Examining Sociodemographic Disparities in Maternal Health in Brooklyn via an Obstetric Outcomes Database

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Abstract

BACKGROUND

Socioeconomic inequities in obstetrics, which manifest as differential rates of maternal adverse events, have been elucidated in past studies. Our obstetric database was created to examine the link between social determinants of health (SDOH) and maternal outcomes in our community in Central Brooklyn, New York, which consists predominantly of the Black and Afro-Caribbean population.

METHODS

Our obstetric database collects information on six categories: 1) severe maternal morbidity events, 2) demographics, 3) prenatal care initiation, 4) risk factors, 5) delivery outcomes, and 6) postpartum follow-up. Data was extracted retrospectively from records at an area hospital in 2019. A data dashboard with analyses on SDOH variables and obstetric outcomes via logistic regression is regularly maintained.

RESULTS

In our population, the prevalence of postpartum hemorrhage, gestational diabetes mellitus, gestational hypertension, preeclampsia, and chronic hypertension are 9.6%, 11.2%, 4.1%, 7.4% and 3.7% respectively. Furthermore, our patients have reported healthcare barriers related to inadequate insurance coverage, transportation to healthcare facility, and childcare. Furthermore, postpartum visit non-attendance was significantly associated with health care barriers (p<0.05), unemployment during pregnancy (p<0.05) and Medicaid usage (p=0.05).

CONCLUSIONS

Our data reveals links between SDOH and postpartum visit attendance, but not obstetric outcomes. Continuous data tracking can reveal the impact of SDOH on obstetrical outcomes and enable institutions to devise initiatives to mitigate health inequities.

Introduction

Social determinants are important drivers of maternal mortality and morbidity, as they can contribute to more proximal risk factors such as chronic diseases, obesity, advanced maternal age, and cesarean delivery.\(^1\) Racial and socioeconomic disparities in maternal health are prominent in New York State, as evident by the data provided by the New York State Report on Pregnancy-Associated Deaths in 2018.\(^2\) The pregnancy-related mortality ratio in New York State was 18.2 per 100,000 live births in 2018.\(^2\) Black, non-Hispanic individuals accounted for 51.2% of pregnancy-related deaths, despite accounting for only 14.3% of all live births.\(^2-3\) Black, non-Hispanic women were five times more likely to die of pregnancy-related causes in 2018-2019.\(^2-3\)
National-level obstetric databases, such as the National Vital Statistics System (NVSS) and Pregnancy Risk Assessment Monitoring System (PRAMS), have widely been used to study health trends and provide basis for policy changes. On the contrary, facility-level surveillance systems were sparsely described in the literature, despite their potential usefulness in the planning and implementation of quality improvement (QI) measures.

In compliance with the New York State Report on Pregnancy-Associated Deaths recommendations on maternal adverse outcomes reduction, the Obstetric Outcomes Database was created as part of a QI initiative at our institution to provide guidance regarding healthcare management.² We sought to better understand the effect of social determinants on obstetric outcomes in our community, which consists predominantly of the Black and Afro-Caribbean populations. We aim to utilize the database to assess and address the potential contributing factors to severe morbidity and mortality (SMM) in our community.

Methods

The Obstetric Outcomes Database was developed to assess birth-related outcomes among predominantly Black and Afro-Caribbean patients at an area in 2019. The time period was selected to reflect these outcomes prior to the historical impact of COVID-19.

The database contains six sections: 1) severe maternal morbidity events, 2) demographics, 3) prenatal care initiation, 4) risk factors, 5) delivery outcomes, and 6) postpartum follow-up. The study received institutional review board (IRB) approval from our institution (#1683755) as an exempt study as a quality improvement project.

The study population consists of a randomized sample population of patients (n = 618) who delivered at our hospital in 2019. Information was extracted retrospectively from electronic health records and input into a dashboard by authors (TT, MF) and graduate students. Records were reviewed by the principal investigator. During analysis, records missing binary data pertaining to the predictor or outcome of interest were excluded.

Outcomes of interest included postpartum hemorrhage (PPH) defined as total estimated blood loss > 1000cc, gestational diabetes mellitus (GDM), gestational hypertension (gHTN), preeclampsia (PEC) (both with and without severe features), chronic hypertension (cHTN) and postpartum follow-up.

Social determinants of health included race, education, nativity, employment, payer source, zip code, Special Supplemental Nutrition Program for Women, Infants, Children (WIC) program participation, and barrier to healthcare access (e.g. inadequate insurance coverage, transportation/distance to healthcare facility, and childcare).

A data dashboard including analyses of SDOH variables and obstetric outcomes was maintained by graduate and medical students. Data quality was assured by standardized training. Data abstraction and data analysis training were regularly administered to new and existing individuals working on the
database. In addition, data audits involving random records review were routinely performed on a monthly basis by senior research staff to ensure accurate data collection.

Categorical variables were assessed using Chi-square and Fisher’s exact tests. Correlations between covariates and outcomes identified by these tests were further analyzed using logistic regression to explore the association between SDOH and obstetric outcomes. The p-values from Wald’s tests were reported for all adjusted logistic regression models. P-values less than 0.05 were considered statistically significant. Proportion tests were used to assess the difference in outcomes proportions between the UHD study population and national statistics using data from the Journal of the American Medical Association (JAMA) and the Centers for Disease Control and Prevention (CDC).

Statistical analysis was performed using R Studio version 1.4.1106.

**Results**

**Summary Statistics**

In our sample population of 618 birthing persons, 59 (9.6%) experienced postpartum hemorrhage (compared to 4.3% in overall US, \( p < 0.001 \)); 69 (11.2%) had gestational diabetes mellitus (compared to 6.9% in overall US, \( p < 0.001 \)); 25 (4.1%) had gestational hypertension (6.5%, \( p < 0.05 \)); 23 (3.7%) had chronic hypertension (2.3%, \( p < 0.05 \)), and 46 (7.4%) had preeclampsia (4%, \( p < 0.001 \)).

Our studied population had higher rates of postpartum hemorrhage, gestational diabetes, preeclampsia, and chronic hypertension.

**Maternal Characteristics**

Among patients whose age was reported, 36 (6.3%) were under age 21, 405 (70.3%) were between age 21 and 24, and 135 (23.4%) were over the age of 35. A total of 449 (80.9%) pregnant persons were non-Hispanic Black. Our descriptive analysis also showed that 298 (52.4%) were foreign born; 288 (52.7%) reported to have at least attained a high school education or equivalent; 360 (64.3%) were employed during pregnancy. A total of 403 (83.1%) were Medicaid recipients or uninsured during the antepartum/intrapartum periods. Further, 340 (61.0%) pregnant persons were WIC program participants.

Additional characteristics such as parity and body mass index (BMI) were analyzed. Our results revealed that 243 (41.3%) individuals were nulliparous, while 188 (32.0%) had a parity of 1 and 157 (30.5%) had a parity of \( \geq 2 \). Regarding BMI, 157 (30.5%) individuals had a normal BMI of 25 or lower, while 153 (29.7%) and 205 (39.81%) were overweight (BMI of 25-29.9) and obese (BMI of 30+), respectively. See Table 1 for an analysis of all measured sociodemographic and maternal characteristics in this study.

Barriers to healthcare were documented in 11.5% of the studied population—11 (1.8%) had transportation or distance issues, 12 (1.9%) had childcare issues, 9 (1.5%) had financial issues, and 14 (1.3%) experienced other hurdles affecting their ability to receive healthcare (see Table 1).
The Association between Parental Characteristics and Direct Obstetric Outcomes

Our analysis revealed that pregnant persons of advanced maternal age (age ≥ 35) had higher odds of experiencing the studied complications (OR$_{PPH}$ 2.61, 95% CI 1.47–4.59, $p = 0.01$; OR$_{GDM}$ 2.62, 95% CI 1.54–4.43, $p < 0.001$; OR$_{gHTN}$: 3.81, 95% CI 1.79–8.68, $p = 0.001$; OR$_{cHTN}$ 6.77, 95% CI 2.87–17.16, $p < 0.001$; OR$_{PEC}$ 2.21, 95% CI 1.15–4.16, $p = 0.02$).

Other maternal factors such as parity, mode of delivery, and BMI were also significantly associated with the studied outcomes. After adjusting for age, pregnant persons with multiparity (parity ≥ 2) experienced higher odds of PPH when compared to those with parity of 0 or 1 (OR 1.90, 95% CI 1.05–3.39, $p < 0.01$). Cesarean section as delivery route was also associated with PPH (OR 10.27, 95% CI 3.47–43.98, $p < 0.001$).

Obese individuals (BMI ≥ 30) had higher odds of GDM (OR$_{GDM}$ 1.87, 95% CI 1.07–3.29, $p = 0.04$) and cHTN than those with lower BMI (OR$_{cHTN}$ 4.82, 95% CI 1.83–15.00, $p < 0.01$). See Tables 2 and 3 for more detailed statistics.

The Association between Social Determinants of Health and Direct Obstetric Outcomes

Social determinants such as education attainment, employment status during pregnancy, and WIC participation were associated with the outcomes of interest (see Tables 2 and 3).

Gestational hypertension and pre-eclampsia were associated with education attainment in both univariate and age-adjusted regression models. Controlling for age, there were 2.87 times greater odds of gHTN and 2.25 times greater odds of PEC among pregnant persons who achieved a level of education exceeding high school compared to those who had a high school education or less (CI 1.10–8.90, $p = 0.05$; and CI 1.15–4.68, $p = 0.05$, respectively).

Employment was associated with higher odds of cHTN (OR 3.46, CI 1.15, 14.89, $p < 0.05$). Furthermore, WIC participation was also associated with a lower odds of pre-eclampsia. Adjusting for age, participants were 59% less likely to experience PEC than those who did not participate (OR 0.41, CI 0.22, 0.76, $p < 0.05$).

Gestational diabetes was found to be associated with foreign-born status in a univariate model OR 1.92, CI 1.14–3.31, $p < 0.05$), but this relationship lost significance after controlling for age ($p = 0.10$).

Postpartum hemorrhage was not found to be linked to any of the studied SDOH factors.

Focused Analysis on Postpartum Follow-up Attendance

Our focused analysis revealed that postpartum visit nonattendance was significantly associated with overall healthcare barriers (i.e. transportation, financial, and childcare) (OR 2.63, 95% CI 1.08–6.25, $p <$
0.05), unemployment during pregnancy (OR 1.87, 95% CI 1.12–3.13, p = 0.02) and Medicaid/uninsured status (OR 0.42, 95% CI 0.18–0.89, p = 0.05). These associations remained significant after adjusting for age, a known predictor for postpartum follow-up attendance elucidated in previous studies (see Tables 2 and 4).

There was no association between postpartum follow-up and age, mode of delivery, parity, BMI, race, education, nativity, or WIC participation. See Table 2 for results of the postpartum follow-up analysis.

Discussion

The obstetric outcomes database has provided vital statistics on the sociodemographic distribution of the populations served by our institution, as well as the incidence of obstetric outcomes and postpartum follow-up rate in this community. Similar to current public surveillance systems, our database lays the groundwork for epidemiological investigation and supplies evidence for any further quality improvement initiatives. Given the comprehensive data collection processes, our database also permits more in-depth analyses compared to public databases.

Comparing our hospital data with national statistics, we found that our patients suffered a higher incidence of postpartum hemorrhage, gestational diabetes, preeclampsia, and chronic hypertension. In addition, certain socio-environmental variables were linked to maternal complications and intermediary factors (e.g. postpartum follow-up) that could influence the risk of adverse events.

Analyses utilizing the database also revealed that among the Black and Afro-Caribbean communities in Central Brooklyn, transportation/distance, childcare, and financial barriers were the main deterrents to care. Such barriers were found to be related to lower rates of postpartum visit attendance.

An Example of Database Utilization: Postpartum Follow-up Data and Policy Implication

In this section, we will describe how our database could guide or influence policy work. Given the recent advocacy for postpartum Medicaid coverage extension to 12 months postpartum across the nation, we decided to perform a focused analysis on postpartum visit attendance. Our results showed that Medicaid usage and unemployment during pregnancy, both closely related to financial barriers, were associated with inadequate postpartum care. We speculate that the low postpartum follow-up rate among Medicaid users was related to early coverage termination at sixty days after delivery—as 12-month Medicaid extension was not implemented until 2022—which significantly narrowed the time frame during which new parents can obtain postpartum care.

Previous studies have yielded similar findings. In a small cohort study at the Oregon Health & Science University, Medicaid usage and unemployment, along with young age, unplanned pregnancy, having multiple children, and no/late prenatal care, were found to be linked to a lower rate of postpartum follow-
Consistently, a cohort of 3,441 women who delivered at Montefiore Hospital, NY, showed that again Medicaid usage and young age were significant predictors of postpartum visit non-attendance. Interestingly, our data did not identify age as a predicting factor for postpartum follow-up attendance.

In the US, a large share of pregnancy-related mortality occurs in the postpartum period. Compared to women from other high-income countries, American women face a higher rate of late maternal deaths (deaths that occurred after six weeks but before one year postpartum), which was largely due to mental health-related conditions, such as substance use and suicide. Optimizing postpartum care are, therefore, our priority as public health practitioners.

Under the recent American Rescue Plan Act, states can now extend Medicaid coverage from 60 days postpartum to 12 months postpartum via a State Plan Amendment (SPA). However, as of December 2022, there are three states—Wisconsin, Texas, and Missouri—that still have not acted to extend Medicaid coverage to 12-months postpartum. In these states, parents whose income is too high to qualify for Medicaid, or too low to be eligible for ACA Marketplace subsidies, go uninsured. Subsequently, these individuals lose access to the many services designed to reduce late maternal deaths, including mental health and substance use programs.

In states that have adopted the SPA—including New York—it is important to recognize that these measures are not permanent and may expire within years. Hence, the advocacy for postpartum coverage extension is an ongoing effort and continued data tracking across the pre- and post-SPA period is necessary to evaluate such policy change on maternal wellbeing.

With comprehensive data extraction from the electronic medical record system, our database allows our team to better understand the existing maternal health disparities impacting our community. Importantly, the database provides a tool for advocacy on issues impacting our patients, such as financial barriers to postpartum care. Our team is committed to routine mass data monitoring and utilizing these data to guide the dismantling of healthcare access barriers. Finally, the use of obstetric database of SDOH and pregnancy outcomes can be applicable to other institutions and communities, enabling a better understanding of local epidemiology and patient needs.

**Strengths & Limitations**

Our study is limited by inadequate power, as our sample size is smaller than that generated by power analyses. To ensure comprehensive chart review, the Obstetric Outcomes Database relies on manual data extraction, which is time-consuming and explains the relatively small sample size. Although our sample size did not provide adequate power for us to control for an extensive list of covariates in regression modeling, we were able to adjust for age, which has been shown to be a significant predictor for many obstetric complications and appointment adherence.
A major strength of our study is the sheer volume of variables we collected with information from the antepartum, intrapartum, and postpartum periods. Our database also contained detailed records of each patient’s demographics and social circumstances, as our data collectors thoroughly reviewed all visit/social work documentation. Furthermore, our delivery list was randomized at the beginning of data collection (the original list was in alphabetical order). This approach can be effective in reducing bias, which is an inherent problem with small sample size.

**Conclusion and Implications**

The *Obstetric Outcomes Database* found that the predominantly Black and Afro-Caribbean patient population in Central Brooklyn experienced common causes of maternal morbidity, including postpartum hemorrhage, gestational diabetes, and hypertension during pregnancy at significantly higher rates than the national average. The findings of our database also highlight the role of social determinants in maternal care and provide the data necessary for health policy advocacy. For instance, unemployment status and financial barriers have been found to be associated with postpartum follow-up non-attendance in our community, supporting the current movement of postpartum Medicaid coverage extension.

An institution-wide data surveillance system, as shown by our initiative, serves as a valuable public health tool. A well-maintained database allows clinicians and administrators to better understand the sociodemographic composition of the populations they serve, as well as the prevalence/incidence of certain maternal outcomes and healthcare barriers encountered by our patients. The statistics collected in such surveillance systems play a crucial role in supporting any policy development and influencing the allocation of public resources.

Maternal morbidity and mortality are the product of multiple factors—rooted in the history, policies, and healthcare structure. One single solution will not rectify the inequities in our communities. Changes must be made in individual interactions with our patients and on a wider scale in the creation of facility- and system-level policies. In compliance with the New York State Maternal Mortality Review Board recommendations, the *Obstetric Outcome Database*, via the provision of vital statistics, serves to investigate structural racism and to address the social determinants of maternal health affecting our population.

**References**


### Tables

Tables 1 to 4 are available in the Supplementary Files section

### Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [OBdatabasemanuscriptTable1Updated.pdf](OBdatabasemanuscriptTable1Updated.pdf)
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