How Drug Usage During Labor and Delivery Affects Infant Health: A Predictive Analysis of APGAR5 Scores*

!!! MAIN RESULTS !!!

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First sentence. Second sentence. Third sentence. Fourth sentence.

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*Code and data are available at: https://github.com/koyunkyung/infant_health.

1 Introduction

Overview paragraph

Estimand paragraph

Results paragraph

Why it matters paragraph

Telegraphing paragraph: The remainder of this paper is structured as follows. Section 2….

2 Data

2.1 Overview

We use the statistical programming language R (R Core Team 2023)…. Our data (Toronto Shelter & Support Services 2024)…. Following Alexander (2023), we consider…

Overview text

2.2 Measurement

Some paragraphs about how we go from a phenomena in the world to an entry in the dataset.

2.3 Outcome variables

2.3.1 Apgar Score: a measure the infant's chance of surviving the first year of life

The Apgar score is a measure of the need for resuscitation (Centers for Disease Control and Prevention (CDC) and National Center for Health Statistics (NCHS) 2023) to the infant, which is the act of bringing someone back to life or waking them (Cambridge University Press n.d.). It is a test given to newborns soon after birth (5 minutes) to check 'Appearance(skin color)', 'Pulse(heart rate)', 'Grimace response(reflexes)', 'Activity(muscle tone)', 'Respiration(breathing rate and effort)' (KidsHealth from Nemours n.d.). Each is rated on a scale of 0 to 2, with 2 being the best score (KidsHealth from Nemours n.d.). Apgar scores range from 0 to 10, with a score of 7 or higher indicating that the neonate is in good to excellent physical condition (Centers for Disease Control and Prevention (CDC) and National Center for Health Statistics (NCHS) 2023).

Figure 1 shows that the majority of infants in the raw dataset achieve a high APGAR5 score, clustering around 9 and 10. Very few observations exist for lower scores, reflecting rare instances of significant distress at birth. Even after filtering the dataset by selecting the relevant variables for analysis and removing the NA values, Figure 2 shows that the observations are overly clustered around high APGAR5 scores.

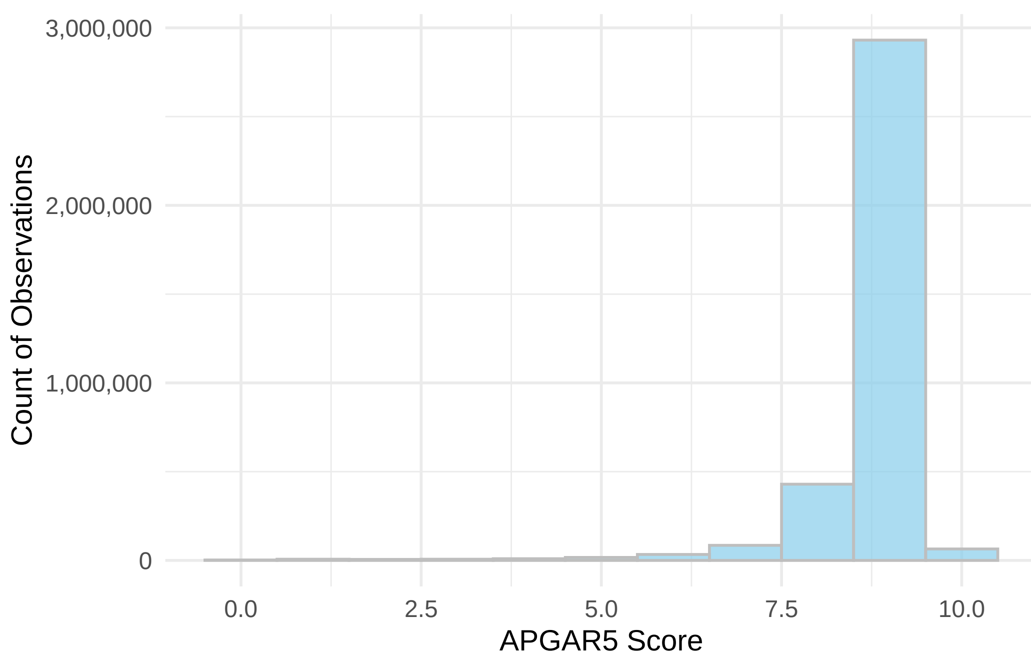

Figure 1: The distribution of APGAR5 scores across the entire observation in the original dataset **Note:** Unknown or unreported observations were excluded so that the distribution could be clearly visualized

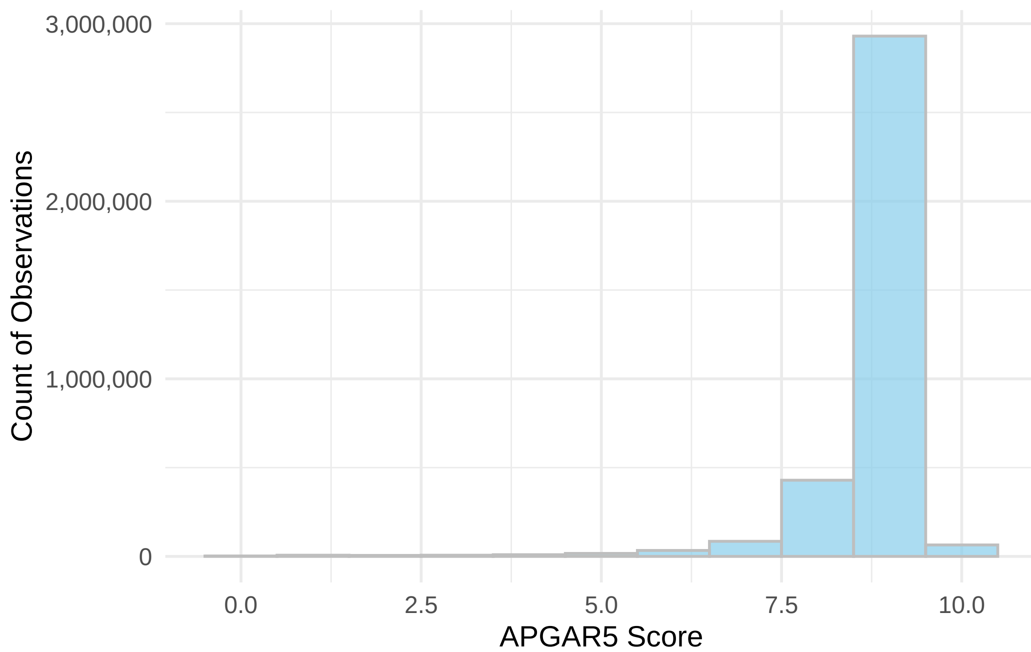

Figure 2: The distribution of APGAR5 scores across the filtered observation in analysis dataset, which selected the relevant variables and removed the NA values

To ensure a balanced analysis and accurately assess the effects of drug treatment during delivery and labor, the data was refined to achieve a more even distribution of observations across APGAR5 scores. Based on the lowest observation count of 2,065 in the original distribution, the number of observations for each APGAR5 score was set to 2,000 as shown in Figure 3. Random sampling was used to ensure a fair distribution across all score levels.

	0	1	2	3	4	5	6	7	8	9	10
Count	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000

Figure 3: The distribution of APGAR5 scores across the filtered observation in analysis dataset

2.4 Predictor variables

All of the predictor variables used in the analysis are classified into the same category, which is the ‘characteristics of labor and delivery’. This item, which contains 6 separate checkboxes that the respondent can choose from, allows for the reporting of more than one characteristic and includes a choice of “None of the above”(Centers for Disease Control and Prevention (CDC) and National Center for Health Statistics (NCHS) 2023).

2.4.1 Number of Treatments Used During Delivery and Labor

Figure 4 shows that the majority of observations involve 0 to 2 treatments during labor and delivery, with a steep decline in counts for 3 or more treatments. Most births reported in this dataset occur with minimal medical intervention, and higher number of treatments are relatively rare.

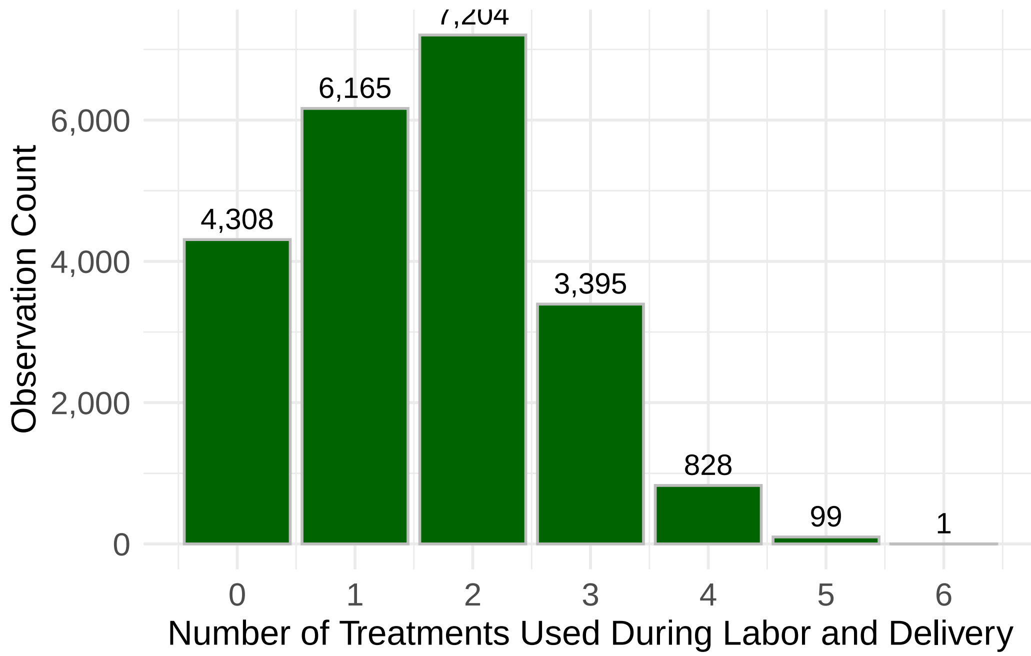

Figure 4: The distribution of observations across different number of treatments used during delivery and labor

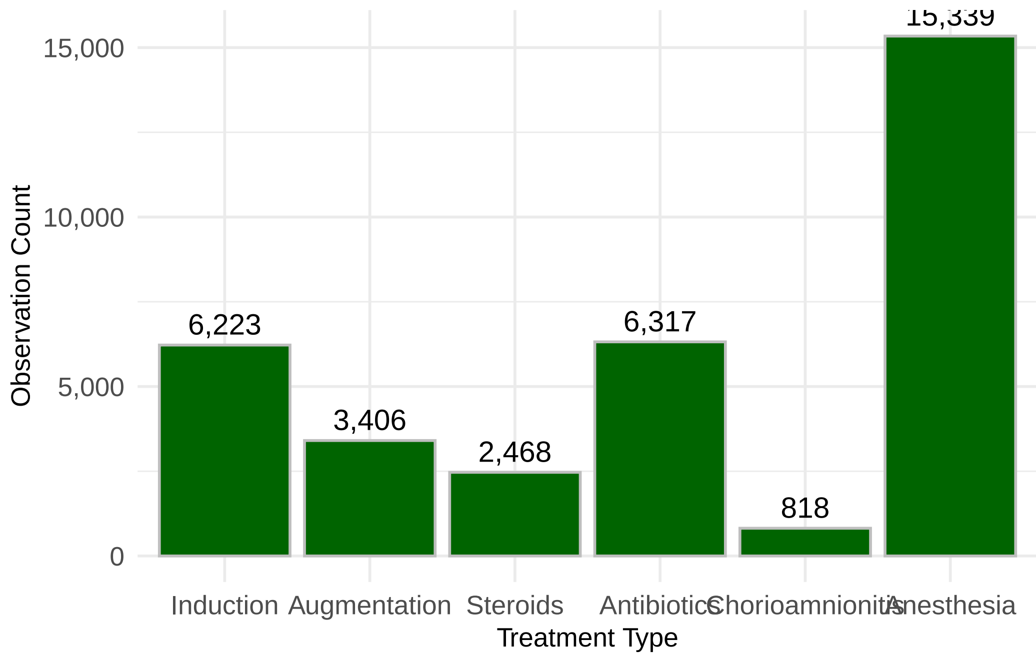

Figure 5: The distribution of observations across different type of treatments used during delivery and labor

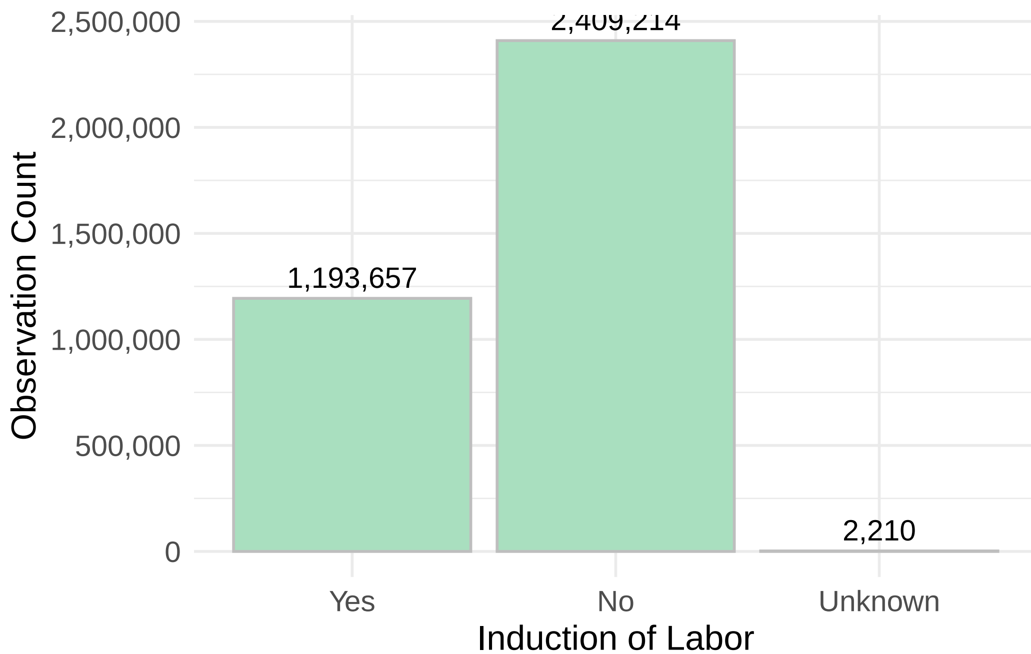

Figure 6: The distribution of observations in the raw dataset based on whether the infant received induction of labor or not

2.4.2 Type of Treatments Used During Delivery and Labor

2.4.3 Induction of labor

2.4.4 Augmentation of labor

2.4.5 Steroids (glucocorticoids) for fetal lung maturation received by the mother before delivery

2.4.6 Antibiotics received by the mother during delivery

2.4.7 Clinical chorioamnionitis diagnosed during labor or maternal temperature over 38 degrees celcius (100.4 degrees fahrenheit)

2.4.8 Epidural or spinal anesthesia during labor

2.5 Correlation between predictor variables

2.5.1 Induction of Labor and Augmentation of Labor

2.5.2 Usage of Steroids and Antibiotics

2.5.3 Usage of Chorioamnionitis and Antibiotics

3 Model

The goal of our modelling strategy is twofold. Firstly,...

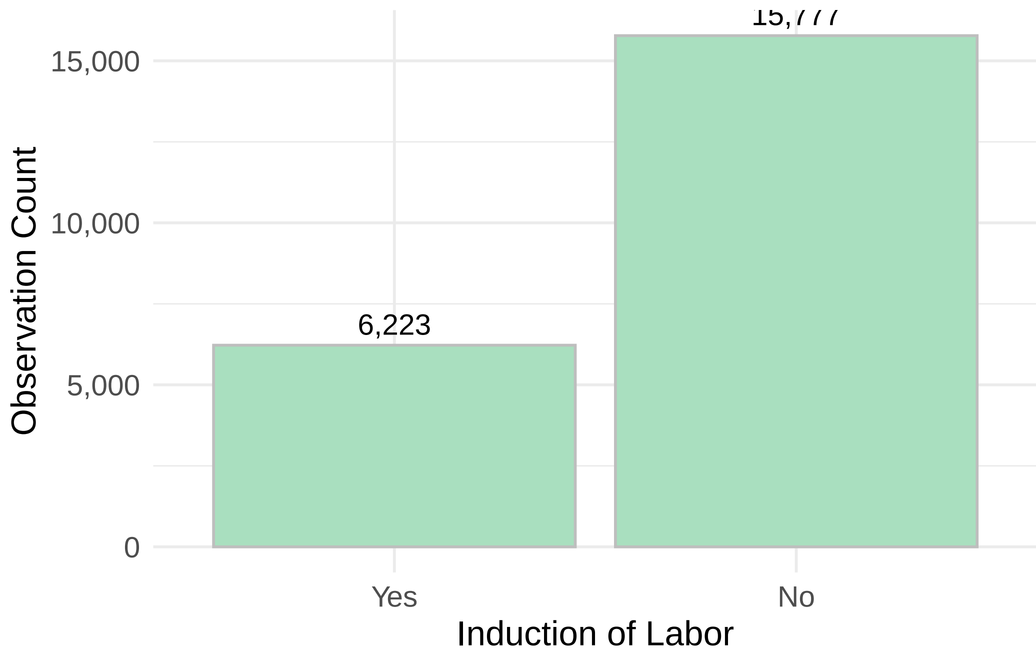

Figure 7: The distribution of observations in the analysis dataset on whether the infant received induction of labor or not,

Here we briefly describe the Bayesian analysis model used to investigate… Background details and diagnostics are included in Appendix B.

3.1 Model set-up

Define y_i as the number of seconds that the plane remained aloft. Then β_i is the wing width and γ_i is the wing length, both measured in millimeters.

$$
\begin{aligned}
y_i|\mu_i, \sigma &\sim \text{Normal}(\mu_i, \sigma) && (1)\\
\mu_i &= \alpha + \beta_i + \gamma_i && (2)\\
\alpha &\sim \text{Normal}(0, 2.5) && (3)\\
\beta &\sim \text{Normal}(0, 2.5) && (4)\\
\gamma &\sim \text{Normal}(0, 2.5) && (5)\\
\sigma &\sim \text{Exponential}(1) && (6)
\end{aligned}
$$

We run the model in R (R Core Team 2023) using the `rstanarm` package of Goodrich et al. (2022). We use the default priors from `rstanarm`.

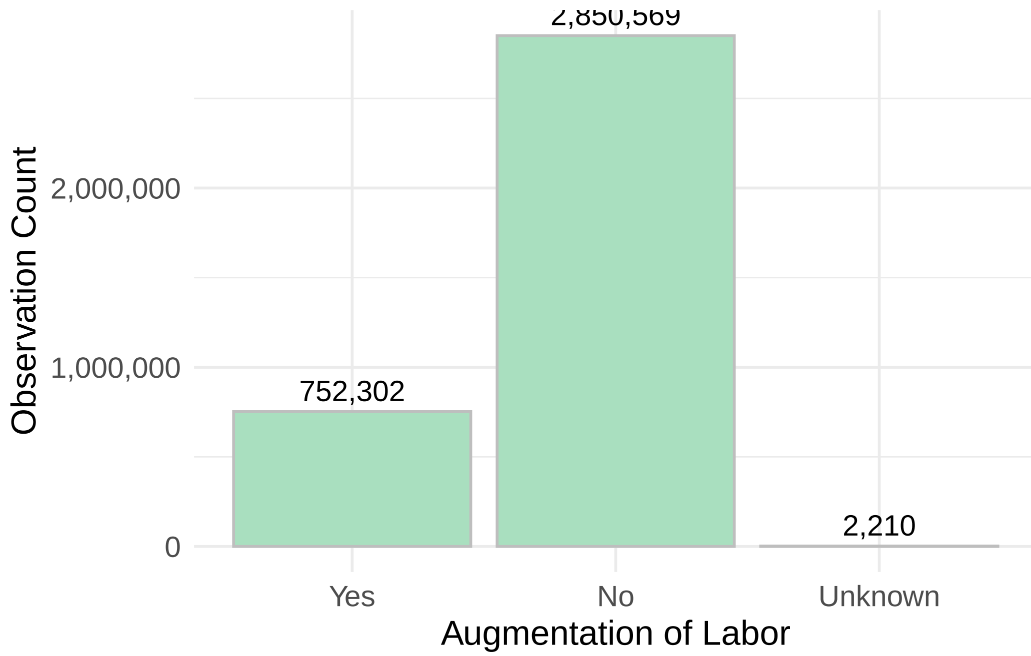

Figure 8: The distribution observations in the raw dataset based on whether the infant received augmentation of labor or not

3.1.1 Model justification

We expect a positive relationship between the size of the wings and time spent aloft. In particular…

We can use maths by including latex between dollar signs, for instance θ.

4 Results

4.1 Results from examining the analysis dataset

4.2 Results from the prediction model

Our results are summarized in **?@tbl-modelresults**.

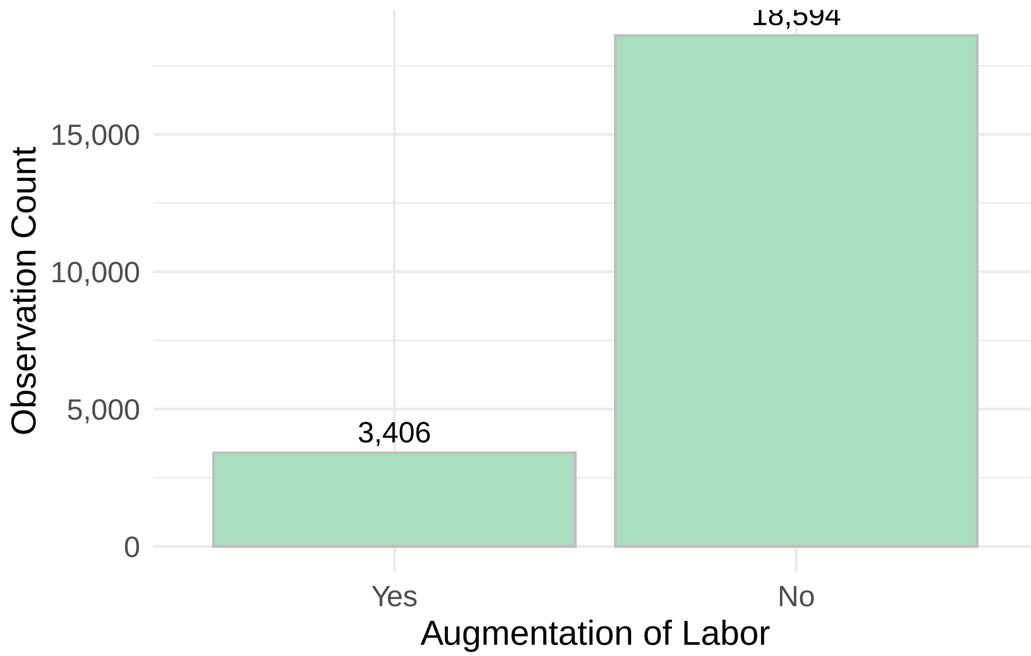

Figure 9: The distribution observations in the analysis datset on whether the infant received augmentation of labor or not

5 Discussion

5.1 First discussion point

If my paper were 10 pages, then should be be at least 2.5 pages. The discussion is a chance to show off what you know and what you learnt from all this.

5.2 Second discussion point

Please don't use these as sub-heading labels - change them to be what your point actually is.

5.3 Third discussion point

5.4 Weaknesses and next steps

Weaknesses and next steps should also be included.

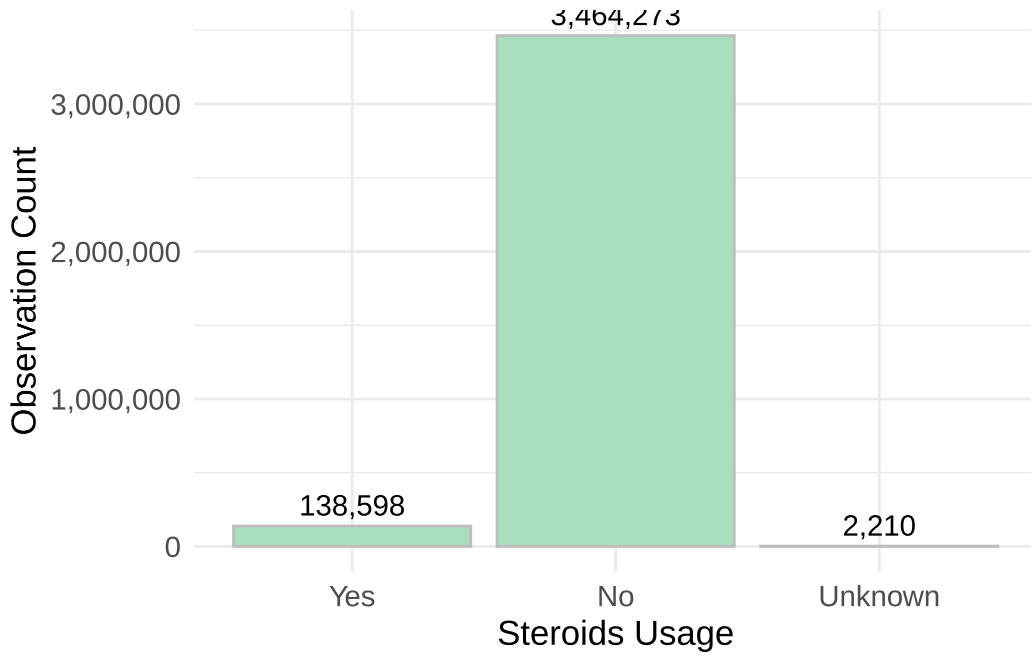

Figure 10: The distribution observations in the raw dataset based on whether the infant received steroid treatments or not

Appendix

A Additional data details

B Model details

B.1 Posterior predictive check

In **?@fig-ppcheckandposteriorvsprior-1** we implement a posterior predictive check. This shows…

In **?@fig-ppcheckandposteriorvsprior-2** we compare the posterior with the prior. This shows…

B.2 Diagnostics

?@fig-stanareyouokay-1 is a trace plot. It shows… This suggests…

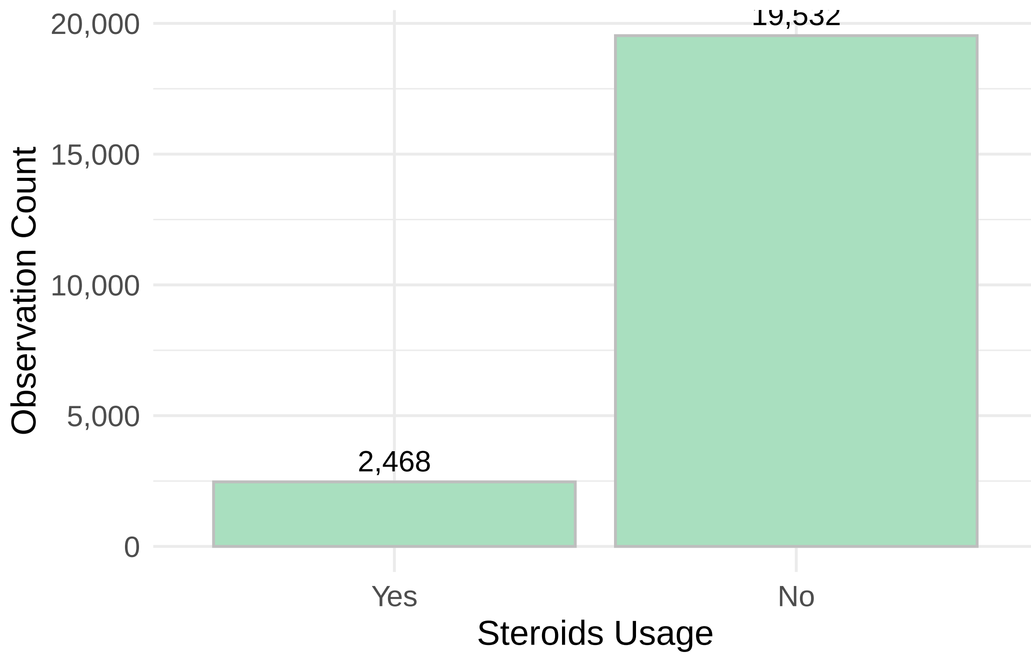

Figure 11: The distribution observations in the analysis datset on whether the infant received steroid treatments or not

?@fig-stanareyouokay-2 is a Rhat plot. It shows… This suggests…

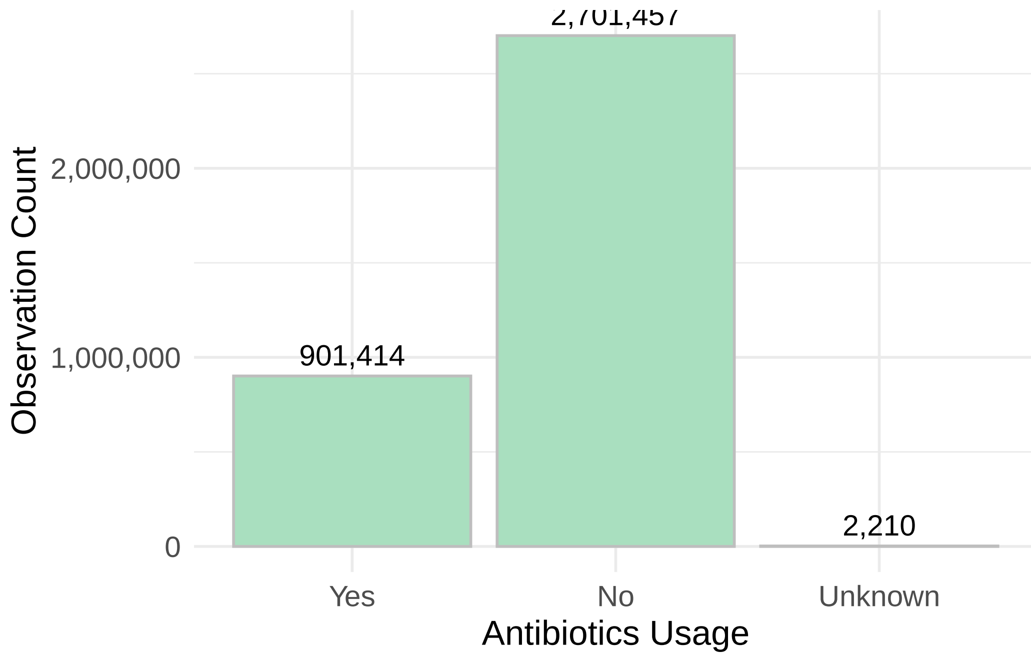

Figure 12: The distribution observations in the raw dataset based on whether the infant received antibiotic treatments or not

References

Alexander, Rohan. 2023. *Telling Stories with Data*. Chapman; Hall/CRC. https://tellingstorieswithdata.com/.

Cambridge University Press. n.d. "Definition of Resuscitation." https://dictionary.cambridge.org/ko/%EC%82%AC%EC%A0%84/%EC%98%81%EC%96%B4/resuscitation.

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Toronto Shelter & Support Services. 2024. *Deaths of Shelter Residents*. https://open.toronto.ca/dataset/deaths-of-shelter-residents/.

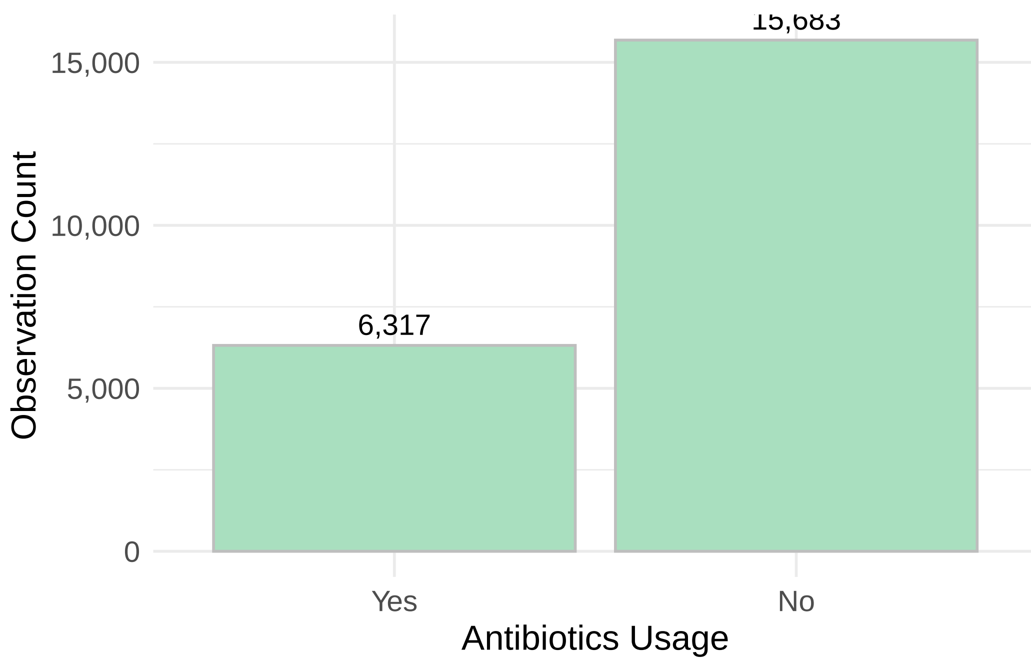

Figure 13: The distribution observations in the analysis datset on whether the infant received antibiotic treatments or not

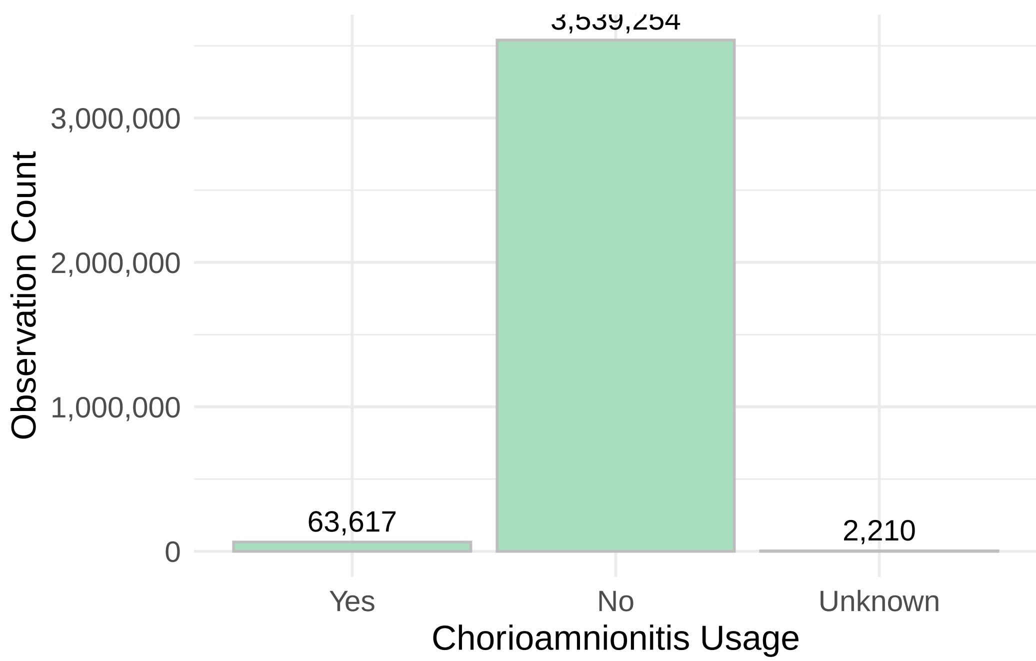

Figure 14: The distribution observations in the raw dataset based on whether the infant received chorioamnionitis treatments or not

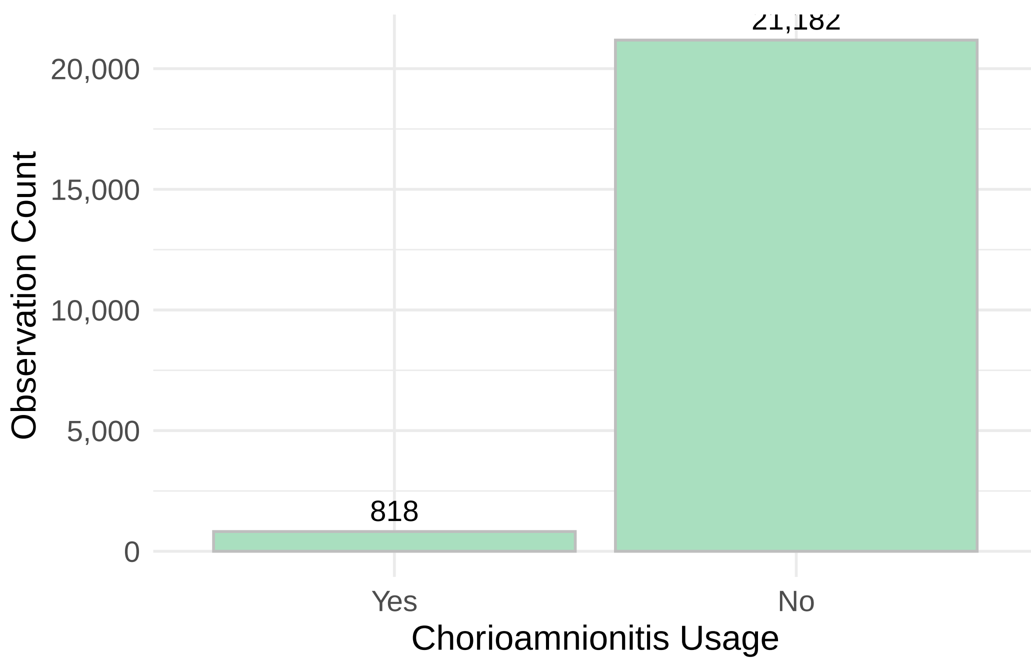

Figure 15: The distribution observations in the analysis datset on whether the infant received chorioamnionitis treatments or not

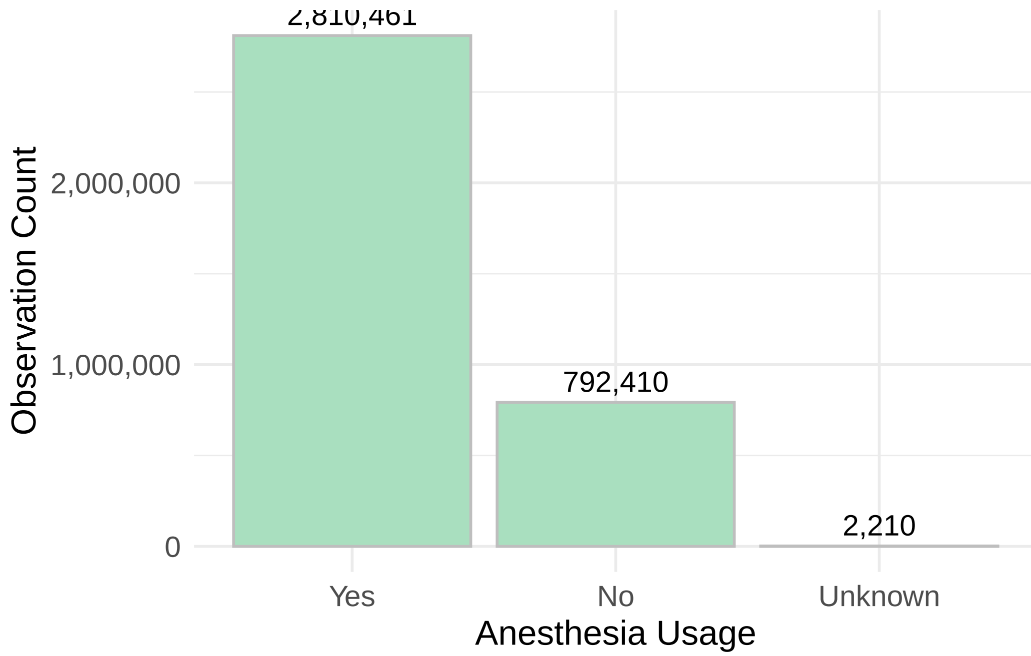

Figure 16: The distribution observations in the raw dataset based on whether the infant received anesthesia treatments or not

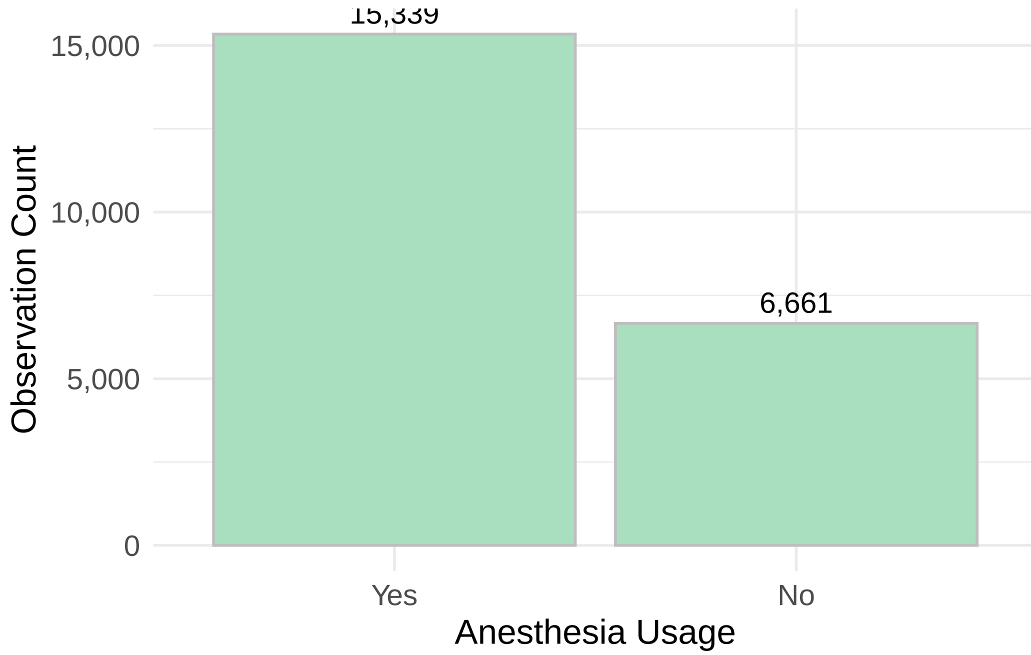

Figure 17: The distribution observations in the analysis datset on whether the infant received anesthesia treatments or not

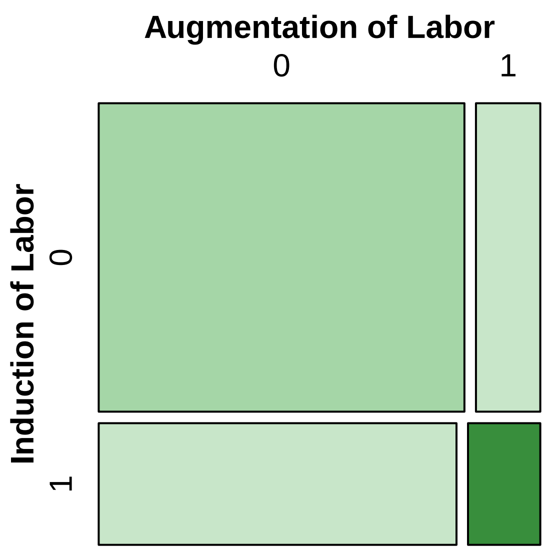

Figure 18: Mosaic plot showing the correlation between induction and augmentation of labor

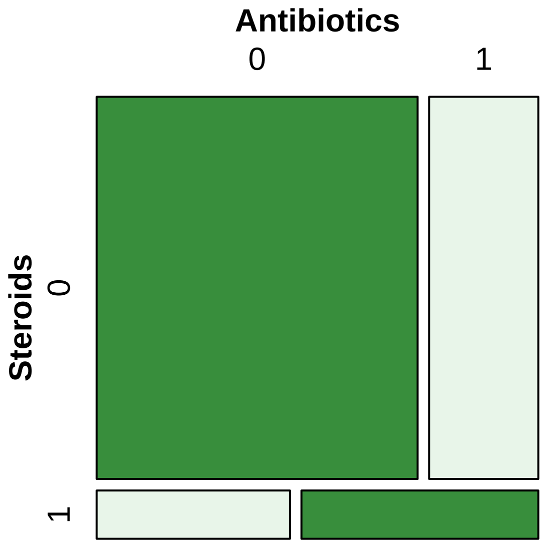

Figure 19: Mosaic plot showing the correlation between usage of steroids and antibiotics

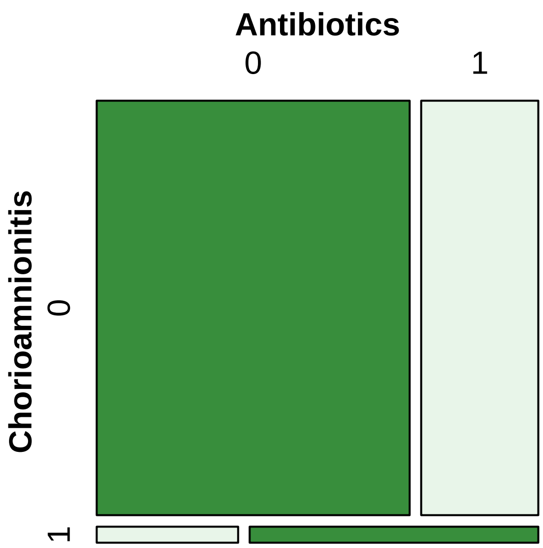

Figure 20: Mosaic plot showing the correlation between usage of chorioamnionitis and antibiotics

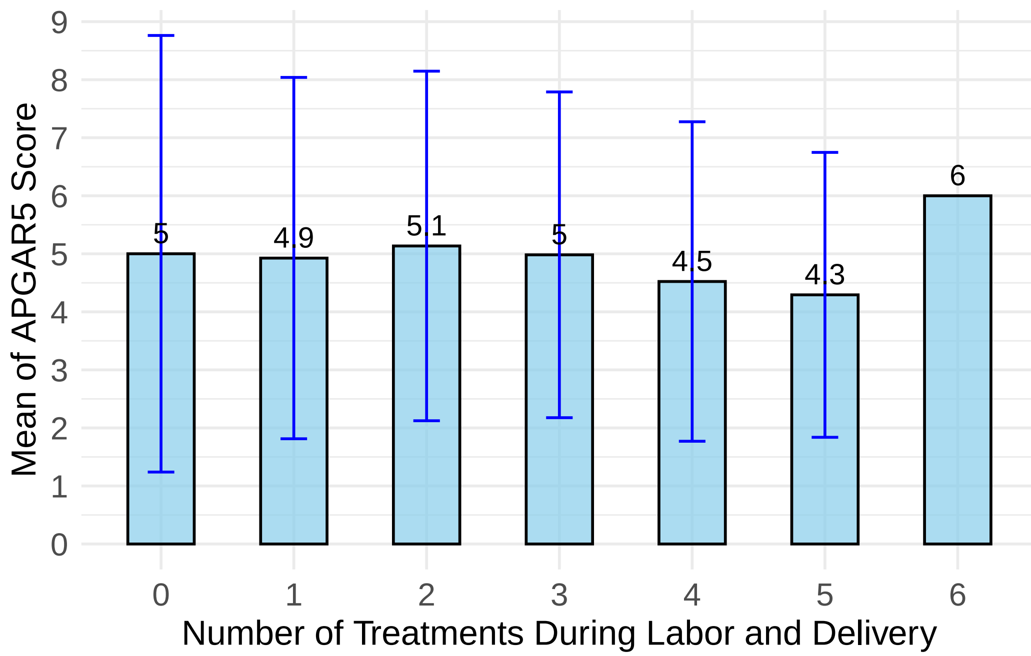

Figure 21: The mean of APGAR5 scores by the number of treatments recieved during labor and delivery

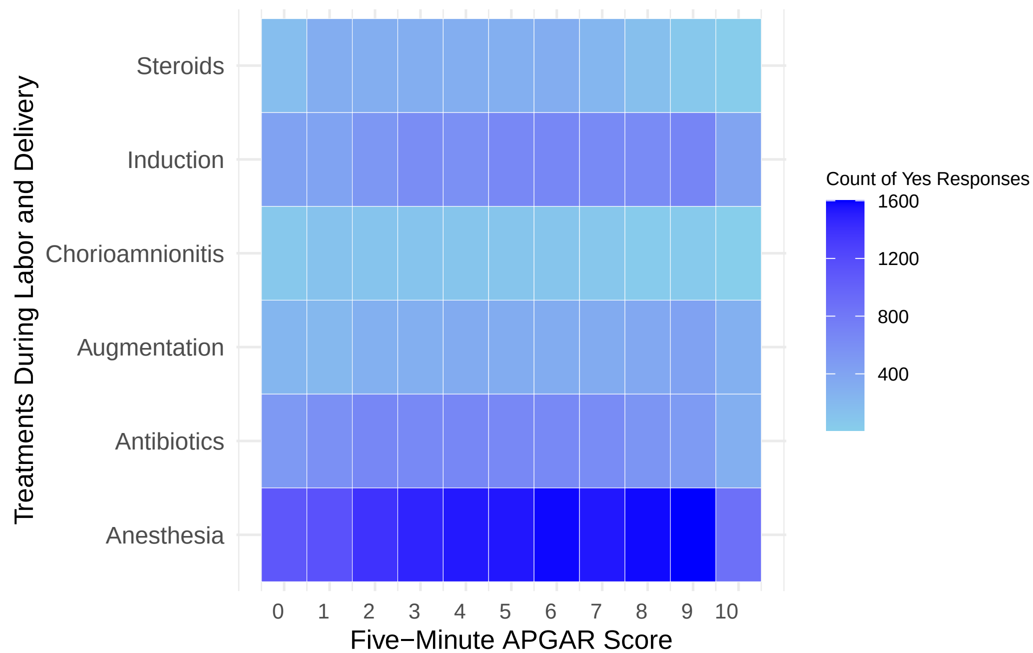

Figure 22: Heatmap of the overall correlation between treatments administered during delivery and APGAR5 scores

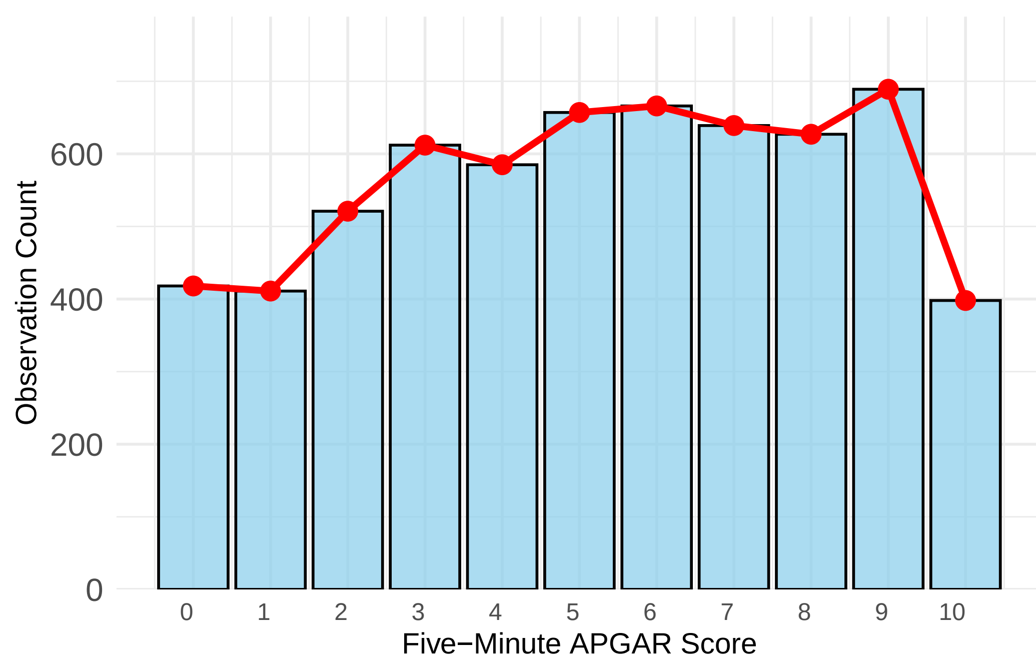

Figure 23: APGAR5 score distribution for the usage of induction labor

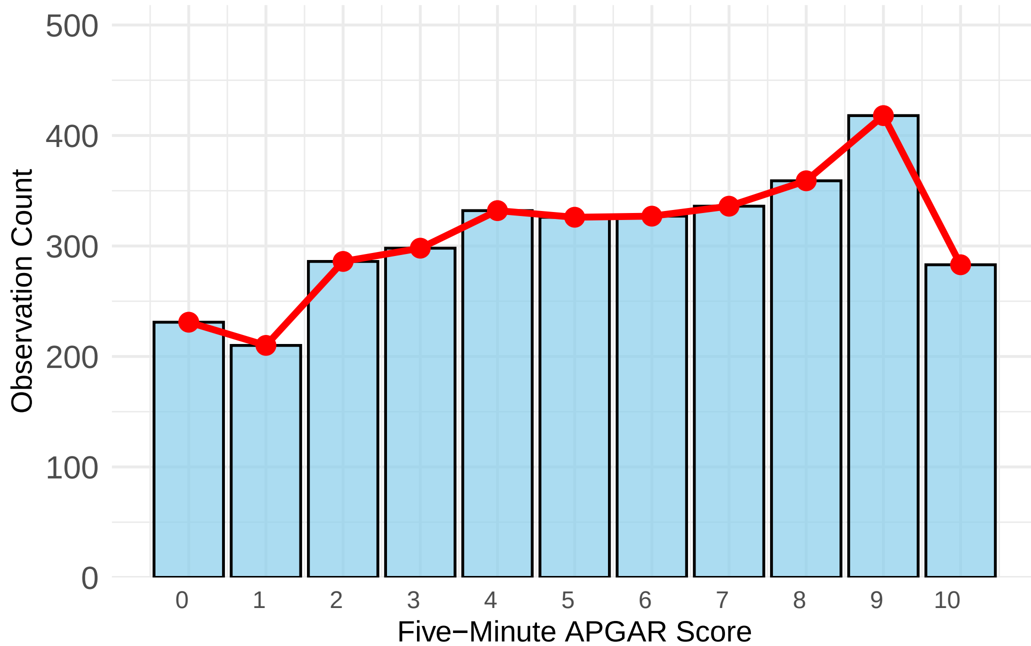

Figure 24: APGAR5 score distribution for the usage of augmentation labor

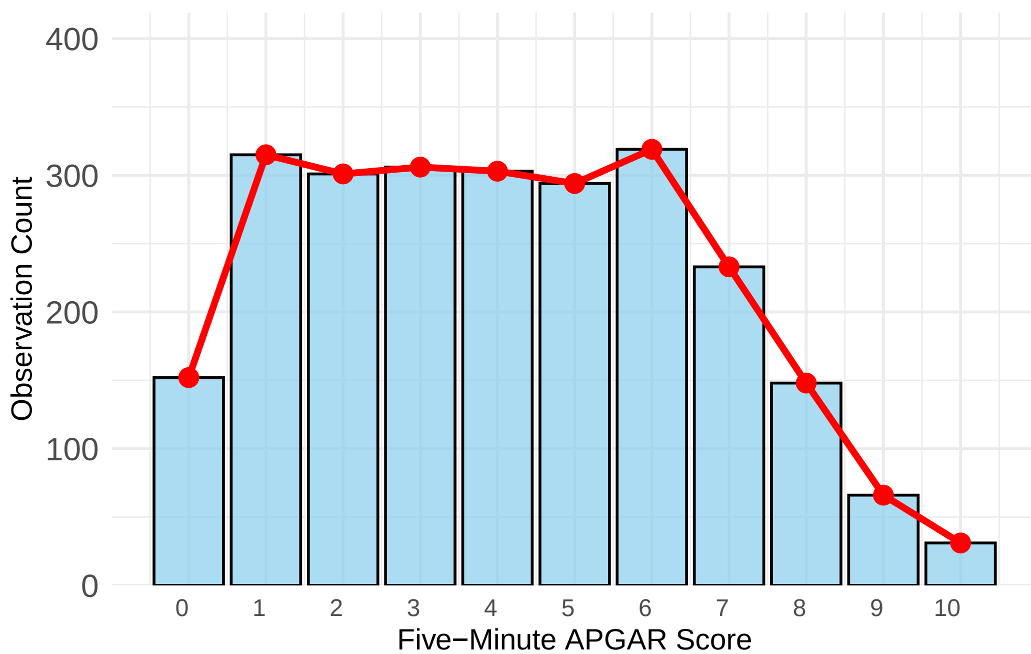

Figure 25: APGAR5 score distribution for the usage of steroids

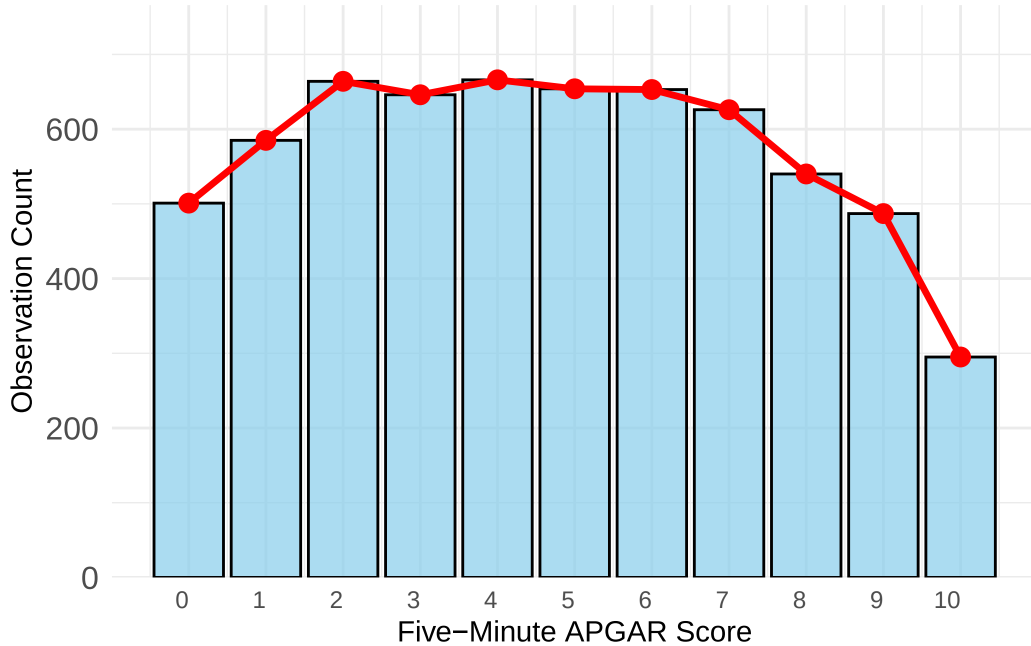

Figure 26: APGAR5 score distribution for the usage of antibiotics

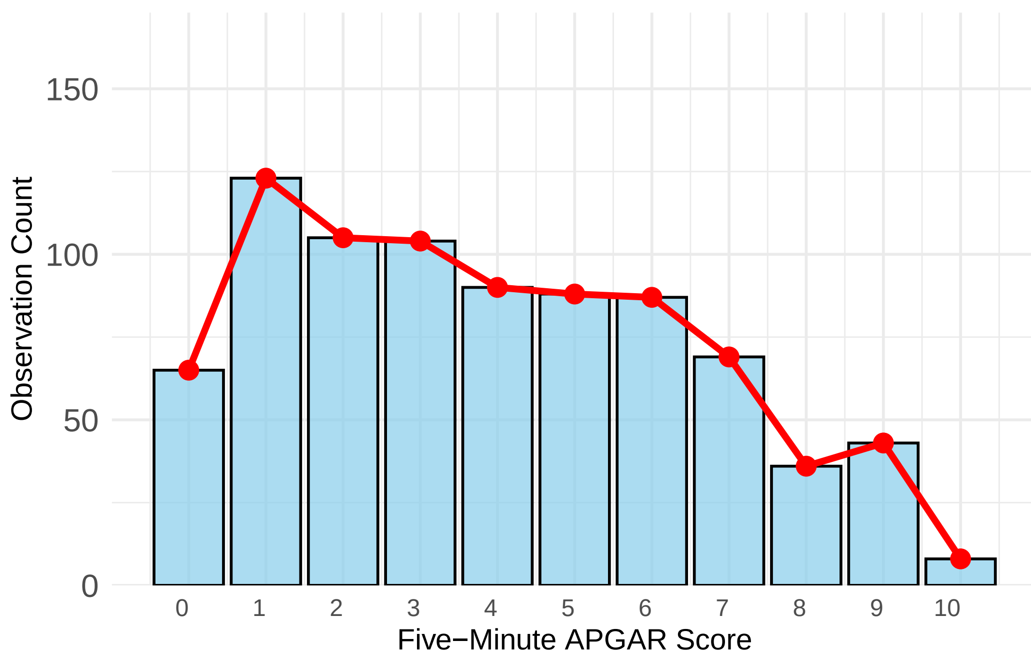

Figure 27: APGAR5 score distribution for the usage of chorioamnionitis

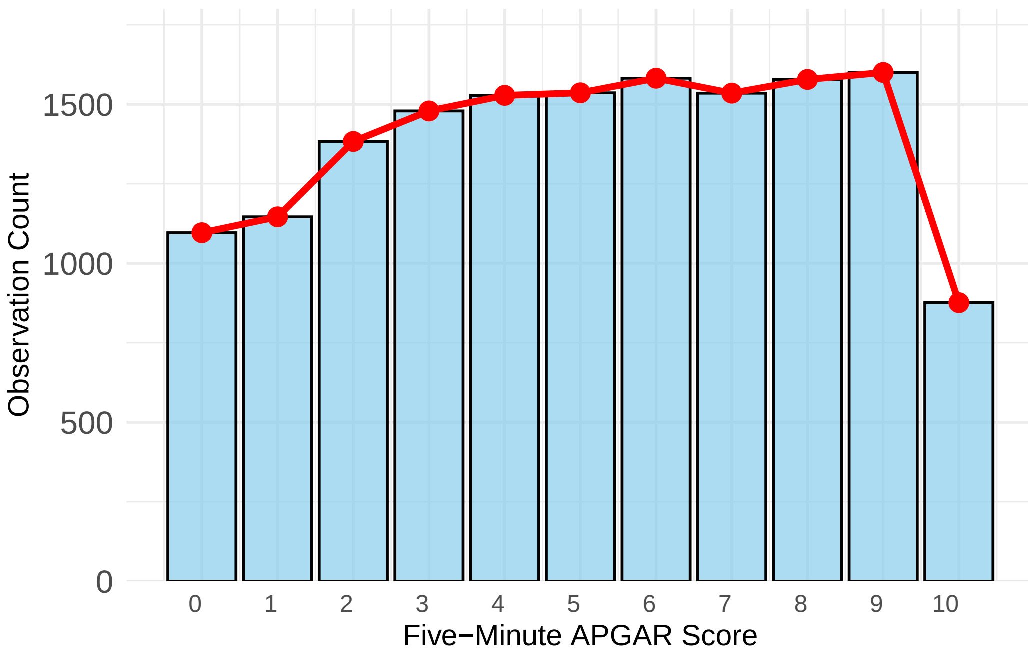

Figure 28: APGAR5 score distribution for the usage of anesthesia