Assessing the Impact of Maternal Substance Use on Preterm Birth using the National Survey of Family Growth, 2017-2019

Introduction
Preterm birth, defined as birth before 37 weeks of gestation, is a significant public health concern as it is associated to both neonatal and long-term child health. It is widely known that maternal substance use during pregnancy is a critical risk factor to preterm birth outcomes. To identify specific risk factors, the primary research question of this study is: How does maternal substance use impact the risk of preterm birth, controlling for age, education, race/ethnicity, income level?

Methods
Data
We used the 2017-2019 National Survey of Family Growth (NSFG), Female Respondent File and Female Pregnancy File. These two datasets were merged based on case identifiers and sociodemographic variables. The final analytic sample included only completed pregnancy records, excluding data from respondents who are currently pregnant since this study will assess if maternal substance use impact the risk of preterm birth, resulting in a final sample size of N=9894. An additional check was conducted if the reported maternal age at pregnancy was greater than the respondent's age at the time of the interview, but no cases were found.

Variables
The outcome variable, preterm birth, was defined as birth occurred in less than 37 weeks at delivery for live births and included all non-live births. For substance use, we coded as 1 for any use of marijuana, cocaine, crack, crystal meth, or injection drugs within the 12 months prior to the survey, and 0 for no reported use of these substances. It was assumed that reported substance use during the last 12 months prior to the survey reflects the individual's general substance use pattern (consistent behavior). Additional covariates included in the analysis were maternal age at pregnancy, education (Less than high school, High school or GED, Some college, College +), race/ethnicity (Hispanic, Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Other), and federal poverty level (<100%, 100%-199%, 200%-299%, 300%-399%, >=400%).

Statistical Analysis
The analysis accounted for the weights of the NSFG data, to conduct nationally representative estimates. A logistic regression model was fit to estimate using the svyglm function from the "survey" package in R (Version 4.4.1) incorporating weights (WGT2017_2019), strata (SEST), and primary sampling units (SECU). The model estimated the impact of maternal substance use on the preterm birth while controlling for maternal age at pregnancy, education, race/ethnicity, and income.

Results
The weighted distribution of demographic characteristics among the study participants of the National Survey of Family Growth from 2017-2019 are shown in Table 1. The total sample included 9,894 respondents. Of these, 37.8% experienced preterm births, while 62.2% did not.

Substance use during pregnancy was reported by 18.1% of the respondents (n=1,911), while 81.9% (n=7,983) reported no substance use. The average age at birth among the participants was 25.5 years (SD=0.09). Among the sample, 12.9% had less than a high school education (n=1,542), 29.0% completed high school (n=3,206), 30.4% had some college education (n=2,937), and 27.6% had a college degree or higher (n=2,209). Hispanics accounted for 24.2% of the sample (n=2,944), Non-Hispanic Whites of 50.5% (n=3,980), Non-Hispanic Blacks of 16.2% (n=2,170), and Non-Hispanic Others of 9.2% (n=800). Income distribution showed that 25.8% of the participants lived below 100% of the Federal Poverty Level (FPL) (n=3,151), 25.4% between 100% and 199% FPL (n=2,560), 16.8% between 200% and 299% FPL (n=1,653), 8.2% between 300% and 399% FPL (n=750), and 23.8% had 400% or above the FPL (n=1,780).

Table 1. Demographic Characteristics Among Study Participants, National Survey of Family Growth, 2017-2019

Variable	N (unweighted)	Weighted % or mean (SD)
Total sample (N)	9894	-
Preterm birth		
Yes	3721	37.8 %
No	6173	62.2 %
Substance use		
Yes	1911	18.1 %
No	7983	81.9 %
Age at birth (years)	9894	25.5 (0.09)
Education		
Less than high school	1542	12.9 %
High school	3206	29.0 %
Some college	2937	30.4 %
College +	2209	27.6 %
Race/ethnicity		
Hispanic	2944	24.2 %
Non-Hispanic White	3980	50.5 %
Non-Hispanic Black	2170	16.2 %
Non-Hispanic Other	800	9.2 %
Income		
<100% FPL	3151	25.8 %
100%-199% FPL	2560	25.4 %
200%-299% FPL	1653	16.8 %
300%-399% FPL	750	8.2 %
>=400% FPL	1780	23.8 %

Odds ratios (ORs) and 95% confidence intervals (CIs) for each predictor, adjusting for all other factors in the logistic model are shown in Table 2.

The risk of preterm birth was significantly higher among those who reported substance use during pregnancy. Those who reported substance use had 1.7 times the odds of preterm delivery compared to those who did not (95% CI: 1.4-1.9). Maternal age at pregnancy did not show significant relationship with an odds ratio of 1.0 (95% CI: 1.0-1.0). Those with a high school

diploma were more likely to have preterm births (OR = 1.5, 95% CI: 1.2-1.8). Education level of some college was associated with even higher odds (OR = 1.7, 95% CI: 1.3-2.1), while college degree or higher had 1.6 times the odds of preterm birth (OR = 1.6, 95% CI: 1.2-2.0) compared to participants with less than high school education. Non-Hispanic Blacks (OR = 1.7, 95% CI: 1.4-2.1) and Non-Hispanic Others (OR = 1.6, 95% CI: 1.2-2.1) had significantly higher odds of preterm delivery compared to the Hispanic. Non-Hispanic Whites also had increased odds (OR = 1.3, 95% CI: 1.1-1.5). None of the income brackets showed a significant association.

Table 2. Odds ratios (95% confidence interval) for a binary logistic regression model predicting preterm birth and substance use controlling for age at birth, education, race and ethnicity, and income.

Variable	OR (95% CI)
Substance use (ref: No)	1.7 (1.4, 1.9)
Age at birth (years)	1.0 (1.0, 1.0)
Education	
(ref: Less than high school)	
High school	1.5 (1.2, 1.8)
Some college	1.7 (1.3, 2.1)
College +	1.6 (1.2, 2.0)
Race/ethnicity (ref: Hispanic)	
Non-Hispanic White	1.3 (1.1, 1.5)
Non-Hispanic Black	1.7 (1.4, 2.1)
Non-Hispanic Other	1.6 (1.2, 2.1)
Income (ref: <100% FPL)	
100%-199% FPL	1.0 (0.8, 1.2)
200%-299% FPL	1.1 (0.9, 1.3)
300%-399% FPL	1.1 (0.9, 1.5)
>=400% FPL	1.3 (1.0, 1.6)

Conclusion
The findings of this study provide evidence for the association between maternal substance use during pregnancy and the incidence of preterm birth. Mothers who reported substance use had 70% higher odds of preterm birth compared to those who did not. Furthermore, the results demonstrated that higher educational level is related to an increased risk of preterm birth, reflecting unmeasured factors such as stress. Racial disparities also existed in preterm birth outcomes: Non-Hispanic Blacks and Non-Hispanic Others had significantly higher odds of preterm delivery as compared to Hispanics. The findings are consistent with existing literature that addresses systemic issues. Interestingly, income level did not influence the preterm birth.