**HDS 5960**

**Capstone Project**

**Race Predicting Neonatal Outcomes**

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**1. Introduction**

Neonatal Intensive Care Unit (NICU) admissions, NAS requiring pharmacological treatment, SGA at birth, and neonatal demise within 1 year of life are components of neonatal healthcare. Understanding the factors influencing these adverse neonatal outcomes is essential for healthcare providers, policymakers, and researchers aiming to enhance neonatal care and optimize resource allocation. This analysis seeks to explore whether there are disparities in these adverse neonatal outcomes based on racial, marital, employment, and insurance statuses. By identifying patterns and disparities, we aim to provide actionable insights that could help target interventions and support services more effectively.

The primary objectives of this analysis are threefold: firstly, to evaluate whether disparities exist in adverse neonatal outcomes according to race, marital status, employment status, and insurance type; secondly, to quantify the risks and odds associated with these factors by calculating Odds Ratios (OR); and thirdly, to offer evidence-based insights that could inform healthcare policy and practice improvements aimed at addressing identified disparities.

This report focuses on analyzing data on adverse neonatal outcomes with respect to several demographic and socioeconomic variables. The dataset encompasses categories such as race (Black, White), marital status (single vs. married), employment status (employed vs. not employed vs. unknown), and insurance type (private, Medicaid/Medicare). By examining these variables, we aim to uncover any significant associations and disparities related to these outcomes.

Understanding how these factors influence adverse neonatal outcomes is crucial for several reasons. Identifying whether certain groups are more likely to require NICU care, NAS treatment, experience SGA at birth, or face neonatal demise can reveal underlying health disparities that need to be addressed. Furthermore, insights into the factors influencing these outcomes can aid in better resource planning and allocation within NICUs. Additionally, data-driven findings can support the development of policies aimed at improving access to and quality of neonatal care for at-risk populations.

Statistical analysis involved using Mann-Whitney U test, Fisher's exact test, and Chi-squared test for demographics, along with logistic regression models to assess the association between demographic and socioeconomic variables and adverse neonatal outcomes. These statistical measures will help quantify the likelihood of these outcomes in relation to each factor, providing a basis for understanding potential disparities and their implications.

**2. Data Description**

The dataset used for this analysis comprises records of neonates admitted to the NICU, NAS requiring pharmacological treatment, SGA at birth, and neonatal demise within 1 year of life, including key demographic and socioeconomic variables.

**Retrospective review:** Patients and neonates from WISH (Women and Infant Substance Help) Center at SSM St. Mary’s Hospital.

Inpatient hospitalizations of pregnant people from the Healthcare Cost and Utilization Project (HCUP) National Inpatient Sample (NIS) from 2016 to 2019.

The variables of interest are:

Race: Categories include Black, White.

Marital Status: Categories include Single and Married.

Employment Status: Categories include Employed, Not Employed, and Unknown.

Insurance Type: Categories include Private, Medicaid/Medicare.

The dataset includes a substantial number of observations, each capturing the above variables along with NICU admission status. Descriptive statistics for each variable are as follows:

Race: The majority of neonates are classified as either Black or White, with a smaller percentage categorized as Other.

Marital Status: A significant proportion of neonates are from single-parent households compared to married-parent households.

Employment Status: Employment status varies, with a notable proportion of records marked as Unknown.

Insurance Type: A mix of private and Medicaid/Medicare statuses is observed, reflecting varying access to healthcare.

These variables are essential for analyzing disparities in NICU admissions and understanding how demographic and socioeconomic factors may impact healthcare access and outcomes.

**3. Methodology**

**3.1 Statistical Measures**

To assess disparities in adverse neonatal outcomes, we use the following statistical measures:

**Odds Ratio (OR):** This measure evaluates the odds of adverse neonatal outcomes for each category compared to the reference category. It helps quantify the strength of the association between each factor and adverse neonatal outcomes.

**3.2 Data Analysis**

**Categorization:** Each variable is categorized, and the dataset is structured to facilitate comparison between categories.

**Calculation:** We compute OR for each variable. For OR, we calculate the ratio of odds of adverse neonatal outcomes between categories.

**Interpretation:** The calculated OR are interpreted to determine whether there are significant disparities based on race, marital status, employment status, and insurance type.

**Statistical Tests:** To assess statistical significance, we employ the following tests:

* **Mann-Whitney U test** for continuous variables that do not follow a normal distribution.
* **Fisher's exact test** for categorical variables with small sample sizes.
* **Chi-squared test** for larger categorical datasets.

**Statistical Significance:** We assess the statistical significance of the results to ensure that observed associations are not due to chance. The p-values obtained from these tests help determine the significance of the associations.

**Logistic Regression Models:** Logistic regression models were used to assess the association between demographic and socioeconomic variables and adverse neonatal outcomes.

**Adverse Neonatal Outcomes:** NICU admission, NAS requiring medical treatment, SGA at birth, and neonatal demise within 1 year.

**Predictor Variables:** Age, Gravida, Parity, Race, Marital status, Employment status, Insurance type.

**Forest Plot:** A Forest Plot of Odds Ratios and P-values for adverse neonatal outcomes was created to visualize the results.

**4. Results**

**4.1 Demographic Summary**

* **Race:**
  + **White:** 73.33% of the sample; 16.11% experienced adverse outcomes.
  + **Black:** 69.60% of the sample; 14.40% experienced adverse outcomes.
  + **P-value:** 0.95 (Chi-squared test)
* **Age:**
  + **Mean ± SD:** Total: 30.31 ± 4.81, Adverse outcome (yes): 30.44 ± 4.78, Adverse outcome (no): 30.07 ± 4.86
  + **P-value:** 0.41 (Mann-Whitney U test)
* **Gravida:**
  + **Median (IQR):** Adverse outcome (yes): 3 (2, 5)
  + **P-value:** 0.35 (Mann-Whitney U test)
* **Parity:**
  + **Median (IQR):** Adverse outcome (yes): 1021 (101, 2130)
  + **P-value:** 0.19 (Mann-Whitney U test)
* **Marital Status:**
  + **Single:** 71.20% experienced adverse outcomes; 16.36% did not.
  + **Married:** 82.35% experienced adverse outcomes; 9.8% did not.
  + **P-value:** 0.24 (Chi-squared test)
* **Employment:**
  + **Employed:** 77.84% experienced adverse outcomes; 13.17% did not.
  + **Unemployed:** 67.54% experienced adverse outcomes; 16.75% did not.
  + **Unknown:** 72.8% experienced adverse outcomes; 16.8% did not.
  + **P-value:** 0.42 (Chi-squared test)
* **Insurance:**
  + **Private:** 74.29% experienced adverse outcomes; 20% did not.
  + **Medicaid/Medicare:** 72.01% experienced adverse outcomes; 15.58% did not.
  + **P-value:** 0.65 (Fisher's exact test)

**4.2 Logistic Regression Results**

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自動產生的描述**

**Figure 1. Forest Plot of Odds Ratios and P-value for Adverse Neonatal Outcomes**

* **Age:**
  + **Odds Ratio (OR):** 1.02 (95% CI: 0.96, 1.08)
  + **P-value:** 0.5282
* **Gravida:**
  + **Odds Ratio (OR):** 0.92 (95% CI: 0.80, 1.07)
  + **P-value:** 0.2817
* **Parity:**
  + **Odds Ratio (OR):** 1.00 (95% CI: 1.00, 1.00)
  + **P-value:** 0.5441
* **Race (Black):**
  + **Odds Ratio (OR):** 1.18 (95% CI: 0.65, 2.24)
  + **P-value:** 0.5896
  + **Interpretation:** Not statistically significant, but suggests a higher risk.
* **Marital Status (Single):**
  + **Odds Ratio (OR):** 0.45 (95% CI: 0.15, 1.12)
  + **P-value:** 0.1172
* **Employment (No):**
  + **Odds Ratio (OR):** 0.67 (95% CI: 0.35, 1.23)
  + **P-value:** 0.1999
* **Employment (Unknown):**
  + **Odds Ratio (OR):** 0.73 (95% CI: 0.37, 1.43)
  + **P-value:** 0.3552
* **Insurance (Medicaid/Medicare):**
  + **Odds Ratio (OR):** 1.70 (95% CI: 0.63, 4.18)
  + **P-value:** 0.2670

**Summary of Results**

* A higher percentage of White and Black individuals experienced adverse outcomes, but the difference was not statistically significant.
* The mean age of individuals with adverse outcomes was slightly higher but not statistically significant.
* Gravida and parity did not show significant associations with adverse outcomes.
* Single marital status showed a potential protective effect, though not statistically significant.
* Employment status and insurance type did not significantly affect adverse outcomes, but Medicaid/Medicare insurance suggested a potential increased risk.

These results highlight the need for further investigation into the factors influencing adverse neonatal outcomes, with a particular focus on race and insurance type, to better understand and address potential disparities in neonatal healthcare.

**5. Discussion**

Our analysis aimed to identify disparities in adverse neonatal outcomes based on demographic and socioeconomic factors. While our study revealed some findings, there are several additional variables that could provide further insights and enhance the robustness of the analysis.

**Potential Variables to Include:**

**Maternal Weight:** Maternal weight during pregnancy significantly influences neonatal outcomes. Higher maternal weight has been associated with increased risk of complications such as gestational diabetes and preeclampsia, which can adversely affect neonatal health.

**Birth Weight of the Newborn:** Birth weight is a indicator of neonatal health. Low birth weight is associated with higher risks of neonatal mortality and morbidity, while high birth weight can indicate complications such as macrosomia.

**Maternal Physical and Mental Health:** The overall physical and mental health of the mother during pregnancy is crucial. Conditions such as depression, anxiety, and chronic illnesses can negatively impact both the mother and the newborn.

**Maternal Genetic Disorders:** Genetic disorders in the mother could predispose the newborn to various health issues. Understanding the genetic background can help in early diagnosis and intervention.

**Study Limitations:**

**Sample Size and Diversity:** The sample size for certain categories, such as uninsured individuals, was small. A larger, more diverse sample could provide more reliable results. Increasing the overall dataset size would enhance the generalizability of the findings.

**Racial Proportions:** The current study's racial proportions were not balanced, which might have impacted the results. Ensuring a more balanced racial representation in future studies could lead to more accurate conclusions.

**Data Completeness:** Missing data on key variables might have influenced the results. Ensuring complete data collection would enhance the validity of the findings.

**External Factors:** Factors such as access to healthcare, environmental influences, and lifestyle choices were not captured in this dataset but could play a significant role in neonatal outcomes.

**Future Research:**

Future studies should consider including the additional variables mentioned above to gain a comprehensive understanding of the factors influencing adverse neonatal outcomes.

Longitudinal studies tracking mother and child health over time could provide deeper insights into the long-term effects of these factors.

Investigating the interplay between multiple factors, such as the combined effect of maternal mental health and genetic predispositions, could uncover more complex relationships impacting neonatal health.

**6. Conclusion**

The study's conclusions provide important new understandings of the relationships between socioeconomic and demographic characteristics and unfavorable newborn outcomes. Despite the lack of statistically significant connections in the analysis, significant trends were found that should be looked into further and taken into account in healthcare policy and practice.

The results of the analysis did not reveal a significant correlation between poor newborn outcomes and the mother's age, marital status, insurance type, number of pregnancies (gravida), or number of prior live births (parity). Within the parameters of this dataset, these variables did not significantly predict neonatal health problems.

There was a larger chance of unfavorable newborn outcomes shown by the odds ratio between Black and White moms. That being said, there was no statistically significant difference. This result suggests that race alone did not substantially affect the likelihood of unfavorable newborn outcomes within the parameters of this investigation.  
  
Trends in the data indicate possible differences that merit additional investigation even in the absence of substantial connections. Though not statistically significant, the greater odds ratio for Black mothers points to a possible area for focused healthcare measures. Furthermore, the impact of Medicaid/Medicare insurance on the outcomes of newborns implies that socioeconomic determinants can be important for neonatal health and should be considered in future research and policy formulation.

Further research is necessary to evaluate these identified trends as well as other relevant variables not included in this study, such as maternal weight, newborn birth weight, maternal physical and mental health, and genetic diseases. A bigger and more diversified sample size, as well as balanced racial representation, would result in more reliable and generalizable conclusions. Future research should also examine longitudinal ways for tracking health outcomes over time.  
In conclusion, while this investigation found no significant predictors of poor newborn outcomes, the observed trends offer topics for further research and healthcare interventions. By addressing the possible discrepancies identified in this investigation, healthcare practitioners and governments can endeavor to improve neonatal health outcomes for all demographics.

**References:**

**1.** Ragsdale, A. S., Al-Hammadi, N., Bass, S., & Chavan, N. R. (2024). Racial and Ethnic Disparities Among Pregnancies with Substance Use Disorder: Impact on Perinatal Outcomes. *Journal of Women’s Health*. https://doi.org/10.1089/jwh.2023.0619