Low Infant Birth Weight in Brazil

A Historical Data Analysis Approach

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# 1. Summary/Abstract

This cross-sectional study uses a linear regression model to understand disparities in infant birth weight in relation to maternal race, age, gestational status (parity or gravidity), and nationality in Rio de Janeiro, Brazil’s first public maternity hospital, the Maternidade Laranjeiras (now Maternidade Escola) in the 1920s. I will use a linear model to estimate the relationship of maternal variables on infant birth weight. I hypothesize that infants born to women of color will have lower birth weights than infants born to White women, whether Brazilian or immigrant, given the historical legacies of slavery, only abolished in 1888, on population health in Brazil.

# 2. Introduction

## 2.1 General Background Information

Public health and medical research over the past twenty years has shown that while race is a biological fiction, its social consequences have far-reaching influences on public health outcomes, particularly in countries with high levels of race-based inequality (1). Studies in Brazil have shown that non-White mothers give birth to infants at lower birth weights than their White counterparts. This is a significant public health concern because low birth weight is associated with higher infant mortality, and with long-term health problems such as diabetes, hypertension, and heart disease.

As a historian of medicine and public health in Brazil, I have collected infant birth weight data from the country’s first public maternity hospital, opened in 1904 in the then-capital city of Rio de Janeiro. Brazil was the last country in the Western Hemisphere to abolish slavery (1888), and it had, and still has, the largest number of African-descended peoples in the world outside of Nigeria. Around 51% of country’s population today is of African-descent.

In the post-abolition period of the 1890s to 1930s, the Brazilian government expanded public health initiatives and the provision of clinical care. Did the legacy of slavery affect the health of infants born in the first public maternity hospital in Brazil? To date, historians have only provided descriptive examples of health inequities.

## 2.2 Description of data and data source

I will analyze a unique sample of 2845 recorded clinical visits to Maternidade Laranjeiras between June 1922 and May 1926. I extracted the sample from Brazil’s major obstetrics and gynecology journal in the first half of the twentieth century, the *Revista de Gynecologia e d’Obstetricia* (RGO). The RGO was associated with the country’s medical association, the National Academy of Medicine (Academia Nacional de Medicina, ANM) and the Brazilian Society of Obstetrics and Gynecology (Sociedade de Obstetricia e Gynecologia do Brasil), both based in Rio de Janeiro. The journal started in August 1907 as the *Revista de Gynecologia e D’Obstetricia do Rio de Janeiro*. In 1919, it changed to the *Revista de Gynecologia, D’Obstetricia e de Pediatria*. In 1922, it became the *Revista de Gynecologia e D’Obstetricia*.

The journal published obstetricians’ and gynecologists’ clinical observations, analyses of new surgical techniques, and ANM proceedings. Between June 1922 and May 1926, RGO also published the monthly clinical reports of all women treated at the Maternidade Laranjeiras. I was unable to locate vol. 18, nos. 4, 5, 6, 8 (1924) and vol. 20, no. 4 (1926). From the available issues, I recorded the following information, when available, for all patients: patient number, gravidity and parity, skin color, age, nationality, type of delivery (natural, interventionist, operative), maternal outcome (death, discharge, transferal to separate hospital), birth outcome (spontaneous abortion, stillbirth, live birth, or neonatal death), and the mother’s reproductive history. Gravidity refers to the total number of pregnancies a woman has, regardless of duration. Parity refers to a woman’s number of past pregnancies that reached viability and have been delivered, regardless of the number of children (2).

Clinical notes only sporadically included infant demographic information for spontaneous abortions or stillbirths. For spontaneous abortions, stillbirths, and live births, I recorded, when available, infant sex, weight, length. I followed the original clinical categorizations for type of delivery in the following cases: natural, indicating minimal medical intervention; interventionist, indicating medium medical intervention through the use of forceps; and operatory, indicating a cesarean section or embryotomy. However, I recategorized external manipulations including version and Mauriceau (used during breech deliveries) ((3)), coded as operatory or natural by physicians, as interventionist.

In the initial months of publication, the reports included more complete information, including labor time or detailed descriptions of surgical procedures. Over time, clinical notes became streamlined. When physicians intervened in birth, the notes included the type of intervention, the indication, and the obstetrician.

The journal is held at the Biblioteca Nacional (BN), the Maternidade Escola, Rio de Janeiro (ME-UFRJ), and the Biblioteca de Biomedicina-A, Universidade Estadual do Rio de Janeiro (BBA-UERJ), all in Rio de Janeiro, Brazil. Between January 2012 and July 2013, I manually digitized the journal by photographing each volume. Then, between January and August 2017, I manually input the data into Excel from the digital reproductions. This will be converted into a .csv file for upload into R.

## 2.3 Questions/Hypotheses to be addressed

I will quantify how maternal race, nationality, age, and gravidity or parity explain racial disparities in infant birth weight in Rio de Janeiro, Brazil’s first public maternity hospital, Maternidade Laranjeiras, in the 1920s. I hypothesize that infants born to women of color, defined as mixed-race (*parda*) or Black (*preta*), will have lower birth weights than infants born to White women, whether Brazilian or immigrant, given the historical legacies of slavery on population health in Brazil.

The outcome I will measure is infant birth weight. The World Health Organization (WHO) currently classifies birth weight into the following categories: extremely low (<999g); very low (1000-1499g); low (1500-2499g); normal (2500-3999g); and high (≥4000g) (4). I will use the WHO’s classification to categorize birth weight.

# 3. Methods

I will use a linear model to estimate the relationship of maternal variables on infant birth weight. Originally, I tried using a logistic regression model with very low birthweight (VLBW), low birth weight (LBW), and normal birth weight as the outcome, but after I started taking a class with Dr. Swartzendruber, I realized that it is important to understand birthweight as a continuous variable.

**This section was written by GitHub copilot** I will use the lm function in R to estimate the relationship of maternal variables on infant birth weight. I will use the tidy function from the broom package to extract the coefficients and standard errors from the model. I will use the glance function from the broom package to extract the R-squared value from the model. I will use the augment function from the broom package to extract the residuals from the model. I will use the ggplot2 package to visualize the results.

## 3.1 Schematic of workflow

## 3.2 Data import and cleaning

Please see the qmd.file processingfile-v1.qmd1 for full detail on the data import and cleaning process.

## 3.3 Exploratory/Descriptive analysis

The exploratory analysis was performed on the ML\_summary dataset with n = 2845 observations and 14 variables. Please see the Codebook for more details on variables.

There were three continuous variables: maternal age, infant birth weight, and infant length. I am aware that this table is not rendering correctly in the word document, but I am unable to figure out why. If I load library(gt), then my word document is corrupted and will not open at all. I will continue to work on this issue.

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| Table 1: Continous Data Summary Table  $`\_data` # A tibble: 3 × 3  Variable Mean StandardDev  <chr> <dbl> <dbl> 1 Maternal Age 25.3 5.76 2 Infant birthweight (grams) 3087. 567.  3 Infant birth length (cm) 48.3 3.93  $`\_boxhead` # A tibble: 3 × 8  var type column\_label column\_units column\_pattern column\_align column\_width  <chr> <chr> <list> <chr> <chr> <chr> <list>  1 Vari… defa… <chr [1]> <NA> <NA> left <NULL>  2 Mean defa… <chr [1]> <NA> <NA> right <NULL>  3 Stan… defa… <chr [1]> <NA> <NA> right <NULL>  # ℹ 1 more variable: hidden\_px <list>  $`\_stub\_df` # A tibble: 3 × 6  rownum\_i row\_id group\_id group\_label indent built\_group\_label  <int> <chr> <chr> <list> <chr> <chr>  1 1 <NA> <NA> <NULL> <NA> <NA>  2 2 <NA> <NA> <NULL> <NA> <NA>  3 3 <NA> <NA> <NULL> <NA> <NA>   $`\_row\_groups` character(0)  $`\_heading` $`\_heading`$title [1] "Summary Statistics"  $`\_heading`$subtitle [1] "Mean Values and Standard Deviations of Continuous Variables"  $`\_heading`$preheader NULL   $`\_spanners` # A tibble: 0 × 8 # ℹ 8 variables: vars <list>, spanner\_label <list>, spanner\_units <chr>, # spanner\_pattern <chr>, spanner\_id <chr>, spanner\_level <int>, gather <lgl>, # built <chr>  $`\_stubhead` $`\_stubhead`$label NULL   $`\_footnotes` # A tibble: 0 × 8 # ℹ 8 variables: locname <chr>, grpname <chr>, colname <chr>, locnum <dbl>, # rownum <int>, colnum <int>, footnotes <list>, placement <chr>  $`\_source\_notes` list()  $`\_formats` list()  $`\_substitutions` list()  $`\_styles` # A tibble: 0 × 7 # ℹ 7 variables: locname <chr>, grpname <chr>, colname <chr>, locnum <dbl>, # rownum <int>, colnum <int>, styles <list>  $`\_summary` list()  $`\_options` # A tibble: 190 × 5  parameter scss category type value   <chr> <lgl> <chr> <chr> <list>   1 table\_id FALSE table value <chr [1]>   2 table\_caption FALSE table value <chr [1]>   3 table\_width TRUE table px <chr [1]>   4 table\_layout TRUE table value <chr [1]>   5 table\_margin\_left TRUE table px <chr [1]>   6 table\_margin\_right TRUE table px <chr [1]>   7 table\_background\_color TRUE table value <chr [1]>   8 table\_additional\_css FALSE table values <chr [0]>   9 table\_font\_names FALSE table values <chr [10]> 10 table\_font\_size TRUE table px <chr [1]>  # ℹ 180 more rows  $`\_transforms` list()  $`\_locale` $`\_locale`$locale NULL   $`\_has\_built` [1] FALSE  attr(,"class") [1] "gt\_tbl" "list" |

Birth weight is the outcome variable of interest, so let’s look at some visualizations of the data. Here is a histogram of the birth weight data, with the two dotted red lines marking the upper and lower limits of what the WHO defines as normal birth weight.

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| Figure 1: Histogram of birth weight |

Birth length is less important for our analysis, but we might want to look at the relationship between weight and length. Below we can see a histogram of the distribution of birth lengths in the sample. The red line marks the average birth length for both male and female infants (49 centimeters).

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| Figure 2: Histogram of birth length |

Finally, we will look at the relationship between infant weight and length, both not-stratified and stratified by sex. Unsurprisingly, birth weight and length are positively correlated.

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| Figure 3: Scatterplot of birth weight by length |

Finally, since male infants are usually slightly heavier than females, let’s look at a scatterplot of birth weight by length, stratified by sex.

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| Figure 4: Scatterplot of birth weight by length stratified by sex |

For information on the categorical variables, please see eda-v1.qmd. Please note Dr. Handel, I am really struggling with making a table of these variables, and I will continue working on that moving forward. If you are interested in the code and data, please see the eda-v1.qmd file.

## 3.4 Basic statistical analysis

## 3.5 Full analysis

# 4. Discussion

## 4.1 Summary and Interpretation

## 4.2 Strengths and Limitations

## 4.3 Conclusions

# 5. References

1. Travassos C, Williams DR. [The concept and measurement of race and their relationship to public health: A review focused on Brazil and the United States](https://doi.org/10.1590/S0102-311X2004000300003). Cadernos de Saúde Pública. 2004 Jun;20:660–78.

2. Posner GD, Dy J, Black AY, Jones GD, editors. Oxorn-Foote Human Labor & Birth. 6th ed. New York: McGraw Hill Education; 2013.

3. Eyraud JL, Riethmuller D, Clainquart N, Schaal JP, Maillet R, Colette C. [Is the Mauriceau maneuver deleterious? Study of 103 cases](https://www.ncbi.nlm.nih.gov/pubmed/9265067). Journal De Gynecologie, Obstetrique Et Biologie De La Reproduction. 1997;26(4):413–7.

4. Organization WH. International Classification of Diseases, Eleventh Revision (ICD-11). Geneva: World Health Organization; 2022.