Maternal Health Group 4

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Potential Question

"How does family history of cardiometabolic disease affect the incidence of preeclampsia among pregnant women across different racial and age groups?"

Subject to change

Diagnosis Included

Cardiometabolic Diagnosis:

- High blood pressure
- Diabetes
- Diabetes mellitus
- Diabetes mellitus type 1
- Hypertension
- Heart Attack
- Stroke
- Heart Disease
- High cholesterol
- Hypercholesteremia
- Hyperlipidemia

Preeclampsia Diagnosis:

- Preeclampsia
- High Blood Pressure
- Hypertension

Lit Review

"Family History of Hypertension, Cardiovascular Disease, or Diabetes and Risk of Developing Preeclampsia: A Systematic Review"

Family History of Cardiovascular Disease:

- A systematic review revealed that a family history of cardiovascular disease significantly increases the risk of developing preeclampsia.
- For instance, the odds ratio (OR) of developing preeclampsia in women with a family history of cardiovascular disease was found to be 1.7 (95% CI: 1.0-3.0) in one study, indicating a notable association.
- Another study reported an OR of 2.82 (95% CI: 1.22-6.51) for developing preeclampsia when there is a family history of cardiovascular disease in first-degree relatives[1]

Lit Review

"Racial Disparities in Comorbidities, Complications, and Maternal and Fetal Outcomes in Women with Preeclampsia/Eclampsia"

Cardiometabolic Conditions During Pregnancy:

- Women with gestational diabetes and hypertension have an increased likelihood of developing preeclampsia. Specifically, **16.69%** of Black women with preeclampsia had hypertension, compared to **9.33%** of White women and **8.53%** of Hispanic women.[2]

"Pre-pregnancy cardiovascular risk factors and racial disparities in birth outcomes: the Bogalusa Heart Study"

Racial Disparities in Preeclampsia Outcomes

- Non-Hispanic Black women exhibited an elevated rate of **6.04%** for developing preeclampsia, compared to **3.75%** in White women and **2.58%** in Hispanic women . These disparities persisted even after accounting for socio-economic and clinical factors.[3]

Lit Review

Hypertensive Disorders in Pregnancy and Mortality at Delivery Hospitalization — United States, 2017–2019

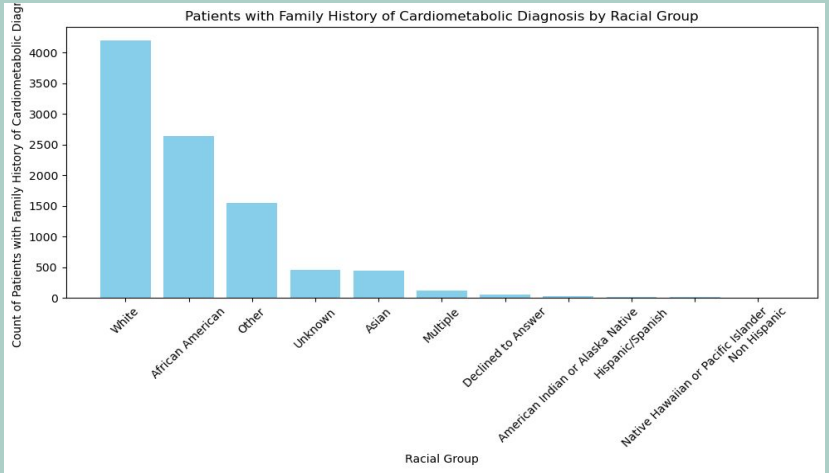
- According to the CDC, the prevalence for hypertensive disorders in pregnant women hospitalized for delivery is highest for Black women (20.9%) and American Indian/Alaskan Native women (16.4%). [4]

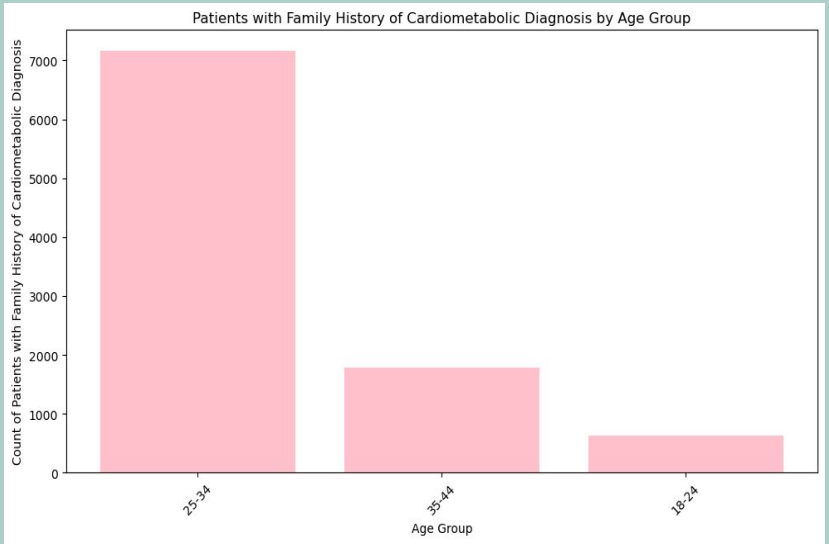
"Pregnancy at Age 35 Years or Older"

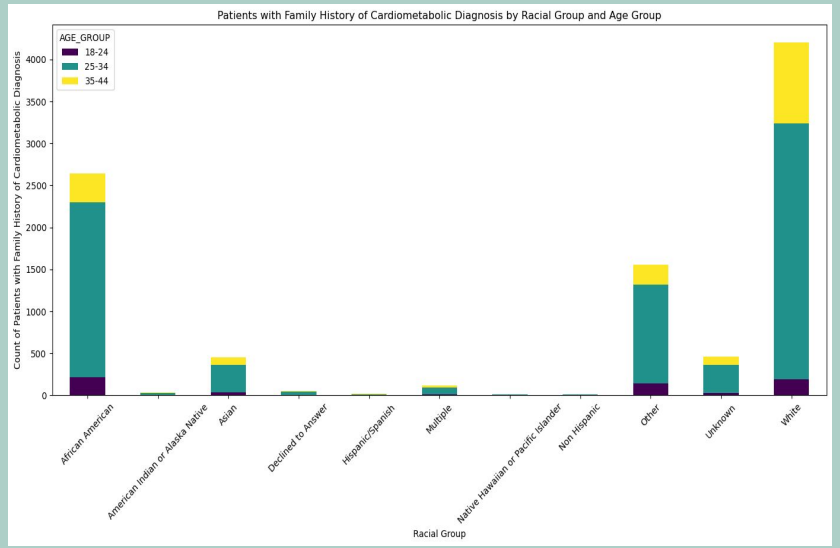
Increased Risk with Advancing Age:

- A retrospective cohort study found that the risk of preeclampsia increases significantly with maternal age beyond 40 years. Compared to women aged 35-39, the risk ratio (RR) for preeclampsia was **1.32** (95% CI 1.25–1.4) for women aged 40-44, and more than doubled to **2.21** (95% CI 1.89–2.58) for women aged 45-59. This indicates a **30%** increased risk for women aged 40-44 and a more than **double risk** for those aged 45-59, highlighting the impact of advanced maternal age on pregnancy outcomes.[5]

Data Exploration







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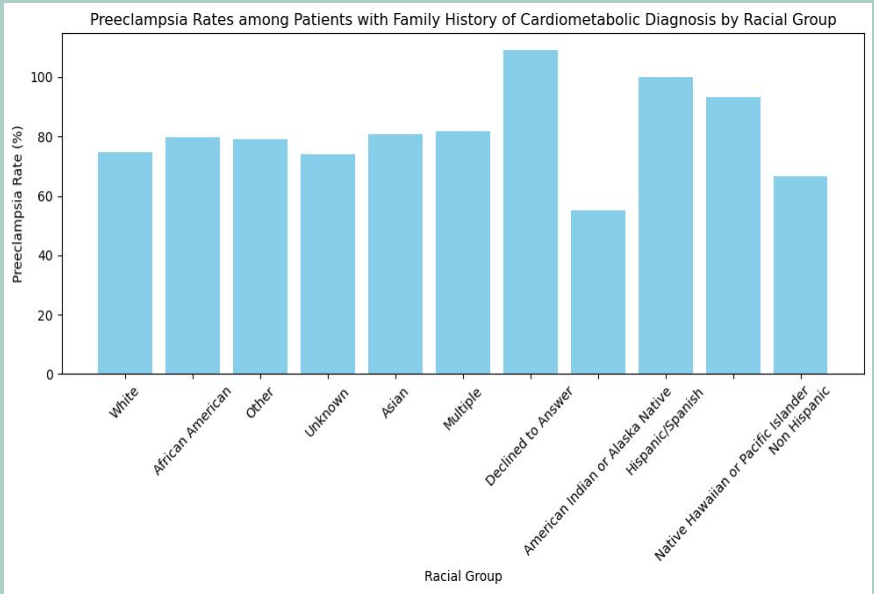
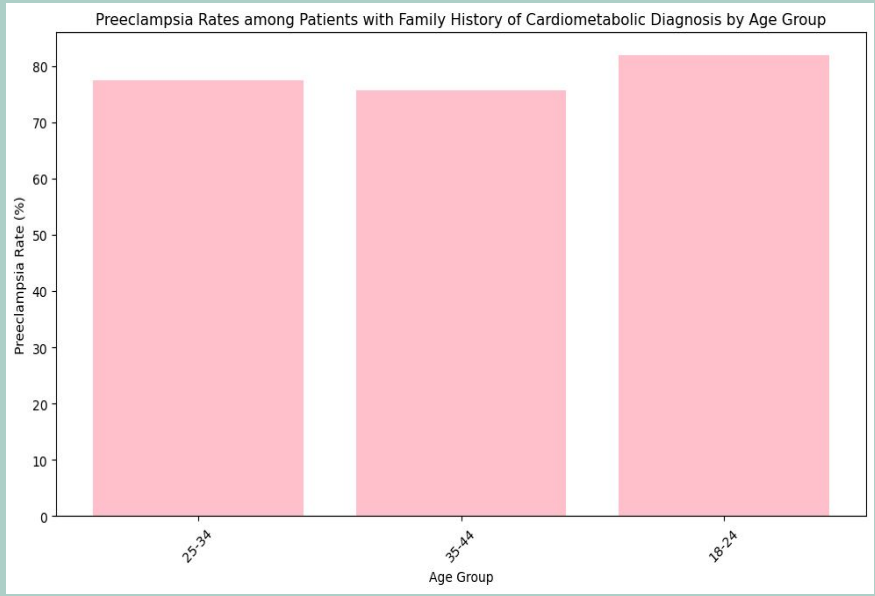




Rate for Patients with Family History Cardiometabolic Risk and Incidence of Preeclampsia for Race

Race	Total Count	Preeclampsia Count	Preeclampsia Rate
White	4699	2597	55.267078
African American	2924	1733	59.268126
Other	1718	991	57.683353
Unknown	527	289	54.838710
Asian	512	306	59.765625
Multiple	131	73	55.725191
Declined to Answer	54	43	79.629630
American Indian or Alaska Native	38	16	42.105263

Data Analysis by Race

High Preeclampsia Rates in Specific Groups:

- **Declined to Answer**: This group has the highest preeclampsia rate at 79.63%.
- **Native Hawaiian or Pacific Islander**: The preeclampsia rate is 73.33%.
- **Hispanic/Spanish**: This group has a preeclampsia rate of 68.42%.
- **African American**: The preeclampsia rate is relatively high at 59.27%.
- **Asian**: The preeclampsia rate is 59.77%.

Moderate to High Rates in Larger Groups:

- **White**: The preeclampsia rate is 55.27%.
- **Other**: This group has a preeclampsia rate of 57.68%.
- **Unknown**: This group has a rate of 54.84%.

Lower Rates in Some Groups:

- **Multiple**: The rate is lower in this group at 55.73%.
- **American Indian or Alaska Native**: The lowest rate is observed in this group at 42.11%.
- **Non Hispanic**: The preeclampsia rate is 41.67%.

Rate for Patients with Family History Cardiometabolic Risk and Incidence of Preeclampsia for Race

Age Group	Total Count	Preeclampsia Count	Preeclampsia Rate
18-24	694	412	59.365994
25-34	7955	4555	57.259585
35-44	2000	1110	55.500000

Data Analysis by Age

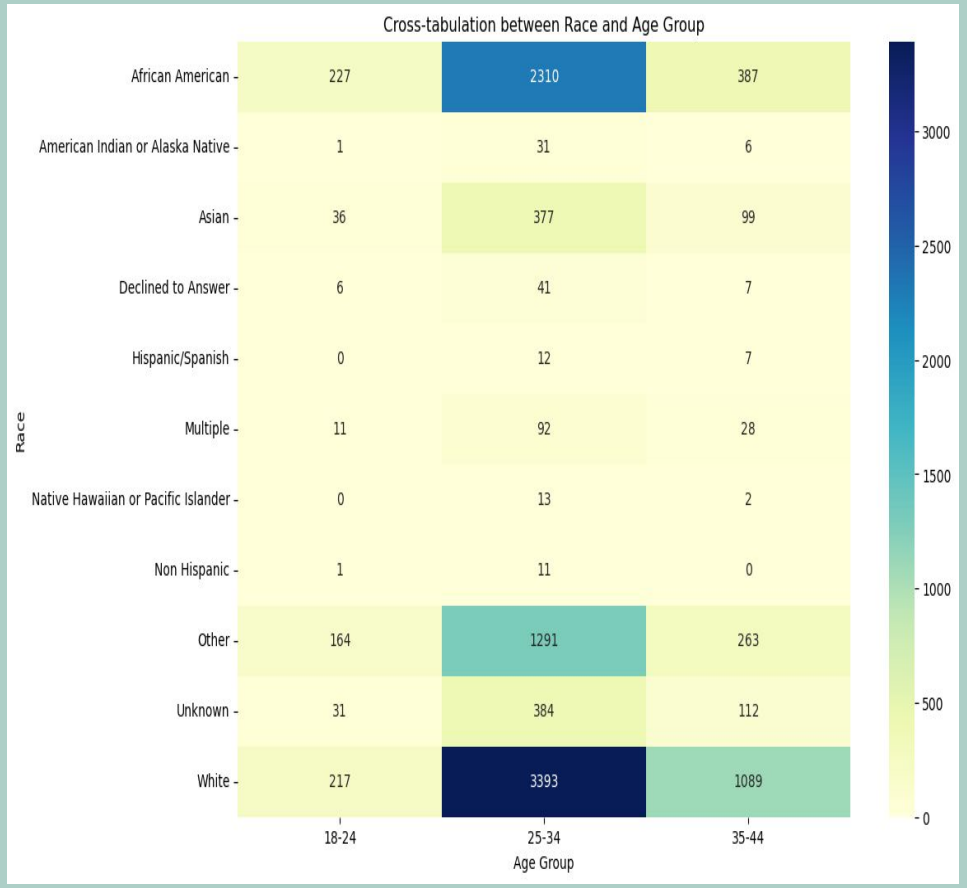
Preeclampsia Rate:

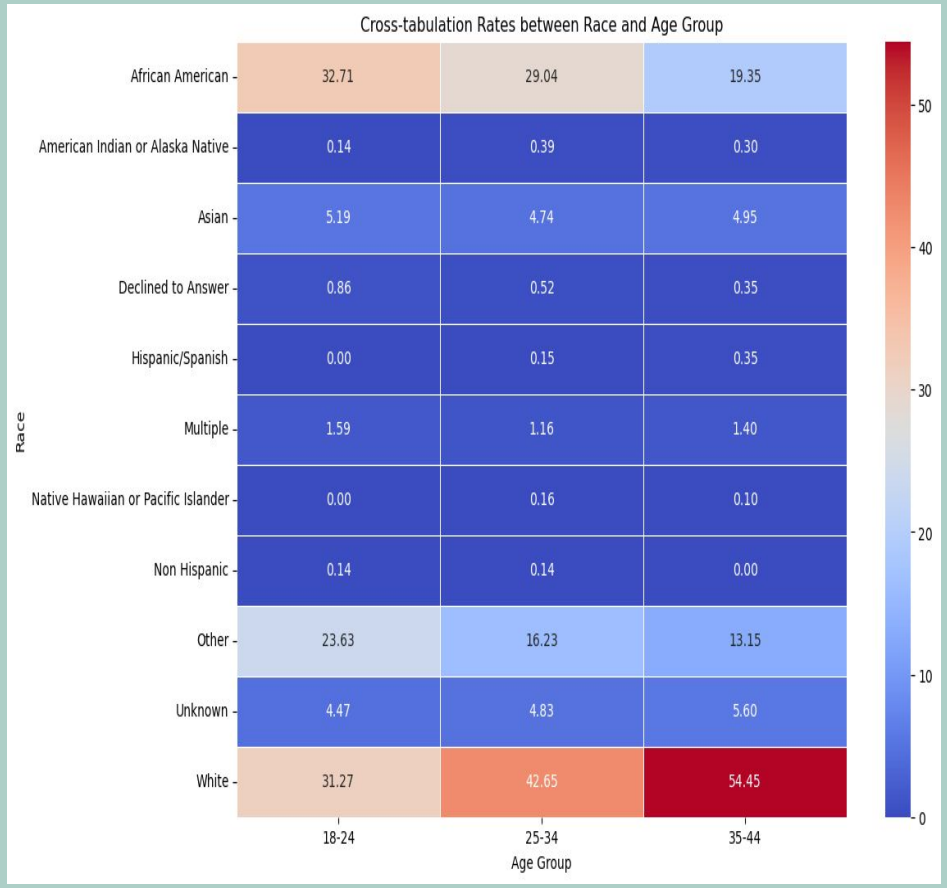
Highest Rate: The highest preeclampsia rate is observed in the age group 18-24, with 59.37%.

Moderate Rates: Age groups 25-34 and 35-44 have similar preeclampsia rates of 57.26% and 55.50%,.

Age Group 25-34: This age group has the highest number of total patients and preeclampsia cases.

Cross-Tabulation Between Race and Age





Cross-Tabulation Analysis

African American and White Population Trends: African Americans are most prevalent in the 18-24 age group (32.71%) but decrease with age. Whites increase with age, peaking in the 35-44 group (54.45%).

Diversity in Age Groups: Younger groups (18-24) show higher diversity, with significant representation from categories like "Other" (23.63%) and Asian (5.19%).

Population Size Effects: The 25-34 age group has the highest counts for many races, affecting percentage distributions.

Proposed Methodology

Logistic Regression Analysis:

Objective: Model the relationship between family history of cardiometabolic conditions and preeclampsia incidence, adjusting for confounders.

Proposed Methodology: Logistic Regression Analysis

1. **Data Collection:**
   - synth_New_FamilyHX, synth_New_Diagnosis, synth_New_Persons
2. **Statistical Analysis:**
   - Model Specification: Define preeclampsia incidence as the outcome; predictors include family history, age, race.
   - Model Fitting: Split data into training/testing sets; train logistic regression model.
3. **Model Evaluation:**
   - Performance Metrics: Evaluate using accuracy, precision, recall, F1 score, and AUC
   - Validation: Perform cross-validation for robustness.
4. **Interpretation of Results:**
   - Coefficients and Odds Ratios: Interpret the impact of predictors.
   - Statistical Significance: Determine significance of predictors

Proposed Methodology: Logistic Regression Analysis: Continued

1. **Sensitivity Analysis:**
   - Assess robustness to changes in model specifications and potential biases
2. **Reporting and Visualizations:**
   - Present findings with tables, charts, and clinical implications.

Using a Logistic Regression Model so far we resulted with:

```
Accuracy: 0.7126285839352156
              precision    recall  f1-score   support

           0       0.00      0.00      0.00      1313
           1       0.71      1.00      0.83      3256

    accuracy                           0.71      4569
   macro avg       0.36      0.50      0.42      4569
weighted avg       0.51      0.71      0.59      4569
```

Sources

1. Jeyabalan, A., & Powers, R. W. (2020). *Preeclampsia: Update on Pathogenesis and Management*. *Journal of Obstetrics and Gynaecology Canada*, 42(10), 1200-1211.
2. Shahul, S., Tung, A., Minhaj, M., Nizamuddin, J., Wenger, J., Mahmood, E., Mueller, A., Shaefi, S., Scavone, B., Kociol, R. D., Talmor, D., & Rana, S. (2015). *Racial Disparities in Comorbidities, Complications, and Maternal and Fetal Outcomes in Women with Preeclampsia/Eclampsia*. Hypertens Pregnancy, 34(4), 506–515.
3. Harville, E. W., Catalano, P. M., & Perng, W. (2018). *Pre-pregnancy cardiovascular risk factors and racial disparities in birth outcomes: the Bogalusa Heart Study*. BMC Pregnancy and Childbirth, 18(1), 216.
4. Ford ND, Cox S, Ko JY, et al. Hypertensive Disorders in Pregnancy and Mortality at Delivery Hospitalization — United States, 2017–2019. MMWR Morb Mortal Wkly Rep 2022;71:585–591. DOI: http://dx.doi.org/10.15585/mmwr.mm7117a1
5. American College of Obstetricians and Gynecologists. (2022, August). *Pregnancy at Age 35 Years or Older*.