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Low Birth Weight And Prematurity in Ohio: A Multivariate Analysis

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Introduction

This paper follows up on a report published by The Center for Community Solutions in November, 2016, *Birth Outcomes in Ohio, 2010-2014*.[1] That report presented characteristics of live births and birth mothers for Ohio counties, Cuyahoga County municipalities, and city of Cleveland neighborhoods. This paper examines demographic and clinical correlates of low birth weight and prematurity among births in Ohio, which have been identified as leading risk factors for infant mortality.[2] In 2014, Ohio's infant mortality rate was 6.8 deaths per 1,000 live births, higher than the national rate of 6.0. The rate among African-American infants in Ohio (14.3 per 1,000) was almost three times that for Whites (5.3).[3]

Over 800,000 Ohio birth records were included in this examination. We applied statistical analysis to identify key risk factors which could contribute to negative birth outcomes and, ultimately, to infant mortality. The effect of several independent variables, such as race/ethnicity, age of mother, and Medicaid coverage were examined. Our findings are consistent with other studies on the issue.

We examine the effect of several independent variables on low birth weight and prematurity, while controlling for all other variables. This allows us to see the effect of, for example, having Medicaid coverage; if all else were equal, or independent of other factors such as the race or ethnicity of the mother.

Key Findings

- Age, race, education, smoking, and marital status are important factors in explaining differences in birth outcomes.
- Being over 35, African American, a smoker, or not finishing high school were factors that increased risk for delivering prematurity and having a baby with low birth weight, even when other indicators are held constant.
- The odds that an African-American mother will give birth prematurely are 1.6 times higher than of non-Hispanic White mothers. The odds that an African-American mother will give birth to a baby with low birth weight is nearly twice as high, even when controlling for other factors.
- Receiving WIC (Women, Infants, Children) benefits, being married, and being covered by private insurance are protective factors which reduce the likelihood of having a low birth weight baby or delivering prematurely.
- Teen childbearing had the highest rates of poor outcomes in the bivariate analysis, but a negligible effect in the multivariate analysis when other indicators are held constant. This indicates that factors other than the young age of the mother contributed more heavily to low birth weight and prematurity.
- Being married is a protective factor for both low birth weight and prematurity. It is likely not the legal status of the relationship that improves birth outcomes, but rather the fact that women who are married are more likely to be planning to get pregnant, marriage is an

indication that the father is involved, and being married can bring personal social support that might not be found among unmarried mothers.
- The fact that WIC reduces risk in the logistic model while Medicaid increases risk suggests that just having health coverage is not enough. Women need more engaged support throughout their pregnancies, and adequate access to high-quality care and supports.
- Beginning prenatal care in the first trimester reduces risk for low birth weight, but slightly increases risk that the baby will be born prematurely, as compared to women who enter prenatal care in the second trimester or later.

Methodology

As with the previous report, the principal data source used for this analysis was the Restricted Access Ohio Resident Live Birth data files for 2010 to 2015 accessed by permission of the Ohio Department of Health.[4] Over 800,000 birth records were included in the analysis.

The first part of the analysis is a bivariate cross-tabulation for low birth-weight (less than 2,500 grams) and prematurity (less than 37 weeks gestation) with individual independent variables of interest. The second part is a logistic regression, where the effect of each independent variable on low birth weight and prematurity is measured while controlling for the other independent variables. Data tables for both analyses are provided in the Appendix at the end of the report.

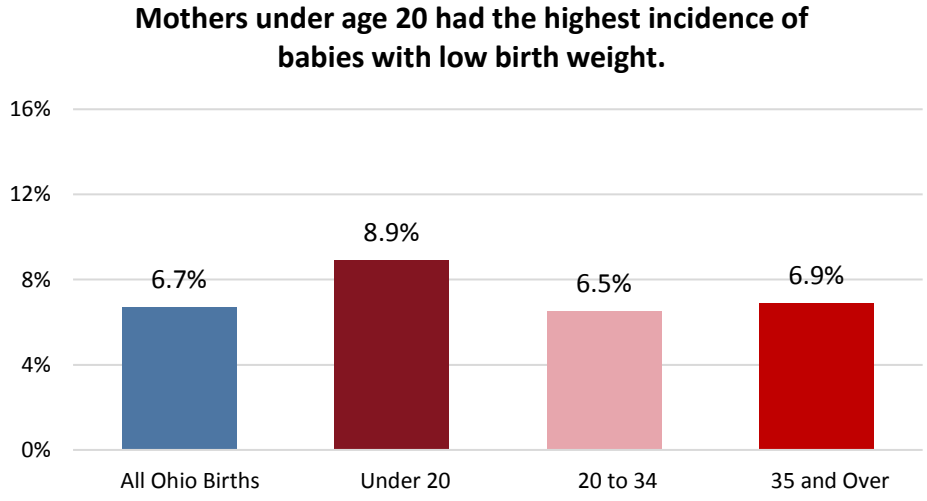
The independent variables include:

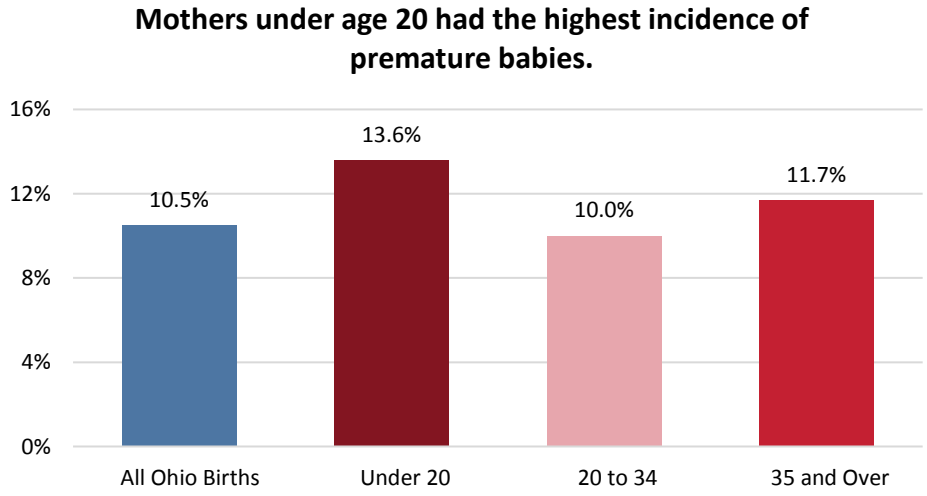
- Age of mother (under 20 / 20 to 34 / 35 or older)
- Mother's race/ethnicity (non-Hispanic White/ African American / Hispanic / Other or Unknown)
- Whether the mother was receiving WIC benefits during her pregnancy
- Whether the mother smoked during her pregnancy
- Mother's educational attainment (high school graduate/ not a high school graduate)
- Mother was married or not married at time of conception, pregnancy, or birth
- Trimester prenatal care began (1st trimester/ 2nd trimester or later)
- Payment source (Medicaid/ private insurance/ other or unknown)
- County type (Appalachian/ Urban / Rural Non-Appalachian/ Suburban)[5]

A. Bivariate Relationships (see Table 1, page 21)

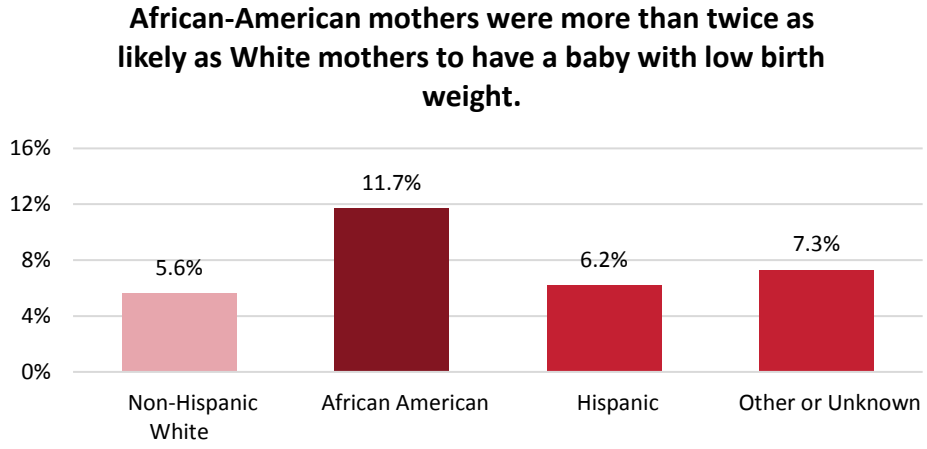
Of singleton[6] births in Ohio from 2010 to 2015, 6.7 percent were low birth weight and 10.5 percent were premature. Low birth weight and prematurity often occur together: 62 percent of low-weight births were premature and 40 percent of premature births were low birth weight.

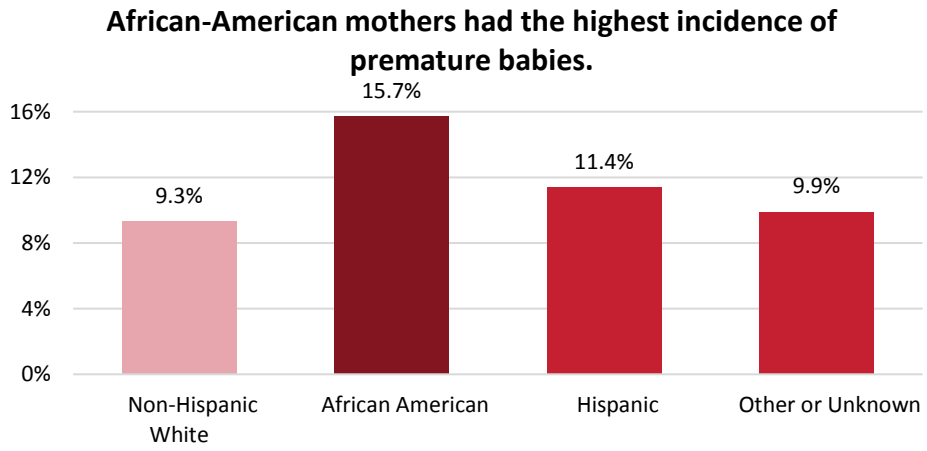
Age: Taking mother's age by itself, the highest rates of poor outcomes were experienced by teen mothers; 8.9 percent of their babies were low birth weight and 13.6 percent were premature. The lowest rates were for mothers 20 to 34.



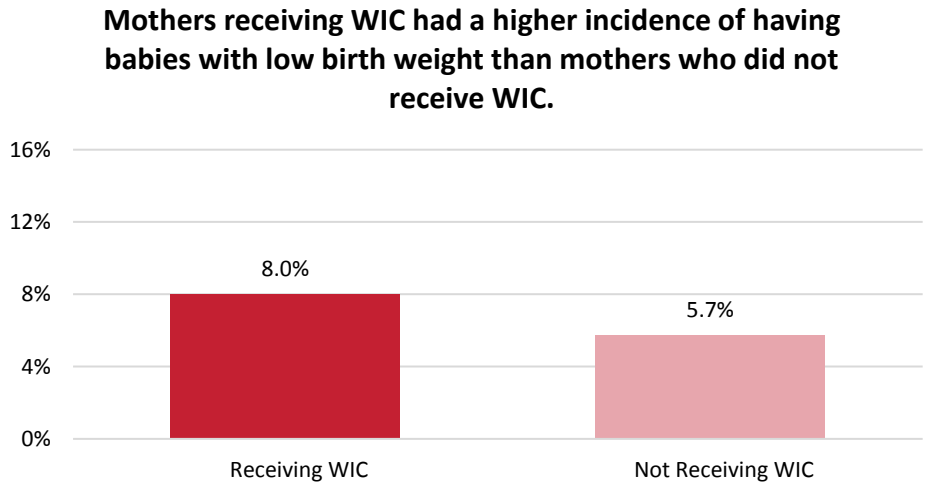


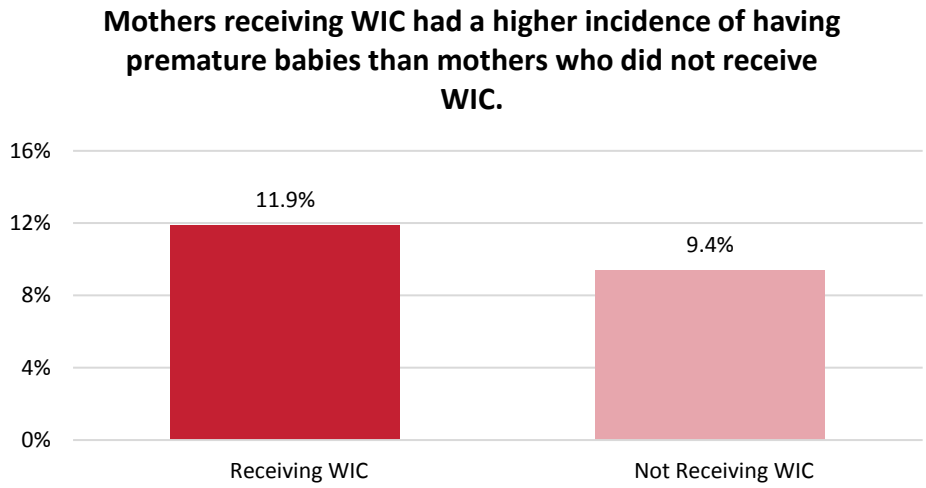
Race/Ethnicity: African-American mothers had higher rates of poor outcomes; 11.7 percent of their babies were low birth weight and 15.7 percent were premature. This was twice the percent of low-birth weights among births to non-Hispanic Whites (5.6 percent), and one-and-a-half times the rate of prematurity among Whites (9.3 percent). Hispanics had intermediate rates of poor outcomes: 6.2 percent of their babies were low birth weight and 11.4 percent premature.



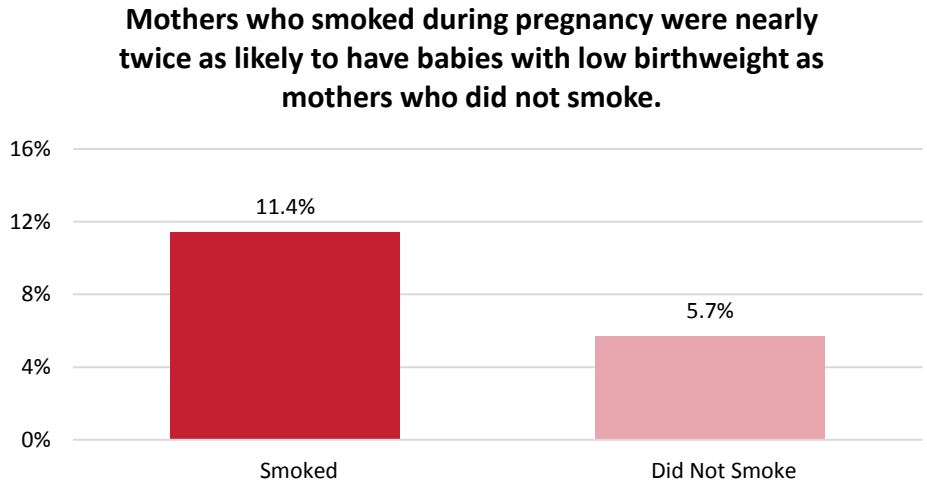


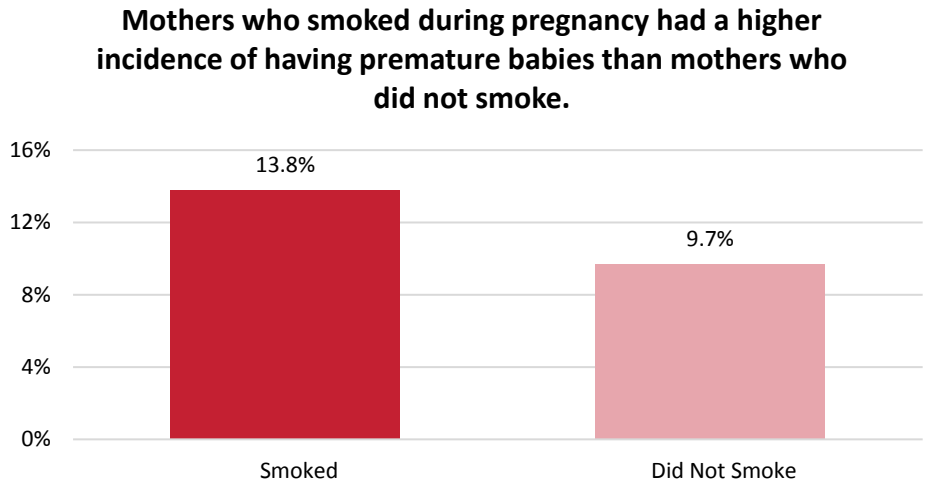
WIC: Mothers who used the Women, Infants and Children supplemental nutrition programs during pregnancy had higher rates of poor outcomes: 8.0 percent of their babies were low birth weight and 11.9 percent were premature, compared to 5.7 percent and 9.4 percent, respectively, among mothers who did not use WIC.



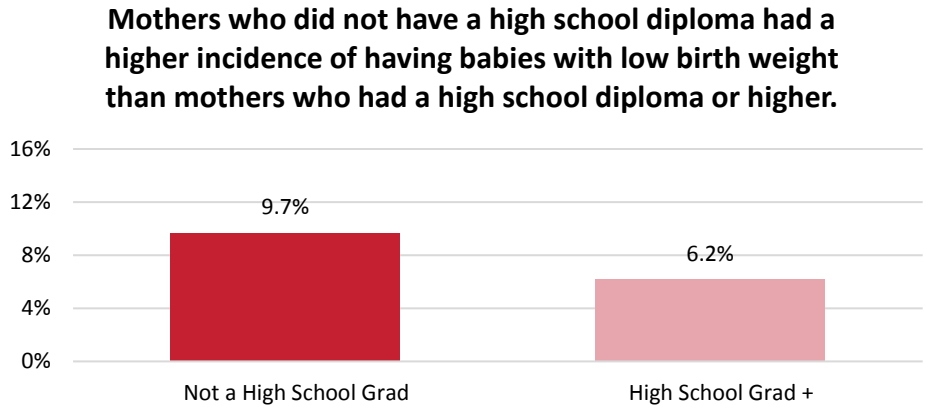


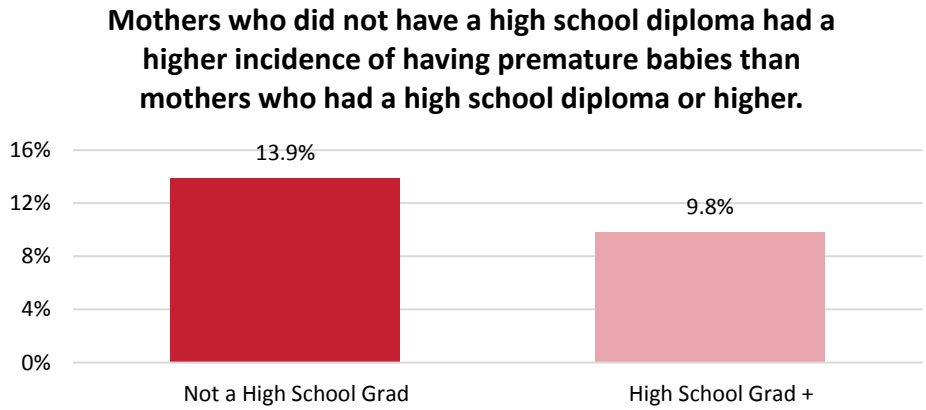
Smoking: Mothers who smoked during pregnancy had twice the percentage of low birth weight babies (11.4 percent) than did non-smokers (5.7 percent). Prematurity was also more common among smokers, 13.8 percent versus 9.7 percent for non-smokers.



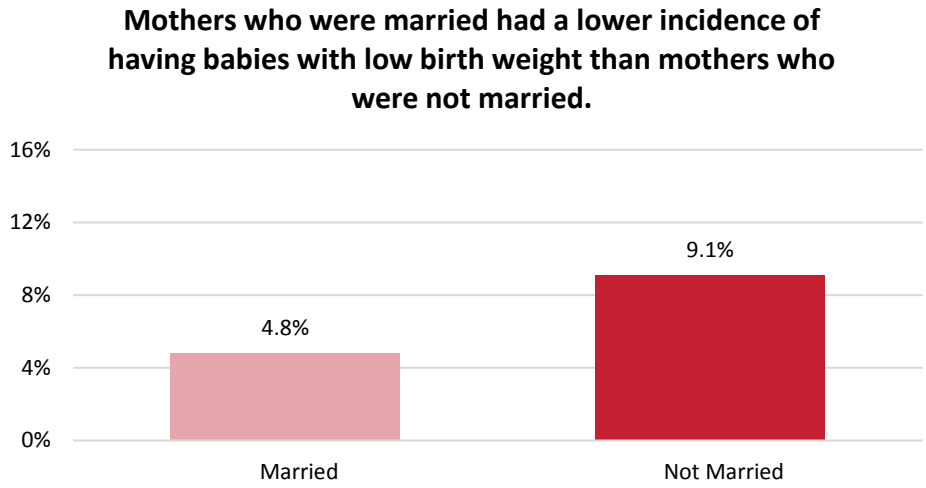


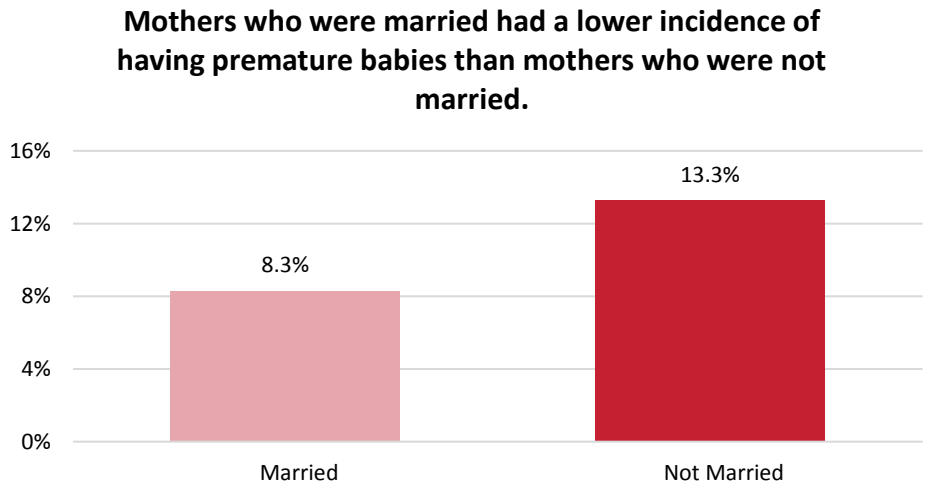
Education: Mothers who lacked a high school diploma had higher rates of poor outcomes: 9.7 percent had low birth weight babies and 13.9 percent had premature births, compared to 6.2 percent and 9.8 percent, respectively, among those with a high school diploma or higher.



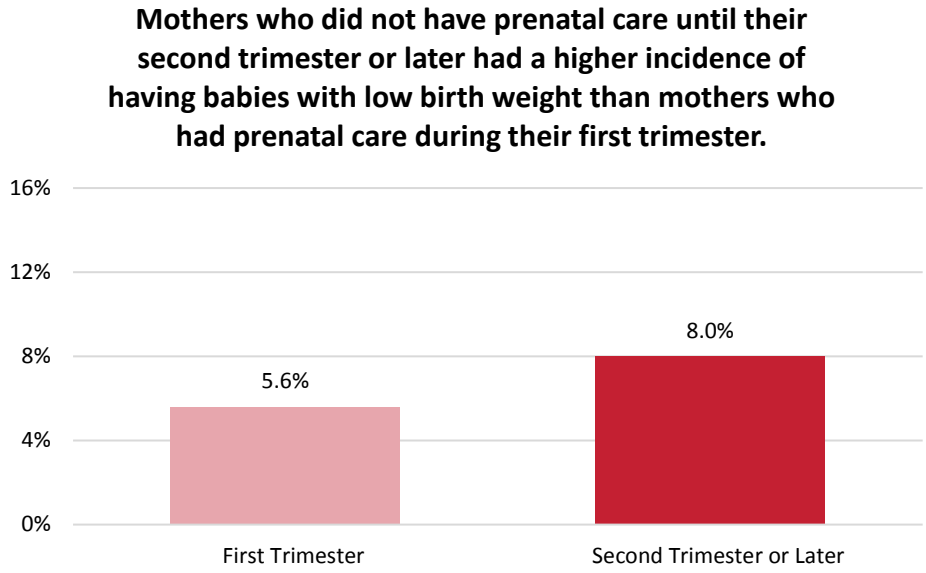


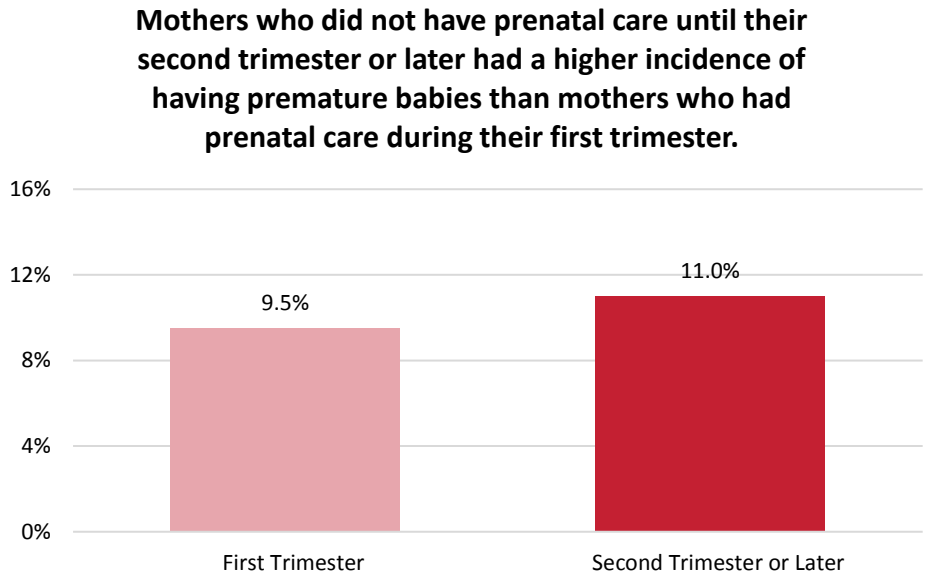
Marital Status: Mothers who were married at any time during conception, pregnancy, or birth had lower rates of poor outcomes than mothers who were not married. Five percent of married mothers had babies with low birth weight compared to 9.1 percent of unmarried mothers, and 8.3 percent had premature births, compared to 13.3 percent of those who were unmarried.



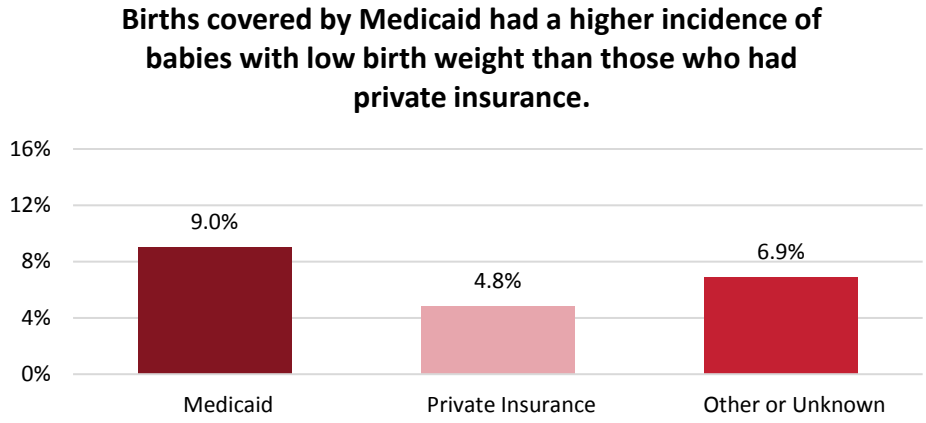


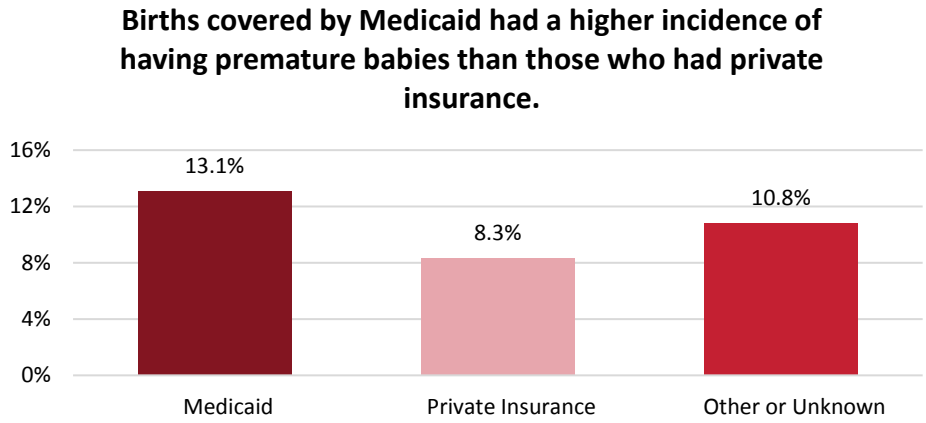
Prenatal Care: Babies born to mothers who began prenatal care in the first trimester had lower rates of low birth weight (5.6 percent) and prematurity (9.5 percent) than those whose mothers began care in the second trimester or later (8.0 percent and 11.0 percent, respectively).



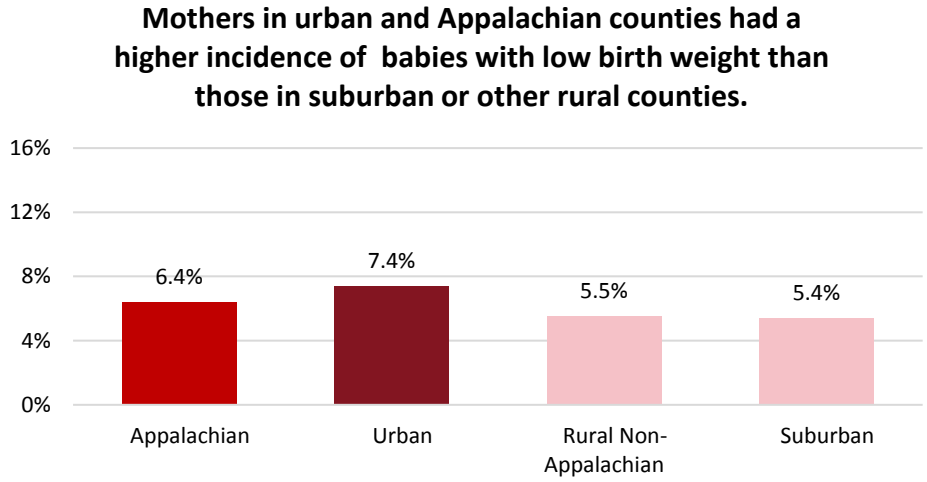


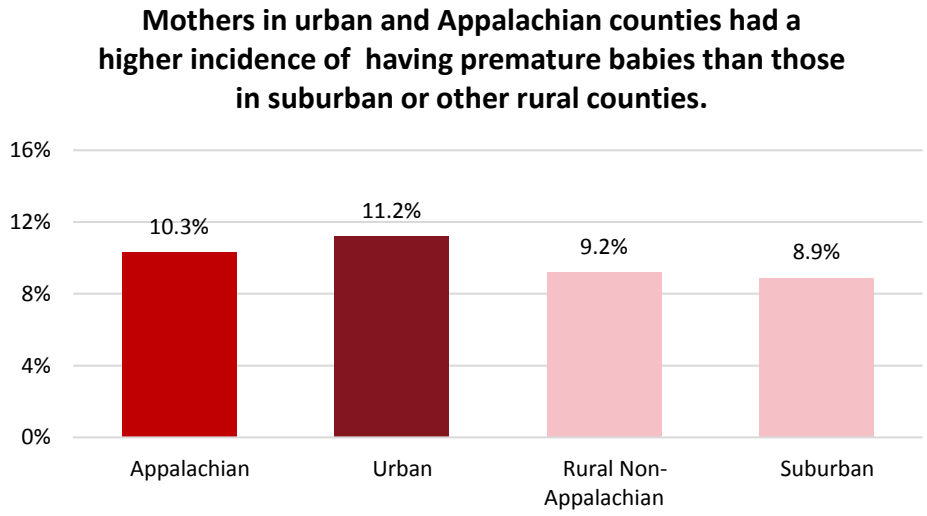
Payment Source: Births whose costs were covered by Medicaid had higher rates of low birth weight (9.0 percent) and prematurity (13.1 percent) than those that were covered by private insurance (4.8 and 8.3 percent, respectively).





County Type: Mothers who lived in urban counties had the highest rates of poor outcomes: 7.4 percent of their births were low birth weight and 11.2 percent were premature. Mothers from Appalachian counties had the next highest: 6.4 percent were low birth weight and 10.3 percent premature. Rural Non-Appalachian and Suburban counties had the lowest rates of births with poor outcomes; 5.5 and 5.4 percent, respectively, were low birth weight; and 9.2 and 8.9 percent, respectively, were premature.



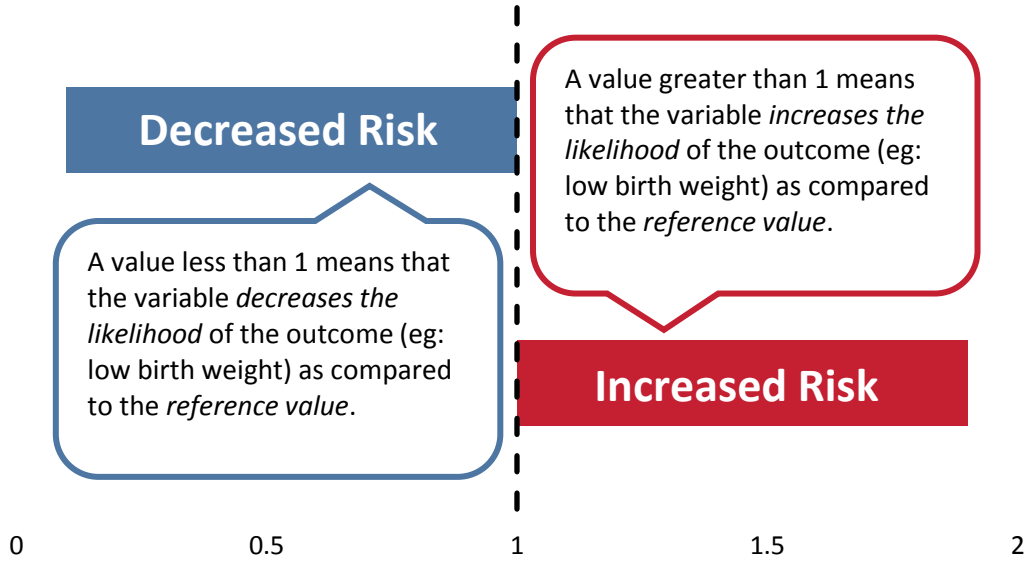


B. Multivariate (Logistic Regression) Odds Ratios (See Table 2, page 22)

A logistic regression analysis measures the effect that each independent variable has on a dependent categorical variable while holding the other independent variables constant. The measurement is an "odds ratio," where a value significantly greater than 1.0 indicates a positive effect (greater likelihood) on the dependent variable and a value significantly less than 1.0 indicates a negative effect. As used here, a "positive" effect means a low birth weight or premature birth and a "negative" effect means a birth of normal weight or gestation.

When using categorical variables as independents, one category is left out of the analysis as a reference value. Here, mothers of ages 20 to 34, White race, "other" payment source, and "suburban" county type are used as reference values.

How to Interpret the Odds Ratios Charts in this Paper

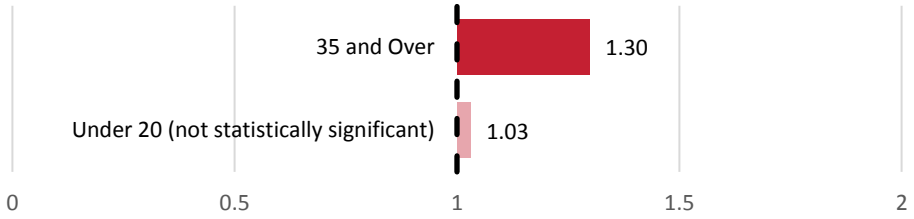


Low Birth Weight: As can be seen in Table 2, a mother's age of 35 or older, non-White race (African American, Hispanic, or Other), smoking while pregnant, not having a high school diploma, being on Medicaid, or living in an urban county, all have odds ratios significantly higher than 1.0, and thus indicate a greater likelihood of low birth weight. Mothers on WIC during pregnancy, those who were married, whose prenatal care began in the first trimester, who had private insurance, or were from rural non-Appalachian counties have odds ratios significantly below 1.0 and so have a lesser likelihood of low birth weight. Teen mothers and

those living in Appalachian counties have odds ratios not significantly different from 1.0 and so cannot be regarded as having either a greater or lesser likelihood.

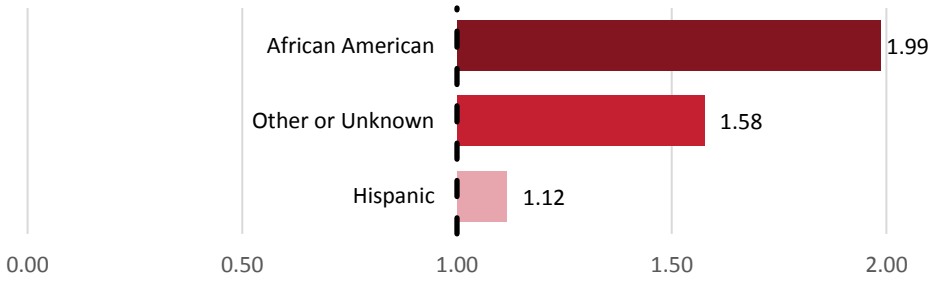
Mothers age 35 and over were at increased risk of having babies with low birth weight.

Reference Value: Mothers Age 20-34



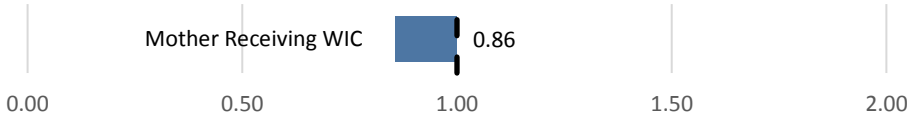
Women of color were at increased risk of having babies with low birth weight, with African-American women having a particularly high risk.

Reference Value: Non-Hispanic White Women



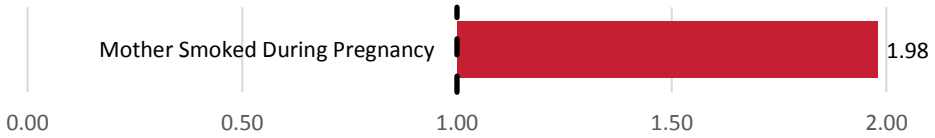
Receiving WIC decreased the risk of mothers having babies with low birth weight.

Reference Value: Mothers Not Receiving WIC



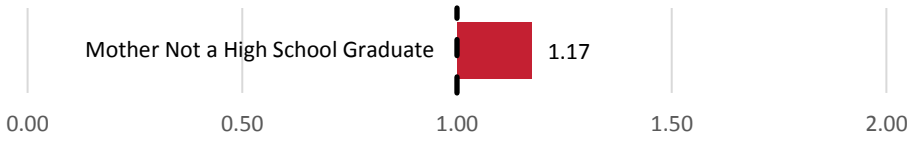
Mothers who smoked during pregnancy had an increased risk of having babies with low birth weight.

Reference Value: Mother Did Not Smoke During Pregnancy



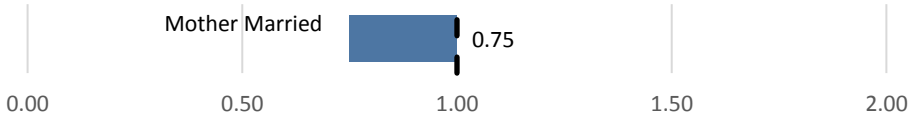
Mothers who are not high school graduates had an increased risk of having babies with low birthweight.

Reference Value: Mother is a High School Graduate or Higher



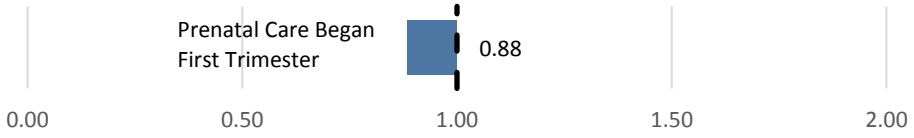
Being married decreased the risk of mothers having babies with low birth weight.

Reference Value: Mother is Not Married



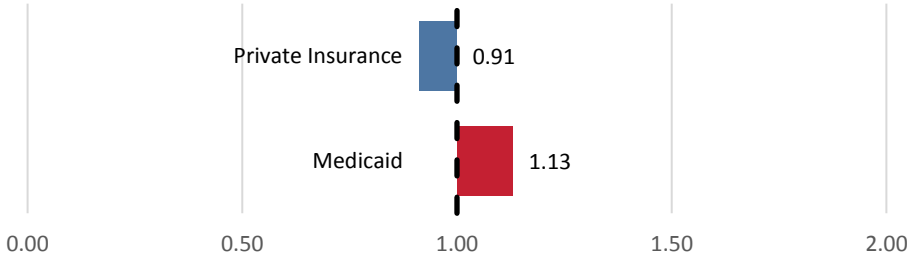
Beginning prenatal care during the first trimester decreased the risk of mothers having babies with low birth weight.

Reference Value: Prenatal Care Began Second or Third Trimester



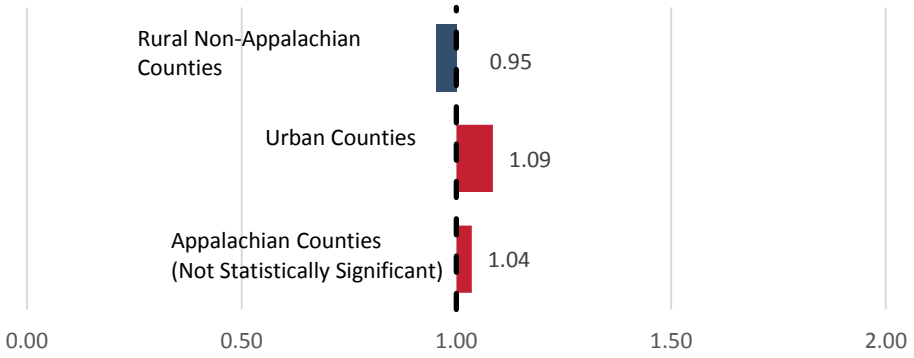
Mothers whose care was paid for with private insurance saw a decreased risk of having babies with low birth weight, while mothers whose care was paid for with Medicaid saw an increased risk.

Reference Value: Other Payment Source



Mothers who lived in rural non-Appalachian counties had a decreased risk of having babies with low birth weight, while mothers who lived in urban counties had an increased risk.

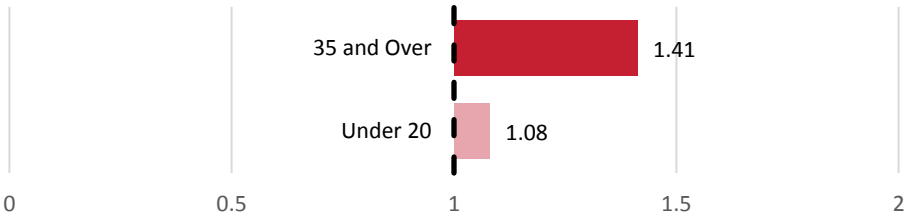
Reference Value: Suburban Counties



Prematurity: Unlike low birth weight, teen mothers and those 35 and over are both more likely to have premature births. Non-White mothers, smokers, high-school dropouts, Medicaid recipients, and mothers from urban counties are all more likely to have premature babies, similar to the risk factors for low birth weight. WIC recipients, married mothers, and those with private insurance were less likely to have premature births. Curiously, mothers whose prenatal care began in the first trimester were slightly *more* likely to be premature than those who started later. Mothers from Appalachian counties were also more likely to deliver prematurely, but those from rural non-Appalachian counties were neither more nor less likely.

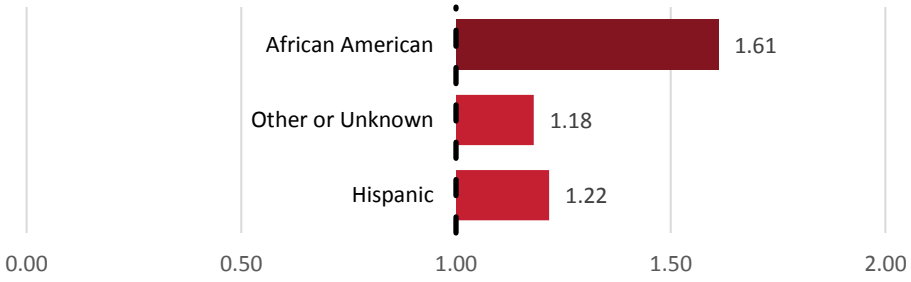
Mothers age 35 and over and teen mothers were at increased risk of having premature babies.

Reference Value: Mothers Age 20-34



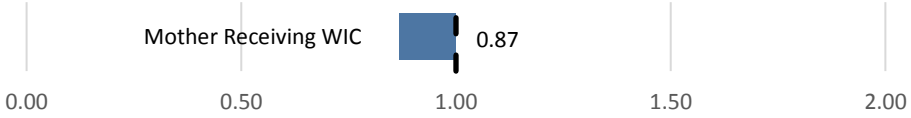
Women of color were at increased risk of having premature babies, with African-American women having a particularly high risk.

Reference Value: Non-Hispanic White Women



Receiving WIC decreased the risk of mothers having premature babies.

Reference Value: Mothers Not Receiving WIC

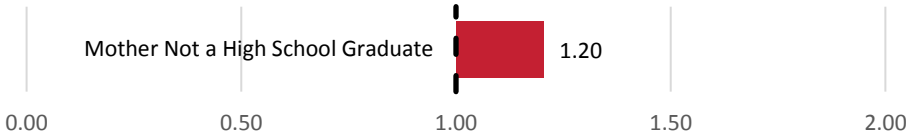


Mothers who smoked during pregnancy had an increased risk of having premature babies.

Reference Value: Mother Did Not Smoke During Pregnancy

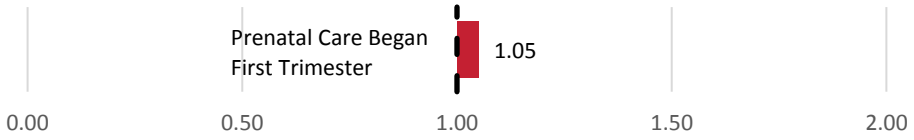
Mothers who are not high school graduates had an increased risk of having premature babies.

Reference Value: Mother is a High School Graduate or Higher



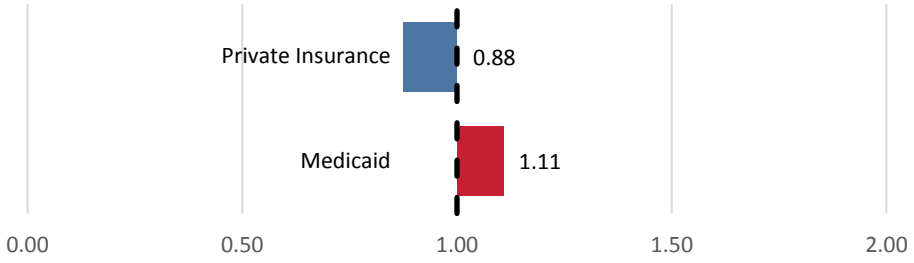
Mothers who began prenatal care during the first trimester had a slightly increased risk of having premature babies.

Reference Value: Prenatal Care Began Second or Third Trimester



Mothers whose care was paid for with private insurance saw a decreased risk of having premature babies, while mothers whose care was paid for with Medicaid saw an increased risk.

Reference Value: Other Payment Source



C. Key independent Variables (See Tables 3a and #b)

It is sometimes useful to reduce the number of independent variables in a regression analysis through a "stepwise" procedure, which finds those variables which make the greatest contribution to the total variation in the dependent variable. Tables 3a and 3b show the results of a stepwise procedure for low birth weight and prematurity, respectively. There was considerable commonality in the variables which made the greatest difference for both. On the "positive" side (increasing risk) were mothers' ages 35 and over, African American race, smoking during pregnancy, and lack of a high school diploma; the mother being married tended to decrease the risk for both.[7] Although the total explained variations in the dependent variables are quite low (less than 5 percent in low birth weight and less than 3 percent in prematurity), these common independent variables can be considered important risk factors for poor outcomes.

Comments

This analysis shows that age, race, education, smoking, and marital status are important factors in explaining differences in birth outcomes. Some of the variables examined here, such as WIC and Medicaid, can be considered proxies for poverty, which might explain why they have increased rates of poor outcomes in the bivariate cross-tabulations. The fact that WIC reduces risk in the logistic model while Medicaid increases risk suggests that just having health coverage is not enough and that women need more engaged support throughout their pregnancies.

There were other differences between the cross-tabulations and the logistic regression. Teen childbearing had the highest rates of poor outcomes in the former, but a negligible effect in the latter. Similarly, the start of prenatal care in the first trimester was related to better outcomes in the cross-tabulations, but was related to a slightly higher risk of prematurity in the regression. These differences are likely due to the effect of controlling for other variables in the regression. On the other hand, geographic differences were more consistent, with Appalachian and urban counties showing greater risk compared to suburban and non-Appalachian rural counties.

Although interactions among independent variables were not included in the logistic model, there is one that is worth noting: African-American women with four-year college degrees had significantly higher rates of poor outcomes than White women with only a high school diploma. Eight percent of college-educated African-American mothers had low birth weight babies, compared to 7 percent of White high-school educated White mothers. Twelve percent of African-American college graduates had premature births, compared to 10.8 percent of White high-school graduates. Clearly in this case, racial disparities could not be overcome by educational attainment alone.

As these findings are limited to the data available in the Ohio birth certificate data files, they necessarily give only a partial picture of key factors in healthy childbearing. For example, differences by income level cannot be determined. However, these findings are consistent with other studies such as a CDC analysis of infant mortality,[8] which shows a higher risk for infant death among African-American mothers, smokers, Medicaid recipients, and those without a high school diploma.

In our analysis, indicators relating to the social determinants of health had a stronger effect on birth outcomes than the clinically related factor of beginning prenatal care during the first trimester. Unfortunately, these variables are some of the most difficult to address. Therefore, initiatives seeking to reduce infant mortality by reducing prematurity and low birth weight should address these disparities, if they are to be successful.

APPENDIX: DATA TABLES

Table 1: Bivariate Crosstabulations

	Percent Low Birth Weight		Percent Premature
Age of Mother			
Under 20	8.9%		13.6%
20 to 34	6.5%		10.0%
35 and Over	6.9%		11.7%
Mother's Race/Ethnicity			
Non-Hispanic White	5.6%		9.3%
African American	11.7%		15.7%
Hispanic	6.2%		11.4%
Other or Unknown	7.3%		9.9%
Mother Receiving WIC			
Receiving WIC	8.0%		11.9%
Not Receiving WIC	5.7%		9.4%
Mother Smoked During Pregnancy			
Smoked	11.4%		13.8%
Did Not Smoke	5.7%		9.7%
Mother's Education			
Not a High School Grad	9.7%		13.9%
High School Grad +	6.2%		9.8%
Mother's Marital Status			
Married	4.8%		8.3%
Not Married	9.1%		13.3%
Prenatal Care Began			
First Trimester	5.6%		9.5%
Second Trimester or Later	8.0%		11.0%
Payment Source			
Medicaid	9.0%		13.1%
Private Insurance	4.8%		8.3%
Other or Unknown	6.9%		10.8%
County Type			
Appalachian	6.4%		10.3%
Urban	7.4%		11.2%

	Percent Low Birth Weight		Percent Premature
Rural Non-Appalachian	5.5%		9.2%
Suburban	5.4%		8.9%

Table 2: Multivariate Odds Ratios

	Low Birth Weight		Prematurity
Age of Mother			
Under 20	1.030 (NS)		1.080
35 and Over	1.298		1.412
Mother's Race/Ethnicity			
African American	1.987		1.611
Hispanic	1.116		1.217
Other or Unknown	1.575		1.181
Mother Receiving WIC	0.858		0.867
Mother Smoked During Pregnancy	1.979		1.344
Mother Not a High School Graduate	1.174		1.204
Mother Married	0.749		0.726
Prenatal Care Began First Trimester	0.884		1.049
Payment Source			
Medicaid	1.130		1.107
Private Insurance	0.912		0.876
County Type			
Appalachian	1.036 (NS)		1.051
Urban	1.085		1.052
Rural Non-Appalachian	0.953		0.993 (NS)
(NS)=not statistically significant at 95% confidence level			

Table 3a: Odds Ratios for Reduced Variable Set for Low Birth Weight

	Low Birth Weight
Age of Mother: 35 or Over	1.294
Mother's Race: African American	2.107
Mother's Race: Other/Unknown	1.615
Mother Smoked During Pregnancy	2.014
Mother Not a High School Graduate	1.242
Mother is Married	0.714

Table 3b: Odds Ratios for Reduced Variable Set for Prematurity

	Prematurity
Age of Mother: 35 or Over	1.401
Mother's Race: African American	1.628
Mother Smoked During Pregnancy	1.344
Mother Not a High School Graduate	1.272
Mother is Married	0.691

[1] *Birth Outcomes in Ohio, 2010-2014* https://ccs.memberclicks.net/assets/docs/Health_Policy/2016/issue%20brief_birth_outcomes_new_final_110716.compressed.pdf

[2] Centers for Disease Control and Prevention. Infant Mortality. https://www.cdc.gov/reproductivehealth/maternalinfanthealth/infantmortality.htm

[3] Ohio Department of Health. 2014 Ohio Infant Mortality Data: General Findings

[4] The inclusion of data provided by the Ohio Department of Health should not be considered an endorsement by the Department of this study or its conclusions.

[5] In this report, county type was adapted from the classifications used in the 2008 Ohio Family Health Survey. "Appalachian" counties refer to the 31 counties in Eastern and Southeastern Ohio designated by the Appalachian Regional Commission (Mahoning County, which the ARC designates as Appalachian, is here classified as "Urban"). The 12 "Urban" counties include Allen, Butler, Cuyahoga, Franklin, Hamilton, Lorain, Lucas, Mahoning, Montgomery, Richland, Stark, and Summit. There are 16 "Suburban" counties: Auglaize, Clark, Delaware, Fairfield, Fulton, Geauga, Greene, Lake, Licking, Madison, Medina, Miami, Pickaway, Portage, Union, and Wood. The remaining 29 counties are designated "Rural Non-Appalachian."

[6] Multiple births were excluded from the analysis because they would skew the results. Sixty percent of multiple births were premature, and 57 percent were low birth weight.

[7] The contribution of independent variables to the total variation of the dependent variable is measured by the Nagelkerke R Squared statistic. The six variables in Table 3a represent 0.044 toward a total of 0.046 for all 16 variables' contribution to the variation in low birth weight. The five variables in Table 3b contribute 0.026 toward a total of 0.029 for all variation in prematurity.

[8] MacDorman M and Mathews T. "Infant Mortality: Trends and Disparities" National Center for Health Statistics. March 26, 2015.

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