health Metrics Analysis

Overview: The analysis reveals that maternal age, gestational age, and prenatal care are key factors affecting maternal health and birth outcomes. Older maternal age is linked to lower pre-pregnancy BMI, while longer gestational periods strongly correlate with higher birth weights. Although prenatal care weeks vary significantly across counties, their impact on birth weight is moderate but important. Overall, gestational age plays the most significant role in birth outcomes, while prenatal care access is crucial in supporting healthier pregnancies. These insights can inform targeted strategies to enhance maternal health and improve birth outcomes.

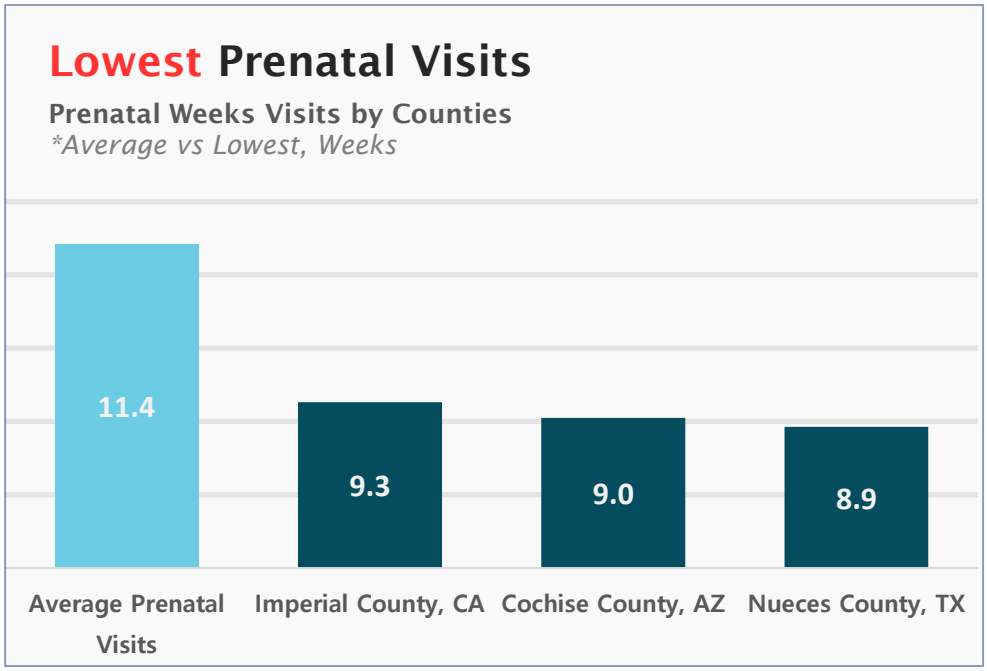
- **Pre-Pregnancy BMI:** In the counties analysed, 566 (98.6% of counties) have an average BMI above 25.0, indicating overweight, with none exceeding 30.0, which is classified as obesity. Sumter County, SC, has the highest average BMI at 29.4, nearing the obesity threshold, while the 8 counties left show normal BMI levels. Some of the key Factors that show a strong effect on the average BMI in a county were:
    - **Average Age:** There is a strong negative relationship between average age and BMI (r = -0.691). This means that in counties with older populations, the average BMI tends to be lower. In other words, older people generally have lower average BMI.
    - **Gestational Age**: Both OE and LMP (*'Obstetric-Estimation'* and *'Last-Menstrual-Period'*) Gestational Age show moderate negative correlations with BMI (r = -0.423 and r = -0.321, respectively). This suggests that a lower BMI has an effect for a mature pregnancy.



- **Average Birth Weight:** The Average Birth weight of a child is **3.27kg** (7.22Lbs) **dropping by -0.16% between 2018 and 2016**. Whatcom, WA, has the highest average birth weight, at 4.3% above the national average, while Hinds, MS, has the lowest, **7.2% below the average**. Some of the key Factors that show a strong effect on the average Birth weight in a county were:
    - **Gestational Age**: There is a strong correlation between gestational age and birth weight (**r = -0.741 for OE and r = -0.711 for LMP**). This means that babies born from longer pregnancies generally weigh more. Essentially, a longer pregnancy usually results in a heavier baby.
    - **Average Age**: The average maternal age has **a moderate negative correlation** with birth weight (**r = -0.374**). This suggests that in counties with older average maternal age, the average birth weight tends to be **slightly lower**.
    - **BMI**: The correlation between BMI and birth weight is **relatively weak** (**r = -0.224**). This indicates that while there is some link between a mother's BMI and her baby's birth weight, it is **less significant** than other factors like **gestational age.**



- **Prenatal visits:** On average, mothers receive **11.4 weeks** of prenatal care. However, there is significant variation, with **Nueces County, TX**, having the lowest average prenatal care duration, at **2.5 weeks**, which is **22% below the national average**.
    - While there is a **moderate correlation** between the number of prenatal visits and birth weight (**r = -0.325**), the relationship is not as strong as other factors such as gestational age. Nevertheless, this correlation is more significant than socioeconomic factors, suggesting that although prenatal care has an impact on birth weight, its influence is relatively modest when compared to other determinants.



2. Socioeconomic and Health Correlation

Overview: Examining the relationship between economic conditions and maternal health shows that income levels play a notable role in shaping health outcomes. Counties with higher net earnings and per capita income tend to have lower pre-pregnancy BMI averages, indicating that stronger financial resources are linked to healthier maternal weight levels. On the other hand, socioeconomic factors have only a minor influence on birth weight, with weak correlations suggesting that gestational factors are far more critical in determining a baby's birth weight than economic status alone.

- **Pre-Pregnancy BMI**: Economic indicators such as net earnings and per capita income show **negative correlations with BMI** (**r = -0.369 and r = -0.619**). This indicates that in counties with higher income levels, the average BMI tends to be lower, reflecting that better economic conditions are associated with healthier BMI levels.

- **Average Birth Weight:** Socioeconomic indicators such as net earnings by place of residence and per capita personal income show **minimal correlation with birth weight** (r values **range from -0.071 to -0.192**). This suggests that economic conditions have a minor impact on birth weight compared to factors like gestational age.

- **Prenatal Visits:** The correlation between **socioeconomic factors and prenatal care weeks is weak**. For instance, counties like Nueces, TX, with prenatal care weeks 22% below the national average, show that higher earnings or per capita income have little direct impact. Instead, factors like healthcare access and maternal education are more influential, emphasizing the need for targeted interventions to improve prenatal care in lower-income areas.

Recommendations

The following recommendations have been provided basedv on the uncovered insights.

- **Focus on Maternal BMI Management in Counties with Overweight Mothers**
  With 566 counties reporting an average BMI above 25, but none exceeding 30 averagely, focus on BMI management for pregnant women in overweight categories. Introduce nutrition and fitness programs to help lower BMI levels and prevent risks associated with obesity. For example, in counties like Sumter, SC which shows the highest average BMI.

- **Tailor Health Interventions for Younger Maternal Populations**
  In counties with Younger maternal populations, which have a strong negative correlation with BMI, implement targeted interventions such as BMI screenings and tailored health education. This will help improve overall maternal health for younger women.

- Prenatal Care Marketing Campaigns and Community Workshop
  Given the strong relationship between gestational age and birth weight, focus on enhancing and marketing prenatal care programs especially in counties with low birth weights e.g. Hinds County, MS and Bibb County, GA. Encourage early and regular check-ups to ensure longer gestation periods, which can lead to healthier birth weights.

- Partnership with Healthcare Providers
  Establish partnerships with local healthcare providers and maternity clinics to create referral programs. These programs could include prenatal health fairs or workshops focusing on healthy lifestyle choices to build brand awareness and foster relationships with potential customers. This could enhance our credibility while promoting our brand as a trusted resource and provide a seamless experience for our customers, ensuring they receive comprehensive care throughout their pregnancy.

- Monitoring and Evaluating Feedback Data
  Establish a monitoring system to track the effectiveness of the implemented programs, ensuring that adjustments can be made based on ongoing data analysis to tailor our campaigns and services to address specific needs.