From womb to world

Predicting Maternal and Infant Morbidity and Mortality

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Agenda

1. Background
2. Exploring the data
3. Prediction model
4. Takeaways and next steps

Background

Objective

At the beginning of a delivery, identify mothers and infants who may face serious complications and/or death to allow hospital staff to take steps to avoid or increase likelihood of survival in the event of complications.

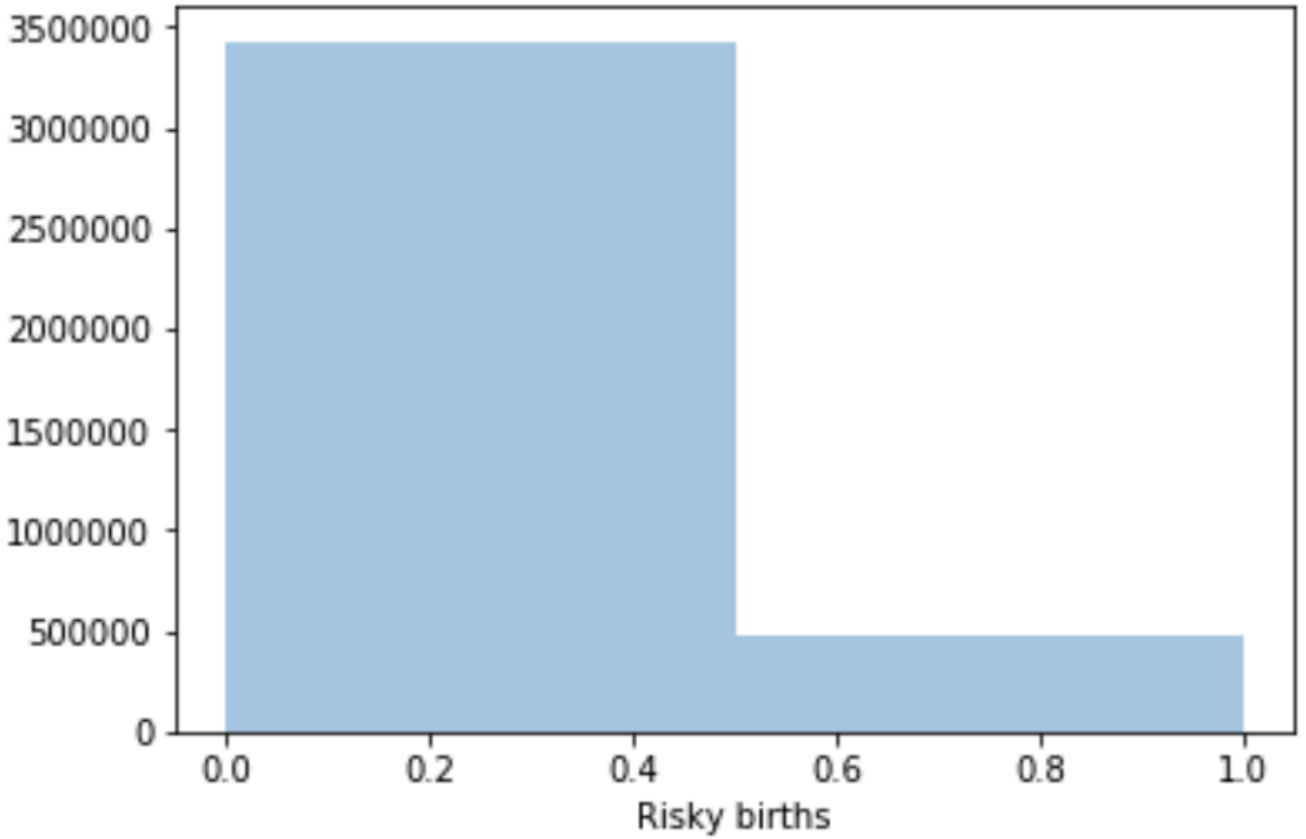
Data source

CDC 2016 Natality Public Use File

- All live births in 2016
- Basic demographics (e.g. age, marital status)
- Health information (e.g. diabetes, hypertension, BMI)
- Prior pregnancies (e.g. birth order, birth spacing)
- Maternal morbidity (e.g. unplanned hysterectomy)
- Infant health, morbidity, and mortality (e.g. apgar score)

Exploratory analysis

Risky births

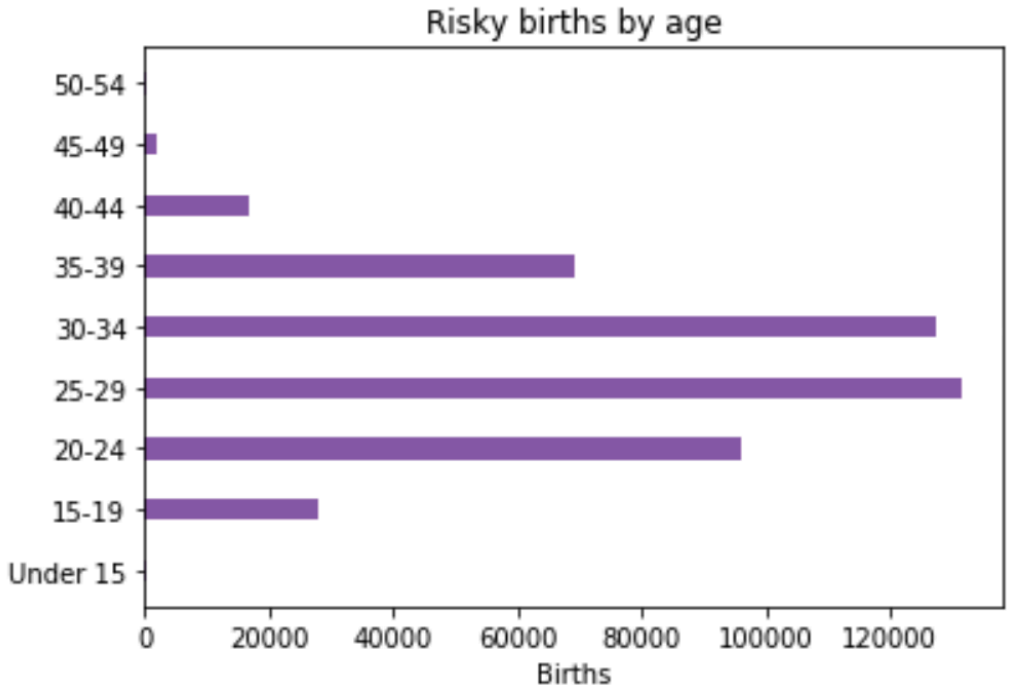


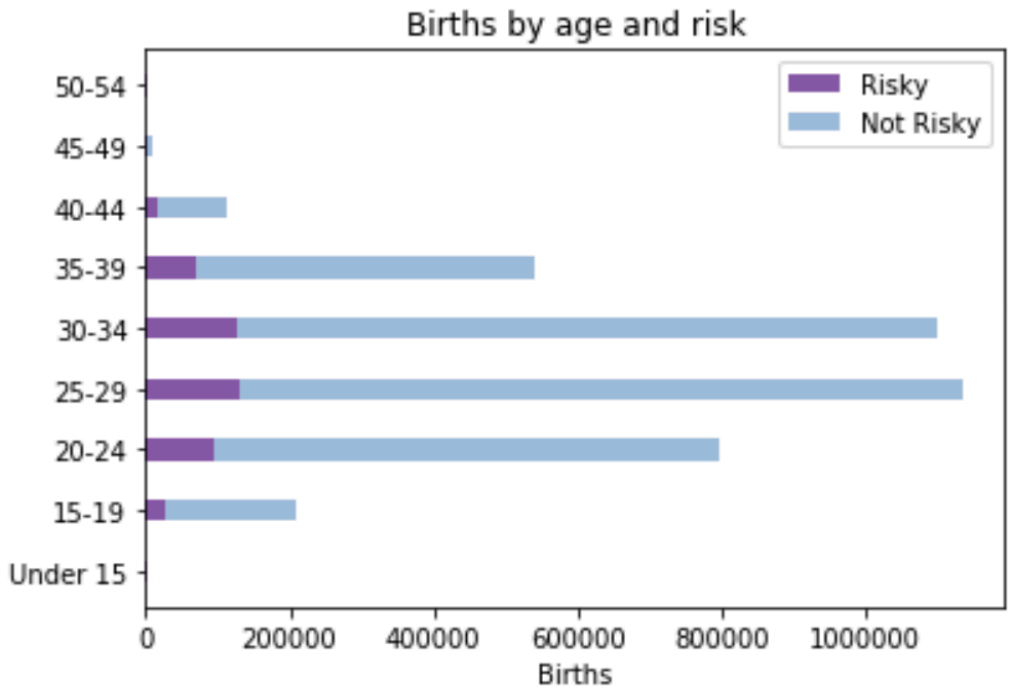
Factors in high-risk pregnancies[1]

- Teen births
- 1st birth after age 35
- Infertility treatment
- Obesity
- Multiple births
- Gestational diabetes
- Eclampsia hypertension

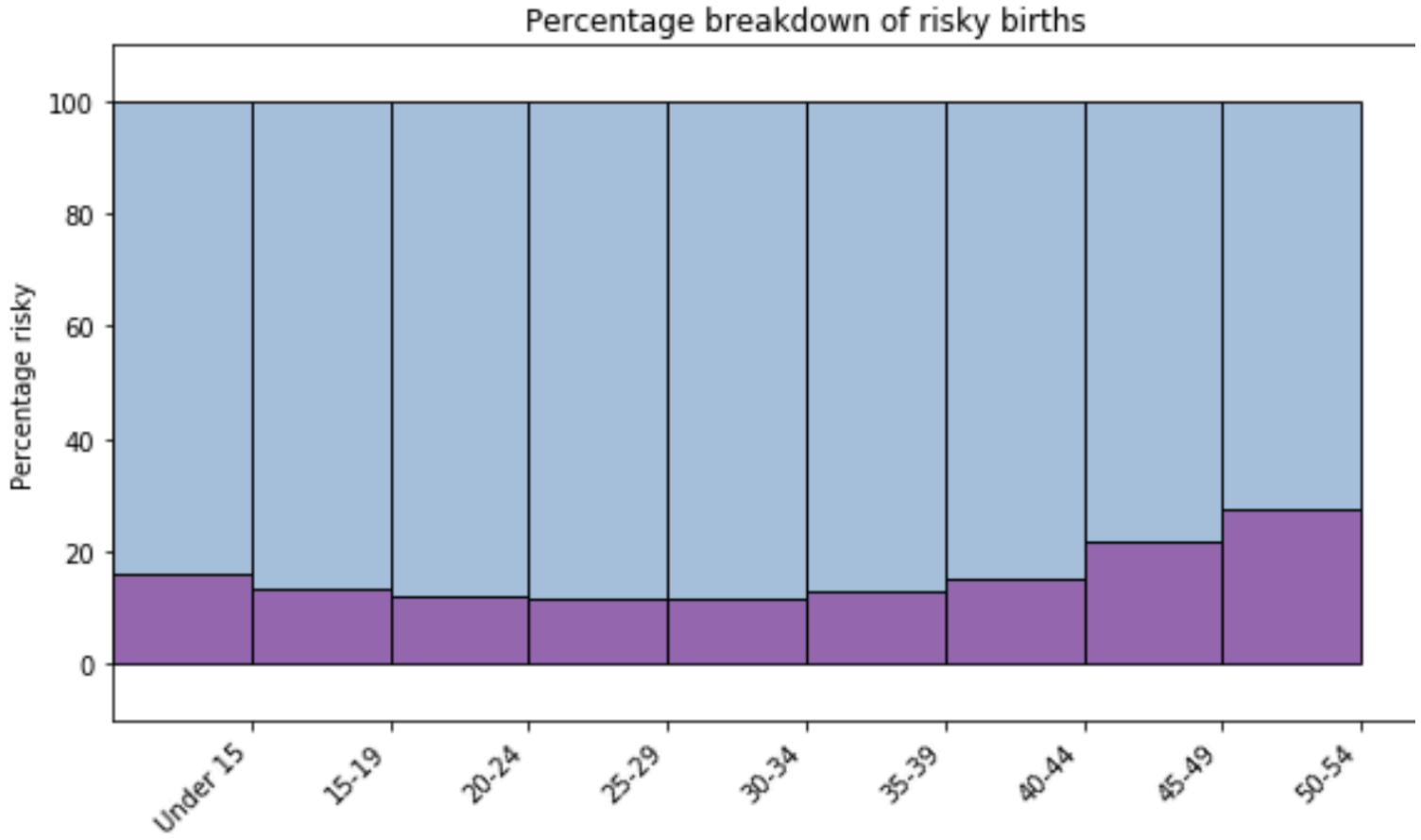
[1]Taken from NIH National Institute of Child Health and Human Development

Mother’s age at delivery

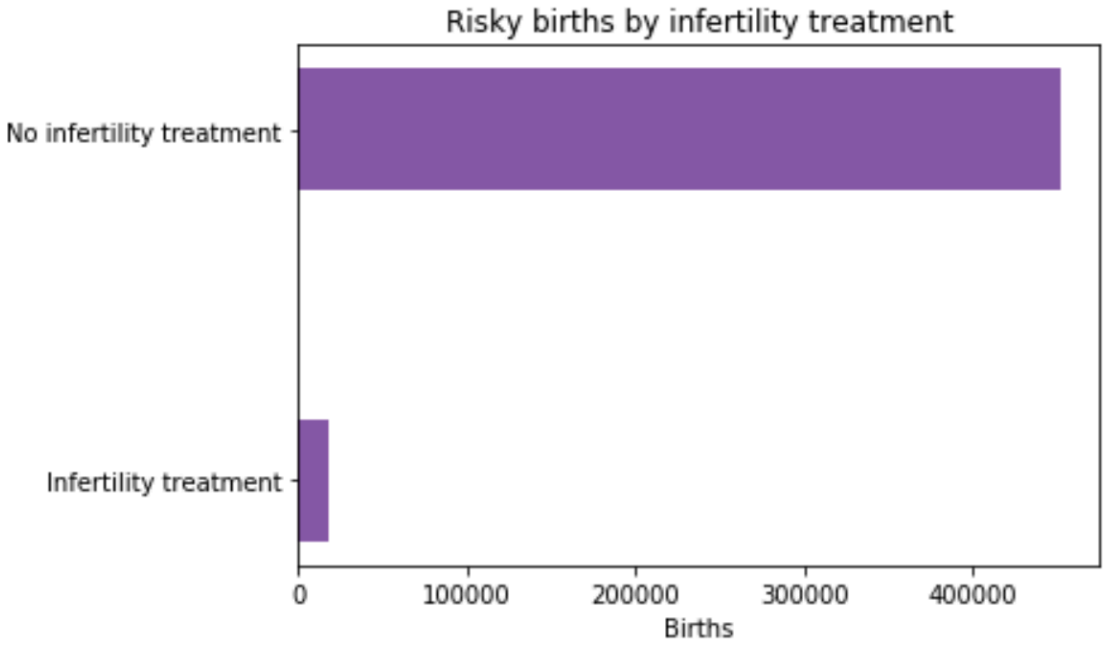


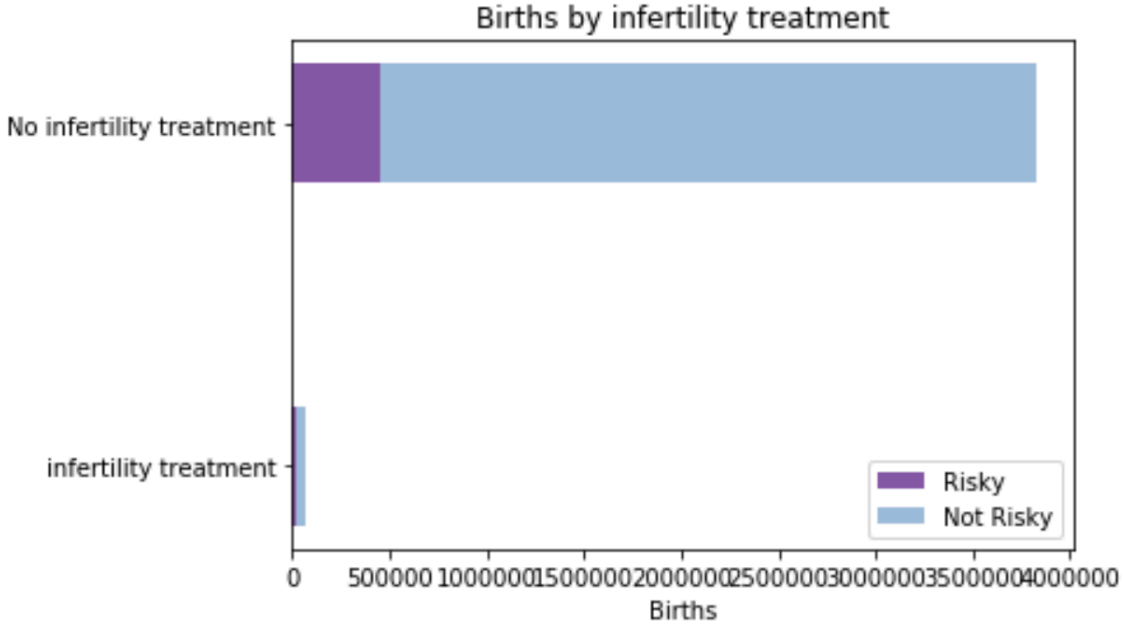


Age at Delivery

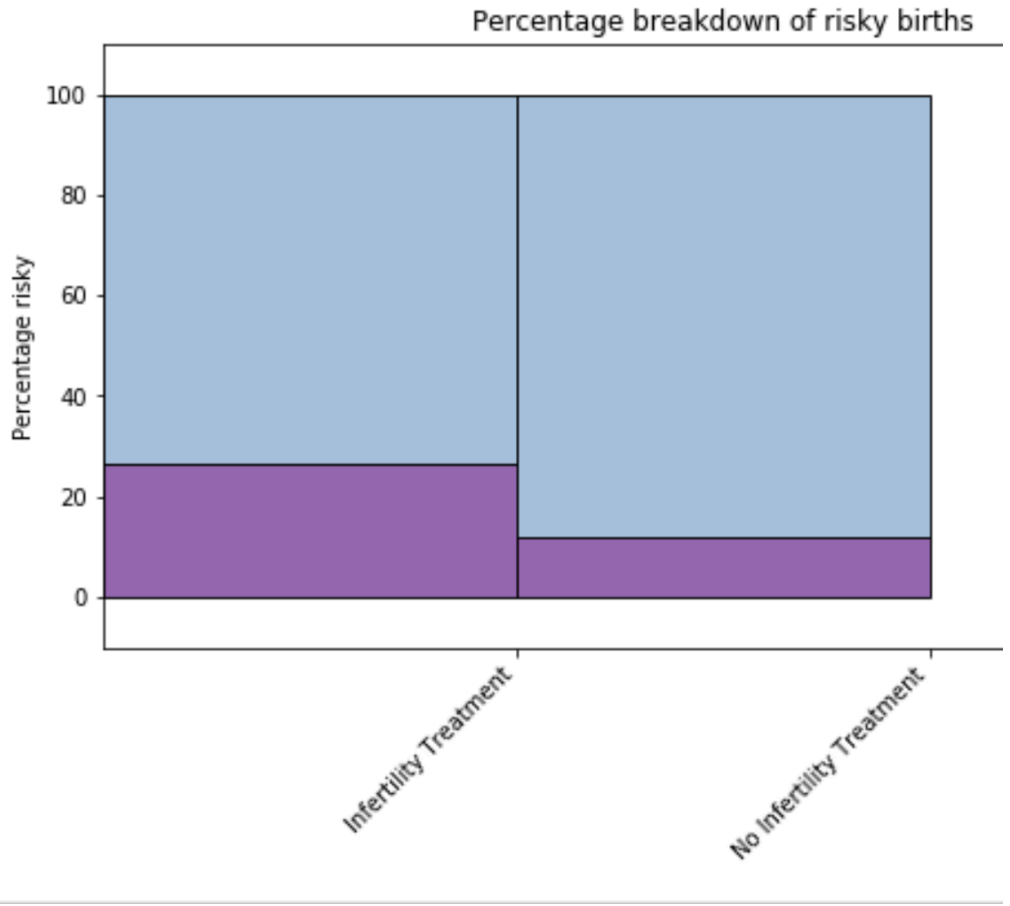


Infertility Treatment

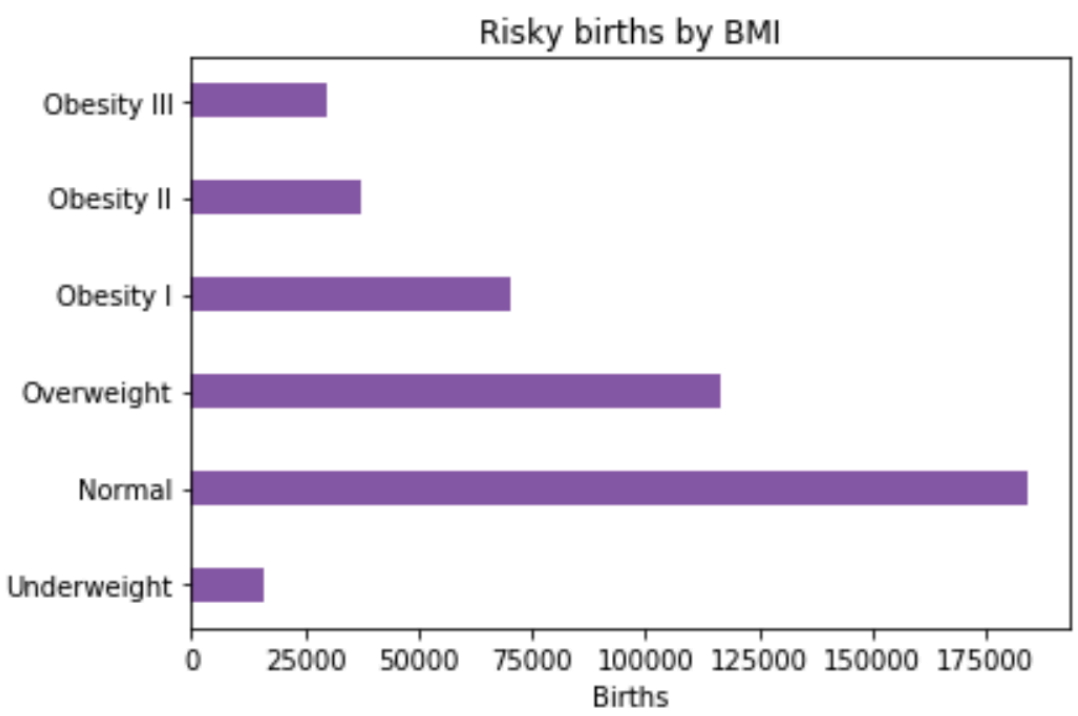


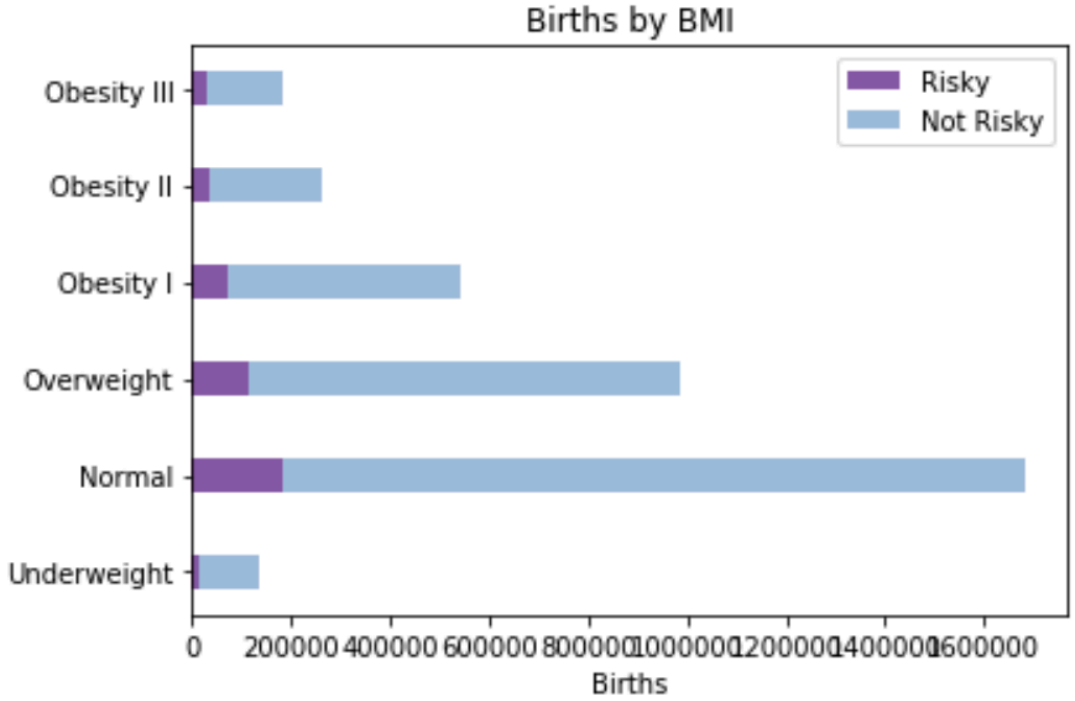


Infertility Treatment

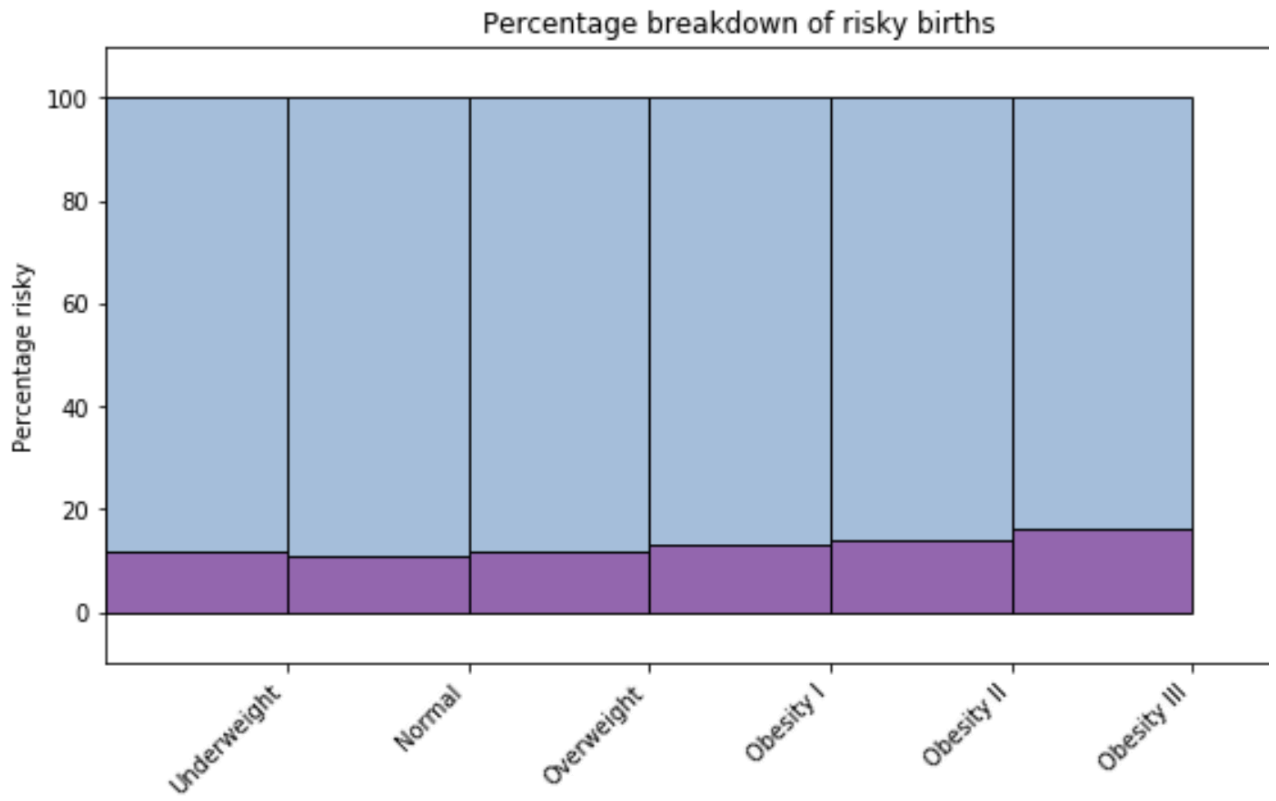


Obesity

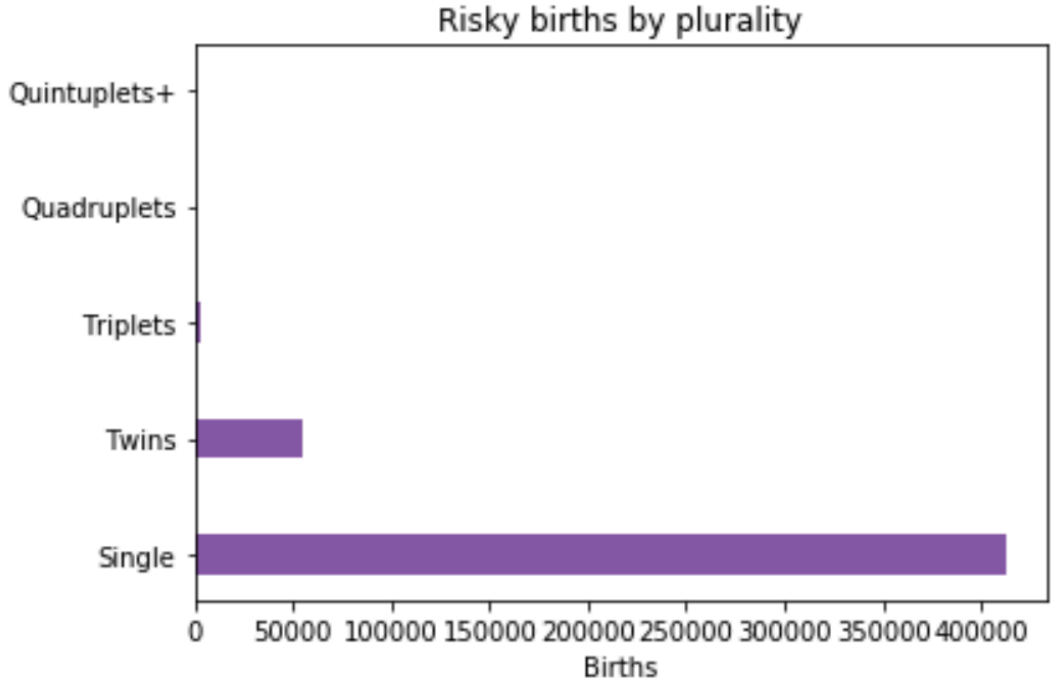

Risky births by BMI
Obesity III
Obesity II
Obesity I
Overweight
Normal
Underweight
0
25000
50000
75000
100000
125000
150000
175000
Births

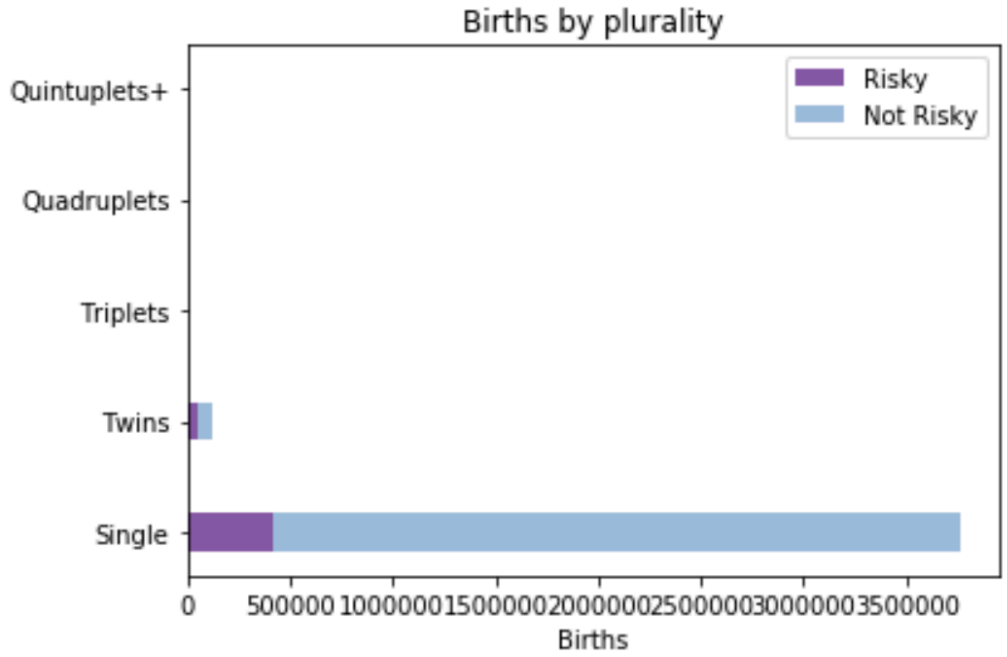

Births by BMI
Risky
Not Risky
Obesity III
Obesity II
Obesity I
Overweight
Normal
Underweight
0
200000
400000
600000
800000
1000000
1200000
1400000
1600000
Births

Obesity

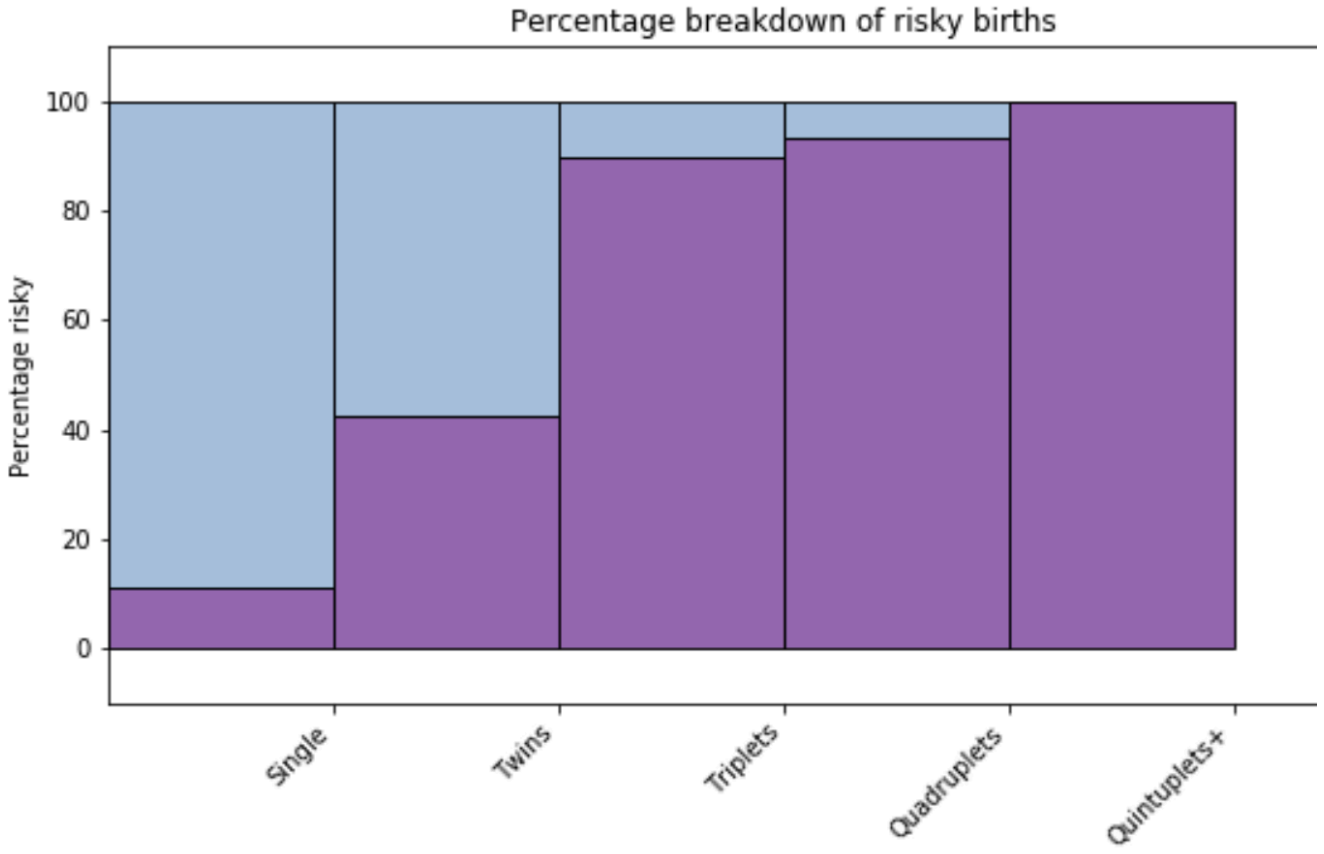

Percentage breakdown of risky births
Percentage risky
100
80
60
40
20
0
Underweight
Normal
Overweight
Obesity I
Obesity II
Obesity III

Multiple Births

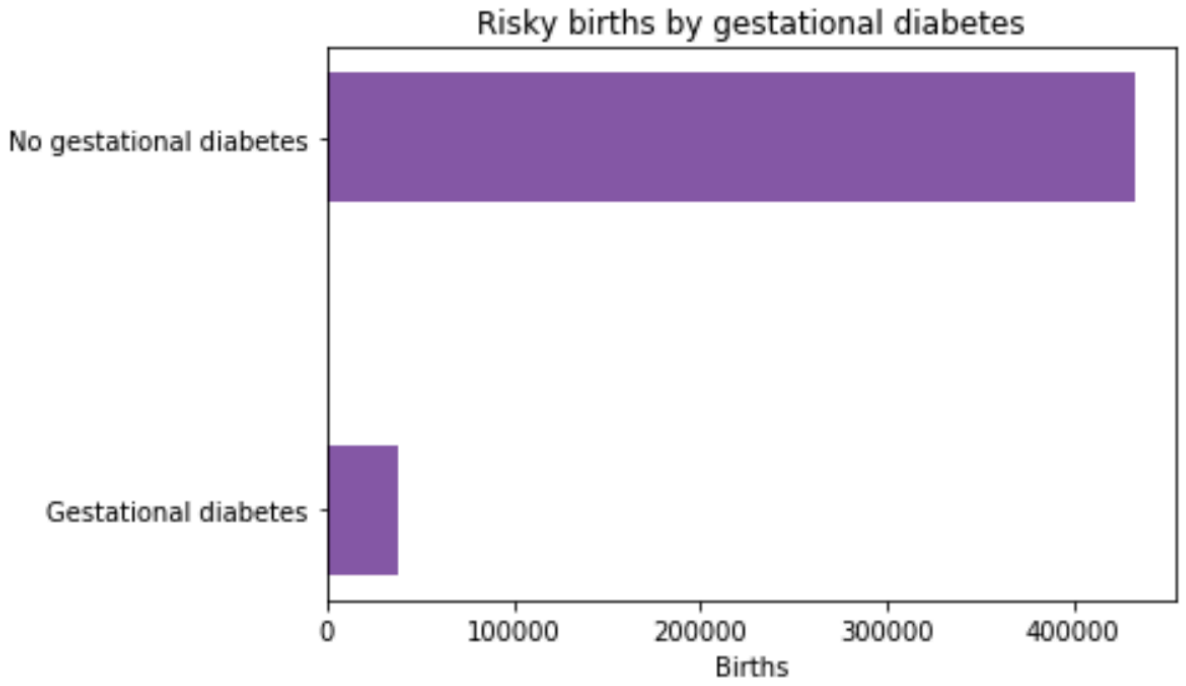


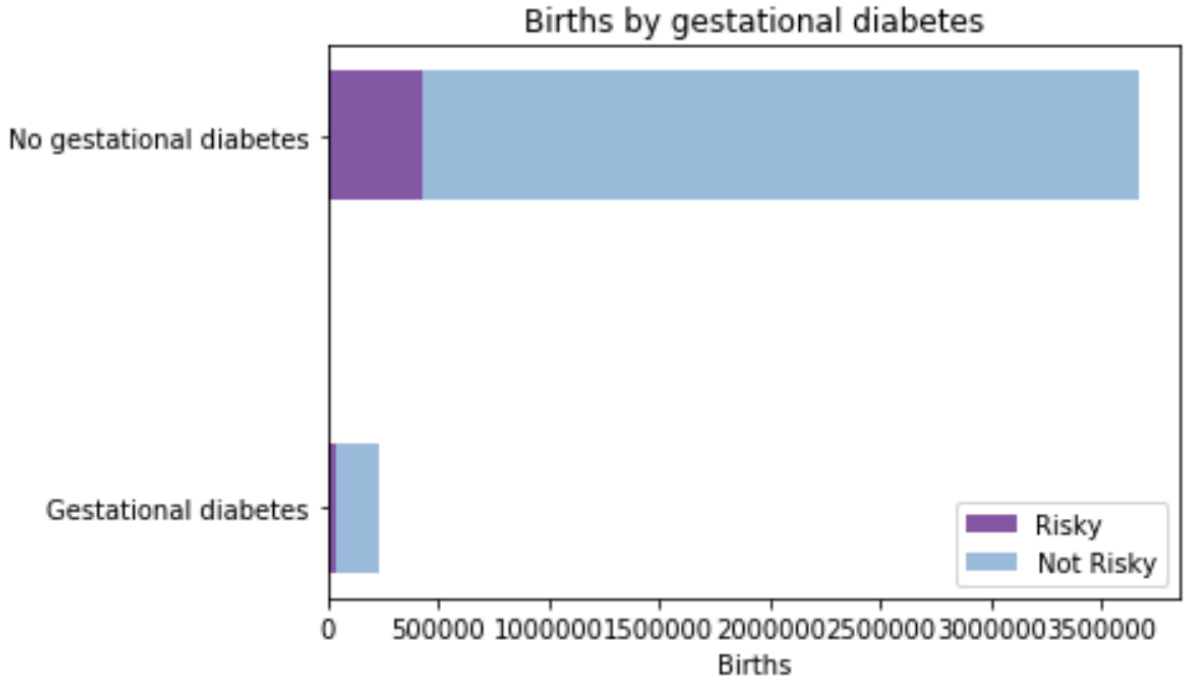


Multiple Births

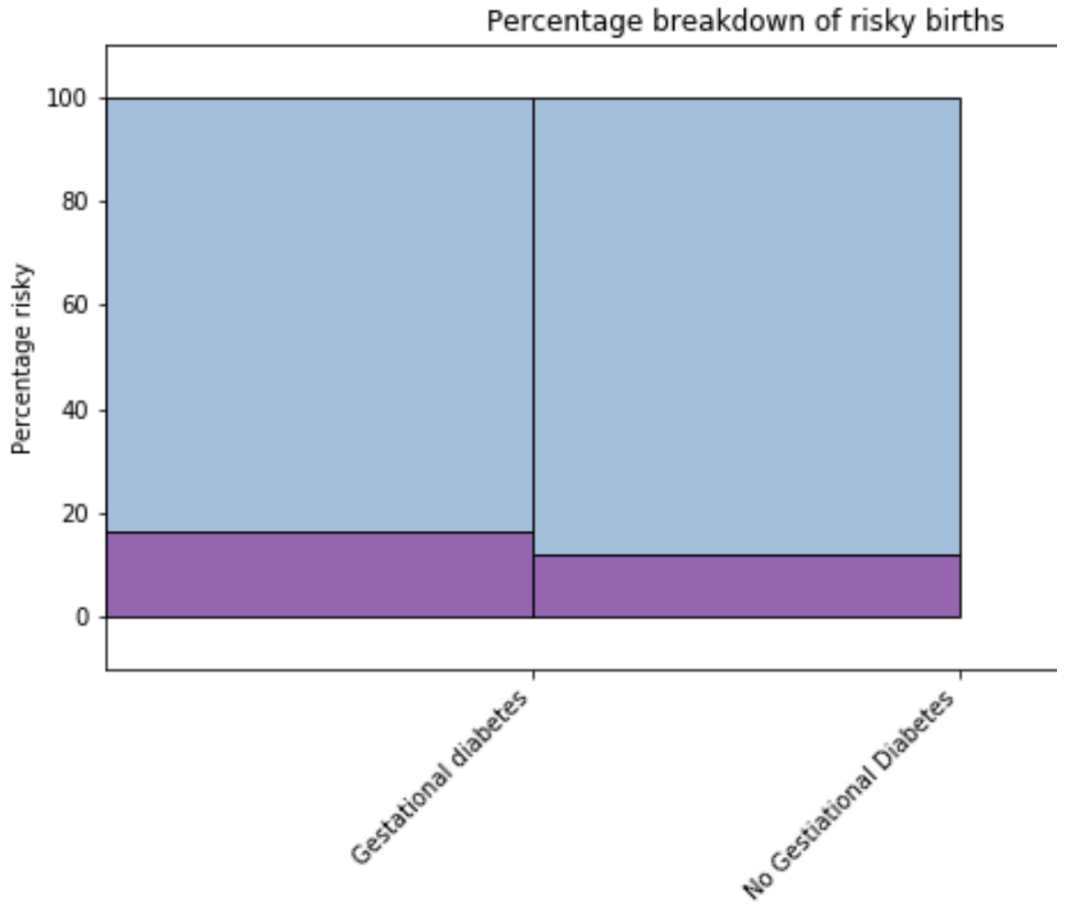


Gestational Diabetes

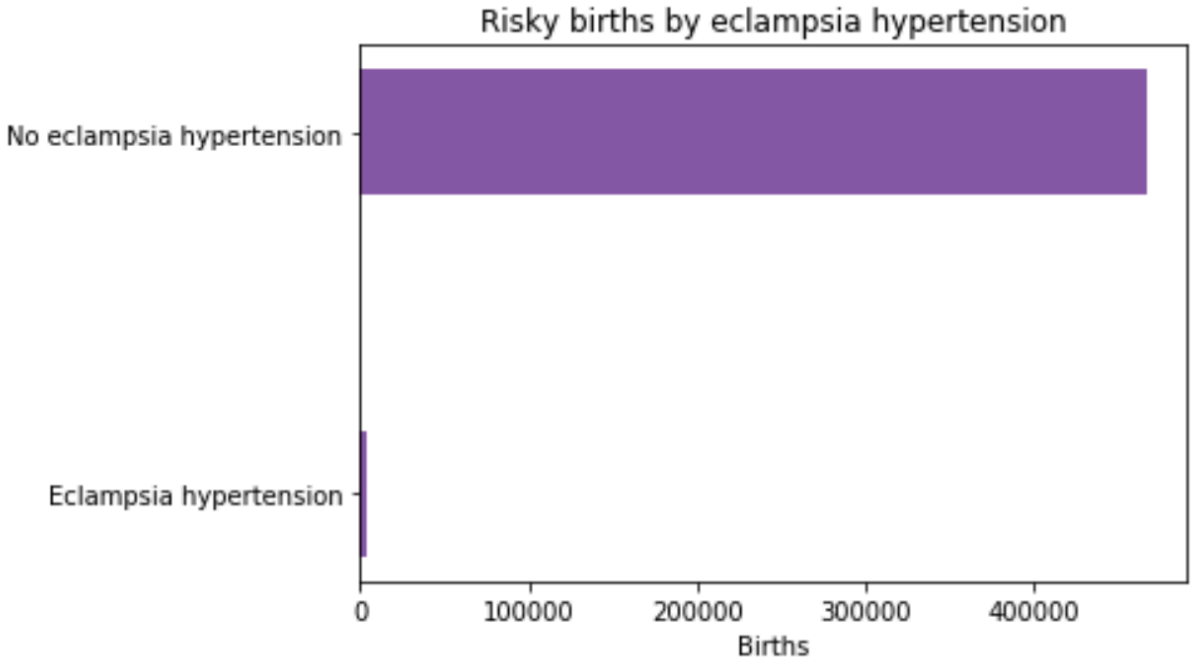


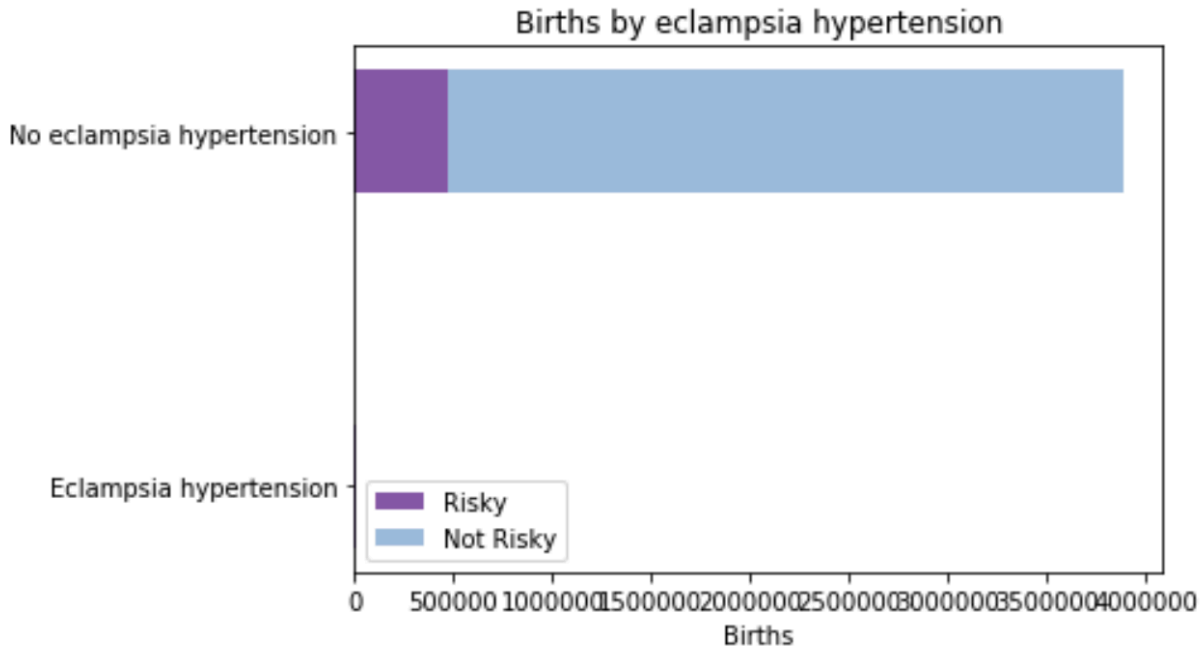


Gestational Diabetes



Eclampsia Hypertension





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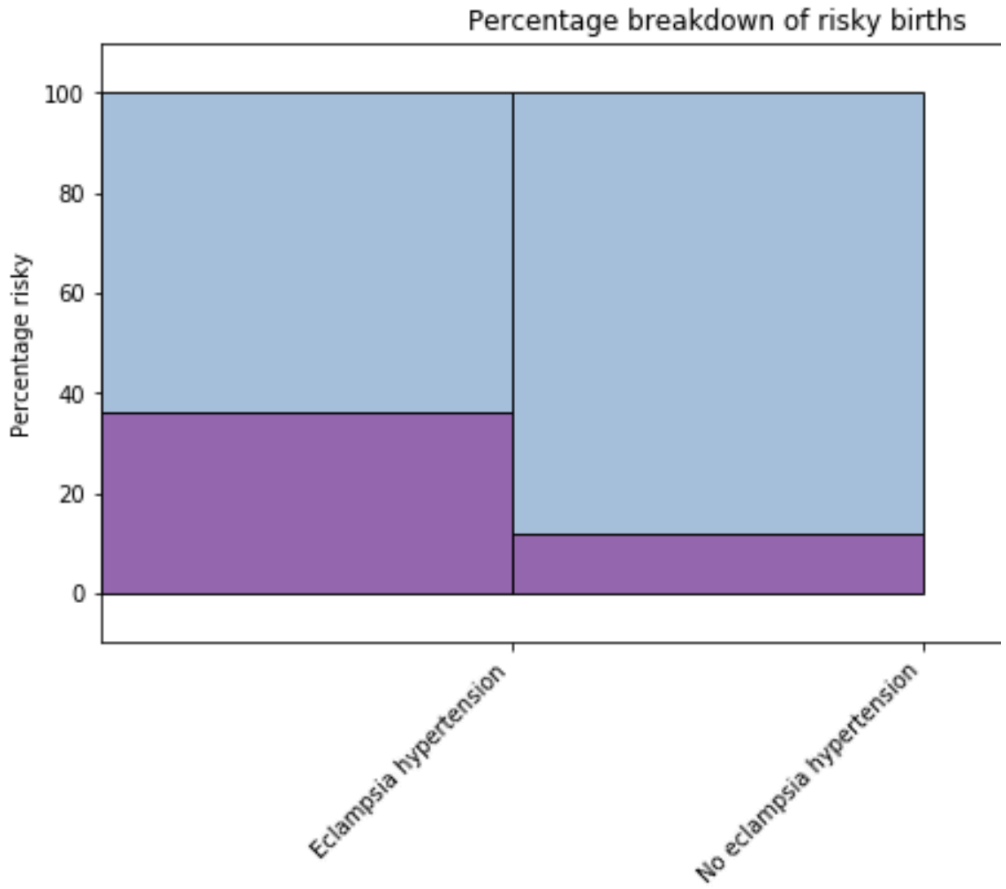
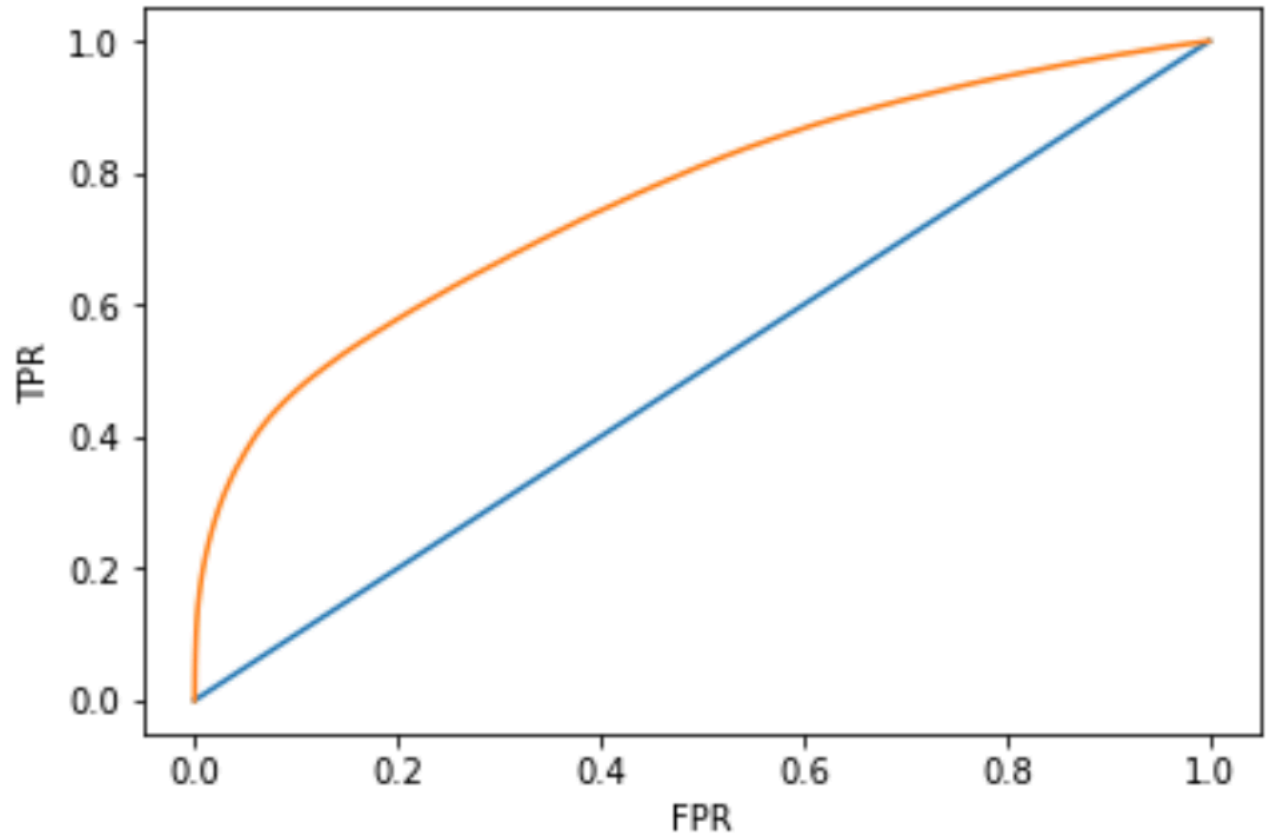
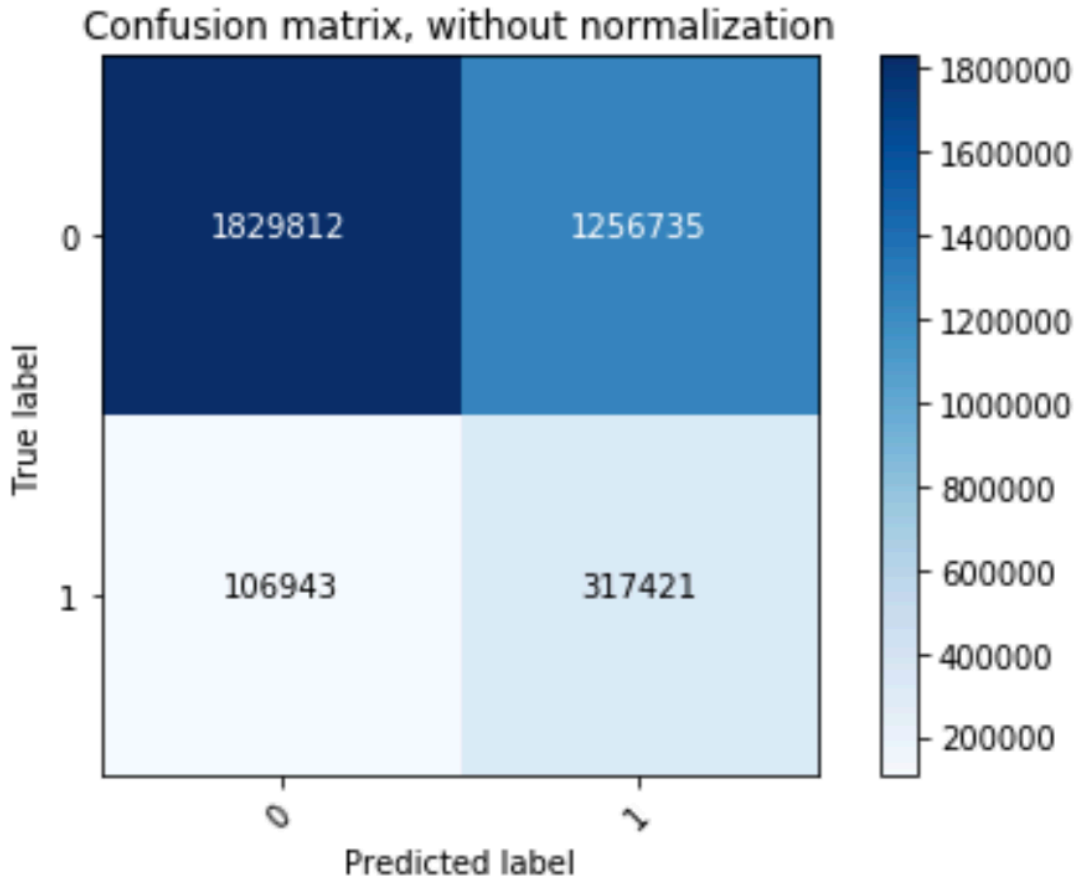


Prediction Model

Sensitivity vs. specificity



Prediction by logistic regression



Validation Set Scores	
Sensitivity	75%
Specificity	20%
Accuracy	61%

Rank	Feature	Increase in OR	Rank	Feature	Increase in OR
1	Under 20 weeks gest. age	444.5%	**13**	No prenatal care	52.6%
2	Triplets	351.6%	**14**	Current hepatitis c infection	51.8%
3	20 - 27 weeks gest. age	312.9%	**15**	Prior pre-term delivery	50.0%
4	28 - 31 weeks gest. age	187.6%	**16**	Hospital birth	48.7%
5	32 - 33 weeks gest. age	148.6%	**17**	2 children dead from prev LB	47.0%
6	Pre-pregnancy diabetes	93.4%	**18**	41+ cig/day in 3rd trim.	46.8%
7	21 - 40 cig/day in 3rd trim.	76.9%	**19**	Intrastate non-resident	45.8%
8	Twins	76.9%	**20**	First birth	43.2%
9	Unmarried	75.8%	**21**	Gestational diabetes	42.2%
10	Quadruplets	55.9%	**22**	Mother aged 50 - 54 years	42.1%
11	Interstate nonresident	54.2%	**23**	Eclampsia hypertension	40.8%
12	Current syphilis infection	53.2%	**24**	Pre-pregnancy hypertension	40.3%

Takeaways & Next Steps

Takeaways

1. Gestational age and plurality are strongest drivers of risky births

2. Major sensitivity/specificity tradeoff

3. Some features may be driven by access to healthcare or other social determinants of health

Next steps

- Fit additional types of models
- Try predicting different types of adverse outcomes
- Add in data from prior years, incorporate time series

Appendix

What counts as a risky birth?

- Chorioamnionitis (dangerous infection)
- Unplanned hysterectomy
- Ruptured uterus
- Mother admitted to intensive care unit
- 5-minute apgar score <= 6
- Assisted ventilation for infant
- Infant admitted to neonatal intensive care unit
- Surfactant Deficiency Disorder (infant respiratory distress)
- Antibiotics for newborn
- Infant seizures
- Infant mortality