

Appendix A: Data on Factors Associated with Infant Mortality in African American Infants and Infants in Rural Communities in Maryland

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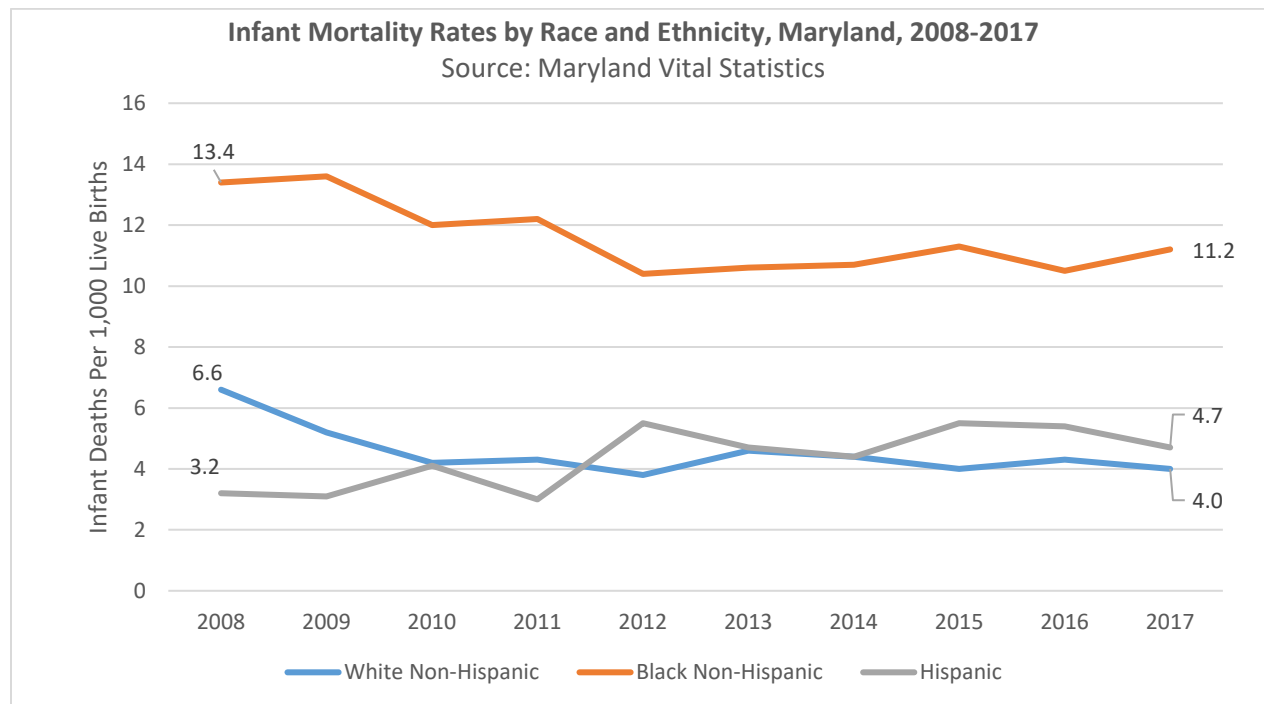
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Introduction

Chapter 83 of the State Laws of Maryland, 2018, requires that the Maryland Health Care Commission (MHCC) “examine factors, beyond the known factors of low birth weight, teen pregnancy, poor nutrition, and lack of prenatal care, affecting the mortality of African American infants and infants in rural areas in the ...State”.

The study of Black Infant Mortality rates, specifically, is justified by the scale of the disparities in outcomes for Black infants, compared to other racial and ethnic groups. Figure 1 shows infant mortality rates for the past decade for Black Non-Hispanic infants (the top line), White Non-Hispanic Infants, and Hispanic Infants in Maryland. Black Non-Hispanic infants consistently experience an infant mortality rate that is more than two times larger than the infant mortality rate for white infants. While there are currently small disparities in outcomes between Hispanic infants and White Non-Hispanic Infants, historically the outcomes between these groups is similar.

Figure 1: Infant Mortality Rates by Race and Ethnicity, Maryland, 2008-2017



Rural infants are also a topic of concern (see Figure 2). Historically, the infant mortality rate in rural jurisdictions in Maryland has been lower than the rate in urban areas. Over the past decade, the infant mortality rate in urban jurisdictions has showed improvement. Rural jurisdictions also showed improvement in the period between 2007 and 2012, but that trend has reversed over the past 5 years. If these trends in rural and urban areas continue, the outcomes for rural infants will soon be worse than the outcomes for urban infants.

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Figure 2: Infant Mortality Rates by Rural/Urban Jurisdictions,

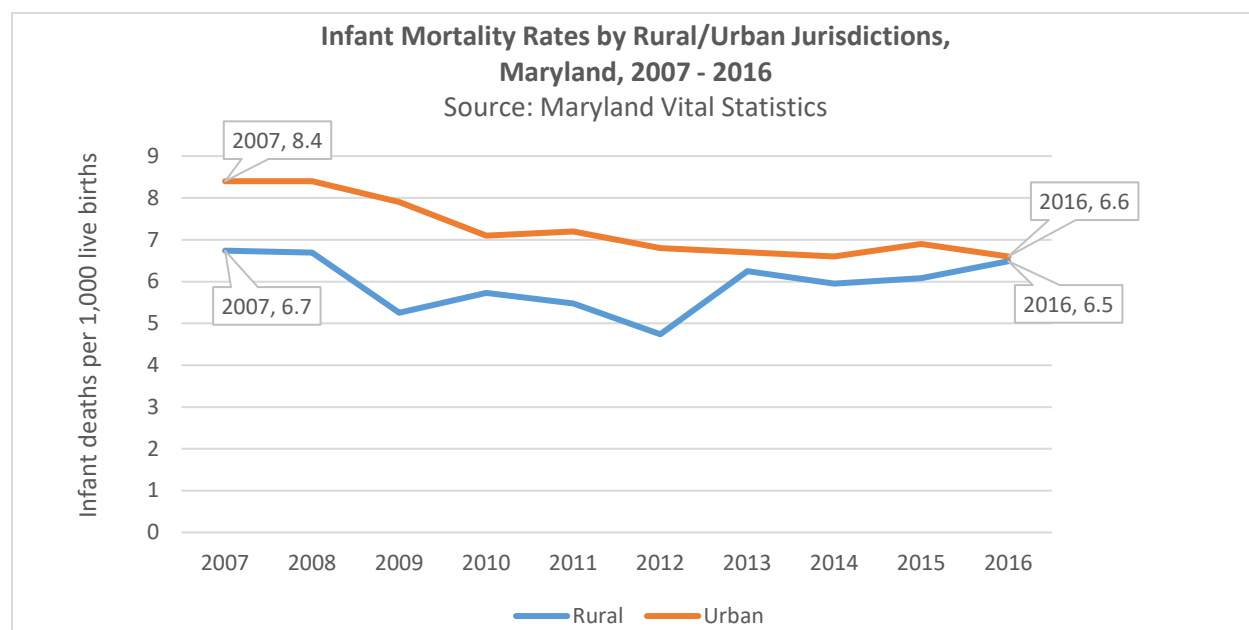
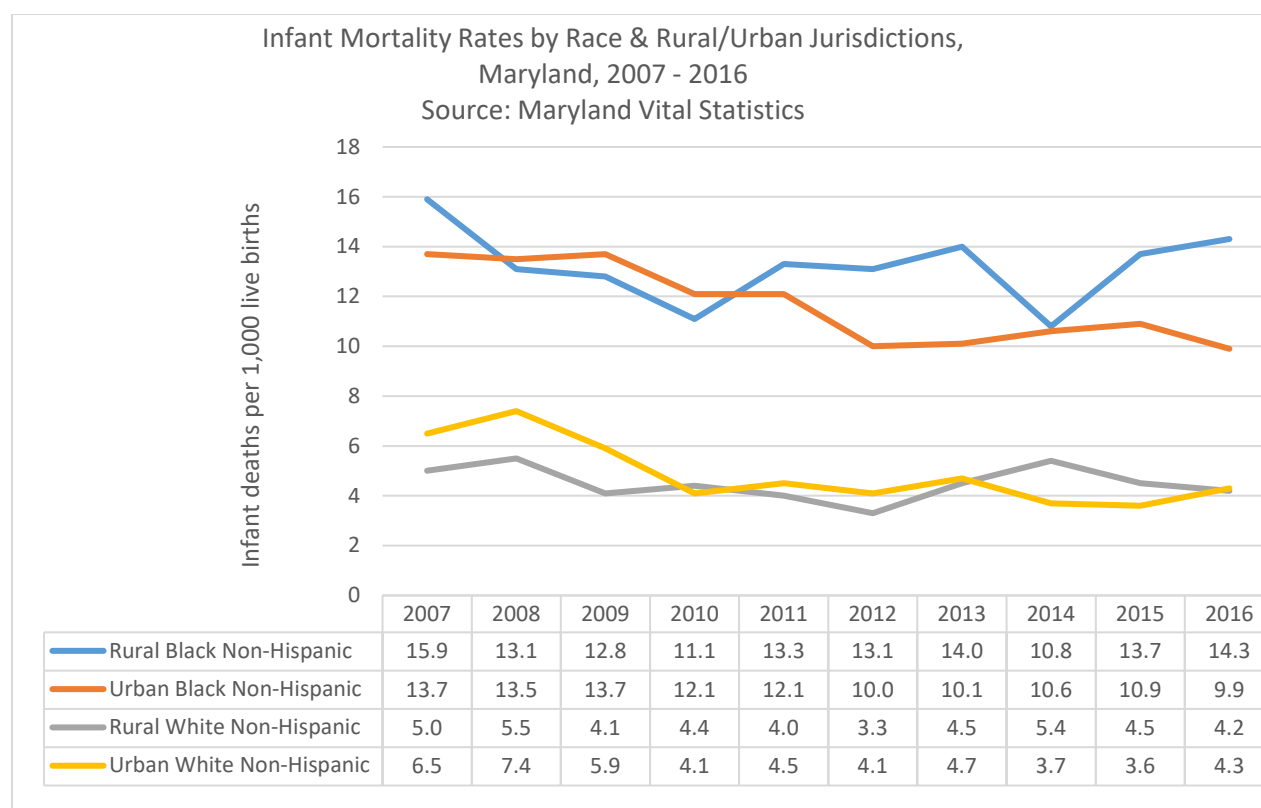


Figure 3: Infant Mortality Rates by Race & Rural/Urban Jurisdictions, Maryland, 2007 - 2016



Race is an important factor in this data story (see Figure 3). The infant mortality rate for White Non-Hispanic infants in rural and urban jurisdictions in Maryland are similar. And the disparities between White Non-Hispanic and Black Non-Hispanic infants exist in both rural and urban areas. However, Black-Non-Hispanic infants in urban areas experienced a decline in infant mortality rates and have maintained a lower rate over the past five years, while Black Non-Hispanic infants in rural communities have not experienced the same trend, particularly over the past five years. As of 2016, the difference between outcomes for Black Non-Hispanic infants in urban communities and Black Non-Hispanic infants in rural communities was statistically significant. Approximately 52 percent of the population in Maryland's urban jurisdictions are Black, while only about 20 percent of the population in rural jurisdictions is Black, so these populations have different levels of impact on the rural and urban infant mortality rates shown in Figure 2.

MHCC collaborated closely with the Office of Minority Health and Health Disparities, the Maternal and Child Health Bureau, the Vital Statistics Administration (VSA), as well as members of the Study workgroup and the subgroup on data analysis in identifying potential factors to study and conducting data analysis on State vital records data. The results of that analysis is included in this appendix.

Data Source and other Resources

Unless specified, the data in this appendix is from Maryland Vital Statistics (i.e. birth certificates and death certificates). Birth data is available through 2017.¹ Most of the data in this report is from a data set that links birth data from 2012-2016 with death data from 2012-2017 (hereafter referred to as the Linked Birth-Infant Death Cohort, 2012-2016 Births). Approximately 281,000 Black Non-Hispanic and White Non-Hispanic infants were born in Maryland between 2012 and 2016 and are included in this cohort. Infants identified as belonging to other race and ethnic groups are excluded.

The Maryland Vital Statistics Administration annually reports on births (in much greater detail than is included in this report) and infant mortality. Those reports are available here:

<https://health.maryland.gov/vsa/Pages/reports.aspx>.

Data from the Pregnancy Risk Assessment Monitoring System (PRAMS) was not used for this analysis because it is reported to the State at the State-level and reweighting the data to allow for the geographical analysis to understand impact on rural communities would require significant (and unavailable) staff resources. PRAMS is a joint research project between the State departments of health and the Centers for Disease Control and Prevention.

Selection of Factors for Study

The factors selected for study in this report were selected through a multi-prong process. The 2011 epidemiologic report "Maryland Infant Mortality Epidemiology Work Group Findings from Data Analysis and Overall Recommendations" as well as a 2018 [PPOR analysis from the Maternal and Child Health Bureau](#) was used to create base list of possible factors for study. Additional possible factors were added and prioritized by workgroup members and as a result of the literature review on risk factors, which is discussed in Appendix C. Finally, State and contractor staff reviewed the list in the context of available data and staff resources available for data analysis. A number of factors that were identified as

¹ Summary 2018 birth data may be released before this report is released, but was not available at the time analysis was completed.

potentially impacting infant mortality (such as stress, experience of bias, and non-marital social supports) were excluded from analysis based on lack of data to support the analysis.

The factors included in this analysis are chronic hypertension, gestational hypertension, gestational diabetes, pre-pregnancy BMI, smoking during pregnancy, breast feeding (prior to hospital discharge at birth), utilization of prenatal care, inter-pregnancy interval, insurance source, maternal education level, and parental marital status.

Other Methodology Issues

Geographic Level of Analysis

Data in this study was analyzed at the State and County level. County level data was combined to generate rural and urban geographic categories. Because infant mortality is a relatively rare event, the data are not presented by individual year or jurisdiction, to avoid reporting small cell sizes and to improve statistical accuracy.

Sub-county level data analysis (e.g. zip code or census tract) could be useful for targeting interventions. The analysis of data at a sub-county level is not included in this document for the same reasons that county-level data is not included. This level of analysis would be less meaningful from both a statistical and policy perspective, as more years of data would need to be combined to obtain adequate cell sizes for analysis (both to ensure privacy and to minimize the influence of chance on the analytic results). This would mask the impact of trends over time, an important focus of this report.

Definition of Rural

For purposes of this report, analysts used the State definition of “rural”.² The following counties constitute rural Maryland: Allegany, Calvert, Caroline, Carroll, Cecil, Charles, Dorchester, Frederick, Garrett, Harford, Kent, Queen Anne’s, Somerset, St. Mary’s, Talbot, Washington, Wicomico and Worcester.

The urban jurisdictions are: Montgomery, Prince George's, Howard, Anne Arundel, Baltimore, and Baltimore City.

Race and Ethnicity

This appendix includes analysis of data on Black Non-Hispanic Infants. These infants are compared with White Non-Hispanic Infants to provide information on disparities in outcomes between these two populations. Maryland’s diverse population includes infants of many races and ethnicities. Outcomes for infants of Hispanic, Native American, Asian, Pacific Islander, and other racial and ethnic barriers are not included in this study due to its focus on Black Non-Hispanic (African American) infants.

Limitation

The correlation for each factor studied with infant mortality by race and geography is reported below. A strong correlation does not mean that infant mortality is caused by that factor. The data analysis conducted does not control for confounding factors, which may be significant. A number of factors that were not evaluated in the Maryland data cohort analysis could influence infant mortality overall and disparities based on race and geography. The analysis of Maryland data in this report does not include

² Md. Code, St. Fin. And Proc. § 2-207, 2018.

analysis of interaction among the factors studied or other potential confounding factors. This data is most useful for providing Maryland-specific context for the findings from the national literature review contained in the report and Appendix C.

Discussion of Findings related to Infant Mortality

Approximately 281,000 Black Non-Hispanic and White Non-Hispanic infants were born in Maryland between 2012 and 2016. Fifty-eight percent of these births were White Non-Hispanic, while 42 percent of these births were Black Non-Hispanic.

Table 1: Number of Infant Births and Deaths for Non-Hispanic Black and White Infants, by Geography, for Infants born 2012-2016, Maryland Source: Maryland Vital Statistics				
	Rural		Urban	
	Births	Deaths	Births	Deaths
Black Non-Hispanic	16,231	193	101,839	1023
White Non-Hispanic	67,057	308	95,764	366

Approximately 1,900 of those infants died in their first year of life (Table 1). Thirty-six percent of the deaths were White Non-Hispanic Infants and 64 percent of the deaths were Black Non-Hispanic infants. The differences between these percentages and the percentages in the previous paragraph give a sense of the disparities in infant mortality outcomes by race (see Figures 5 and 6).

This disparity is clearly reflected in the infant mortality rate (Figure 4). White Non-Hispanic Infants have a much lower infant mortality rate than Black Non-Hispanic Infants in both geographic categories. And urban infants of a specified race have a lower infant mortality rate than their peers in rural areas. The disparities in outcomes between White and Black infants are large for both geographic areas, but more pronounced in rural areas.

Figure 4: Infant Mortality Rate, Infants Born 2012-2016, Maryland

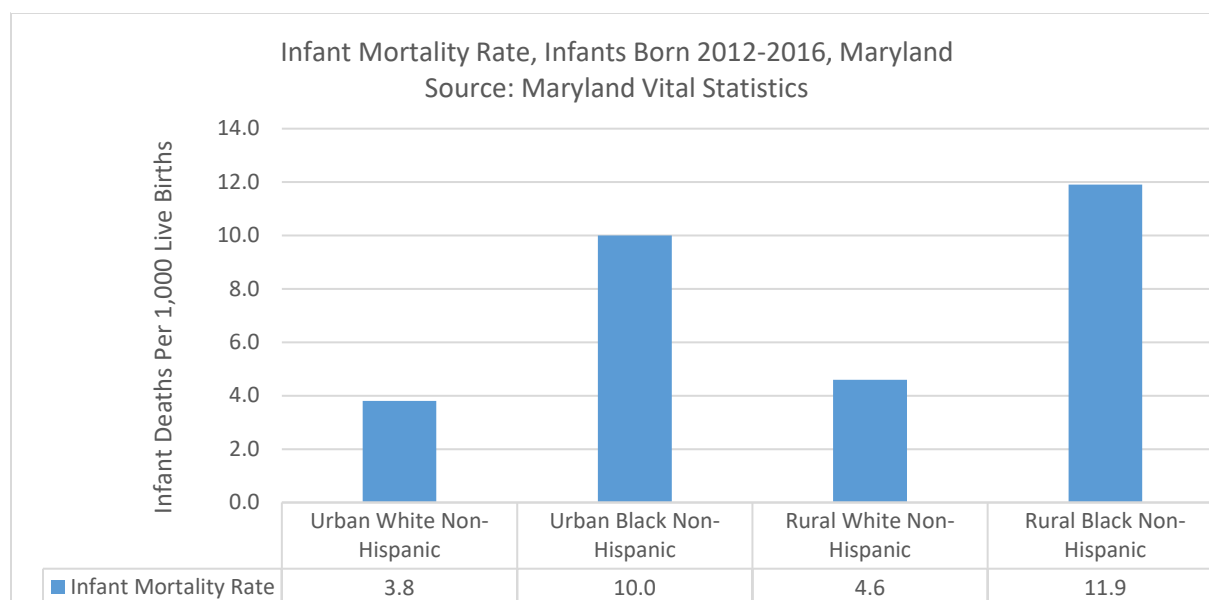


Figure 5: Infant Births for Non-Hispanic Black and White Infants by Geography, Maryland, 2012-2016

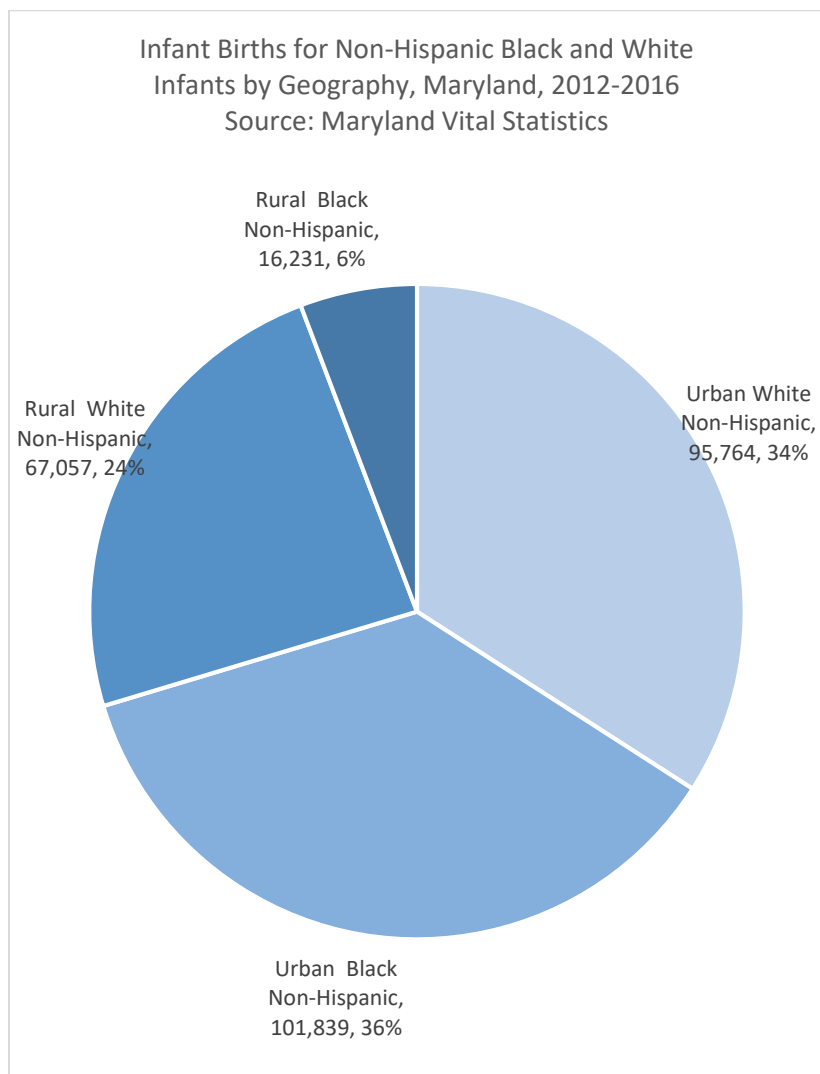
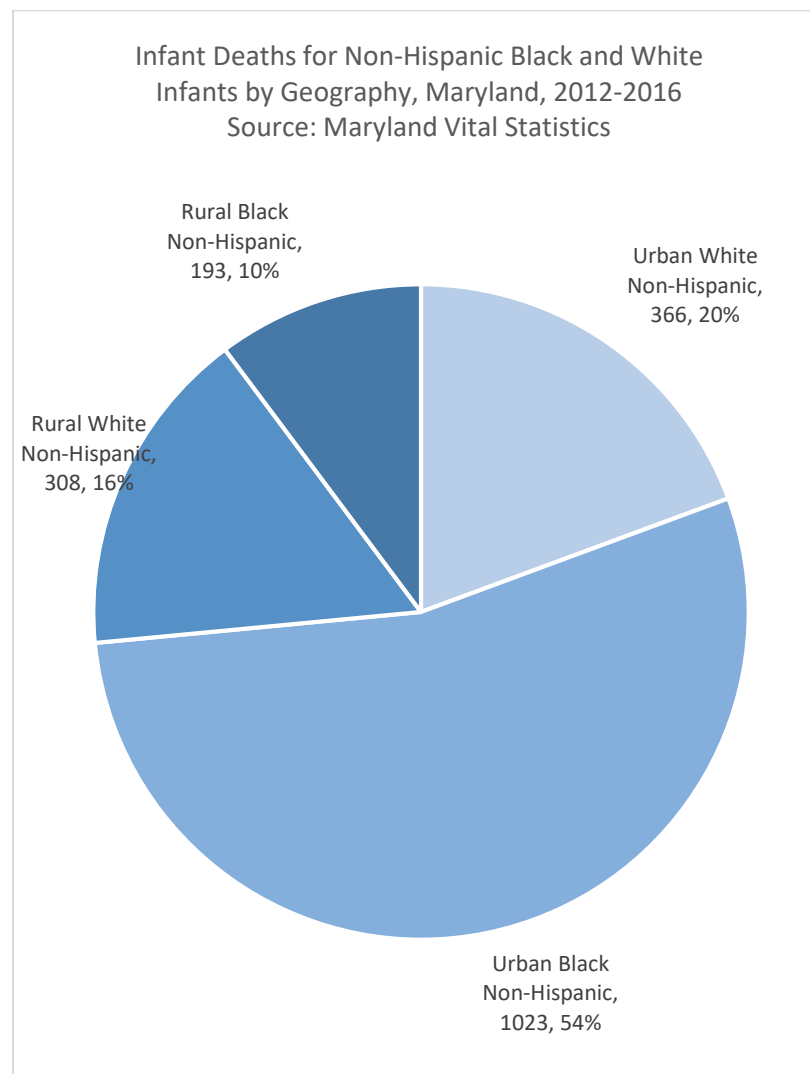


Figure 6: Infant Deaths for Non-Hispanic Black and White Infants by Geography, Maryland, 2012-2016



The following pages will show the infant mortality rates associated with following single factors: maternal education level, smoking during pregnancy, maternal marital status, insurance source, utilization of prenatal care, chronic hypertension, gestational hypertension, gestational diabetes, breast feeding (prior to hospital discharge at birth), inter-pregnancy interval, and pre-pregnancy BMI. Please note the limitation section above for important considerations when interpreting this data.

Factors related to Maternal Health

The 2011 Epidemiology Work Group on Infant Mortality found that maternal health is a key factor in infant mortality outcomes.³ The national literature review, in Appendix C, also found that maternal health is important to infant health. For this reason, this study examined a number of factors related to maternal health status, including chronic hypertension, gestational hypertension, gestational diabetes, breast feeding (prior to hospital discharge at birth), pre-pregnancy BMI, and smoking. Analysis for each of these factors is presented below.

Chronic Hypertension

In the Maryland Linked Birth-Infant Death Cohort data for 2012-2016 births, chronic hypertension (i.e. high blood pressure unrelated to pregnancy) is associated with worse outcomes for all infants in the cohort. The impact of chronic hypertension is particularly severe for rural Black women: this population has an infant mortality rate of 26.1 per 1,000 live births (Figure 7).

Chronic hypertension is more common in older women (and maternal age is itself a risk factor for infant mortality).

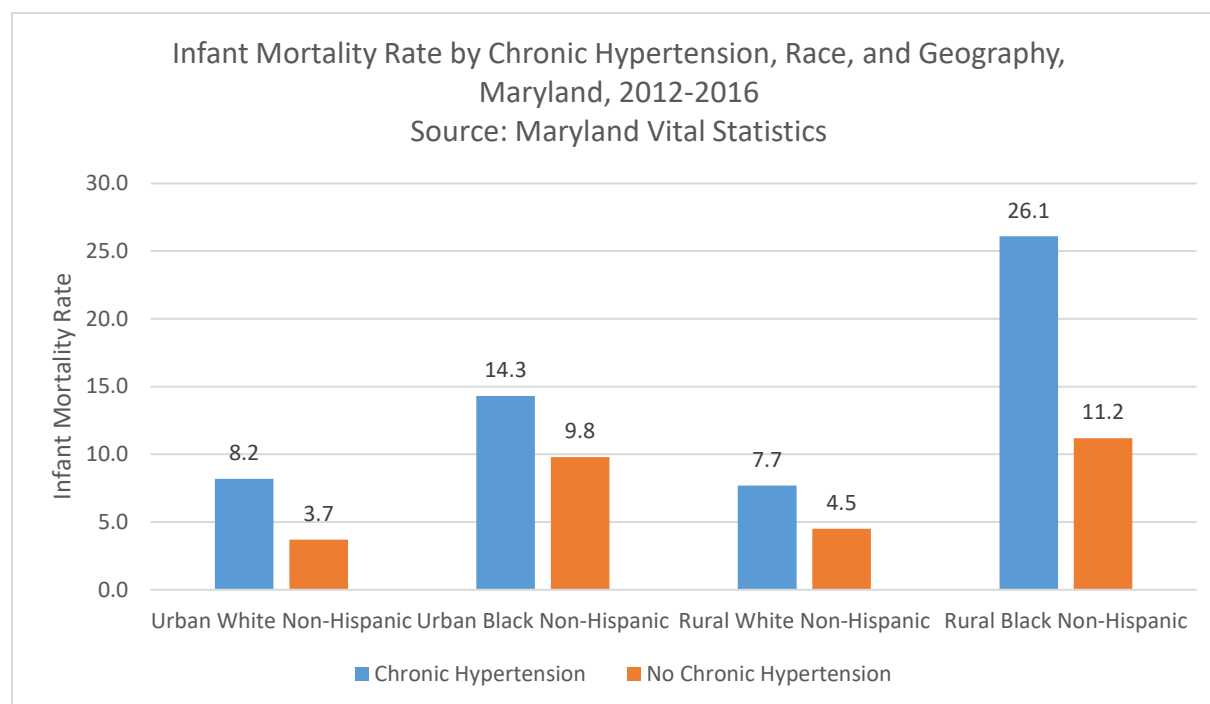
Chronic hypertension is also correlated with race (rates are higher in the Black population) and socio-economic status.⁴ These are all potential confounding variables that could explain a portion of the association between chronic hypertension and infant mortality rates.

Table 2: Relative Risk of Infant Mortality, No CHBP v. Chronic HBP, Infant Mortality, Maryland, 2012-2016		
Source: Maryland Vital Statistics		
	Rural	Urban
Black Non-Hispanic	0.43	0.69
White Non-Hispanic	0.58	0.45

³ Maryland Department of Health. Maryland Infant Mortality Epidemiology Work Group: Findings from Data Analysis and Overall Recommendations. Baltimore, MD: 2011 Aug 24. 1-31. Available from: https://health.maryland.gov/babiesbornhealthy/pdf/IM_Epi_Work_Group_%20Report_Final_Aug_24_2011.pdf

⁴ Lackland D. T. (2014). Racial differences in hypertension: implications for high blood pressure management. *The American journal of the medical sciences*, 348(2), 135–138. doi:10.1097/MAJ.0000000000000308; D. Edmund Anstey, Jessica Christian, and Daichi Shimbo, “Income Inequality and Hypertension Control” *Journal of the American Heart Association*, Jul 31, 2019, <https://doi.org/10.1161/JAHA.119.013636>

Figure 7: Infant Mortality Rate by Chronic Hypertension, Race, and Geography, Maryland, 2012-2016



Gestational Hypertension

In the Maryland Linked Birth-Infant Death Cohort data for 2012-2016 births, gestational hypertension (i.e. high blood pressure that develops during pregnancy) has limited association with infant mortality outcomes (Figure 8). In the national literature, gestational hypertension is one of the leading causes of maternal deaths.⁵ Maternal mortality is not the focus of this study, but is an important factor in infant wellbeing.

Table 3: Relative Risk of Infant Mortality, No Gestational HBP v. Gestational HBP, Infant Mortality, Maryland, 2012-2016

Source: Maryland Vital Statistics

	Rural	Urban
Black Non-Hispanic	1.14	1.00
White Non-Hispanic	0.85	0.81

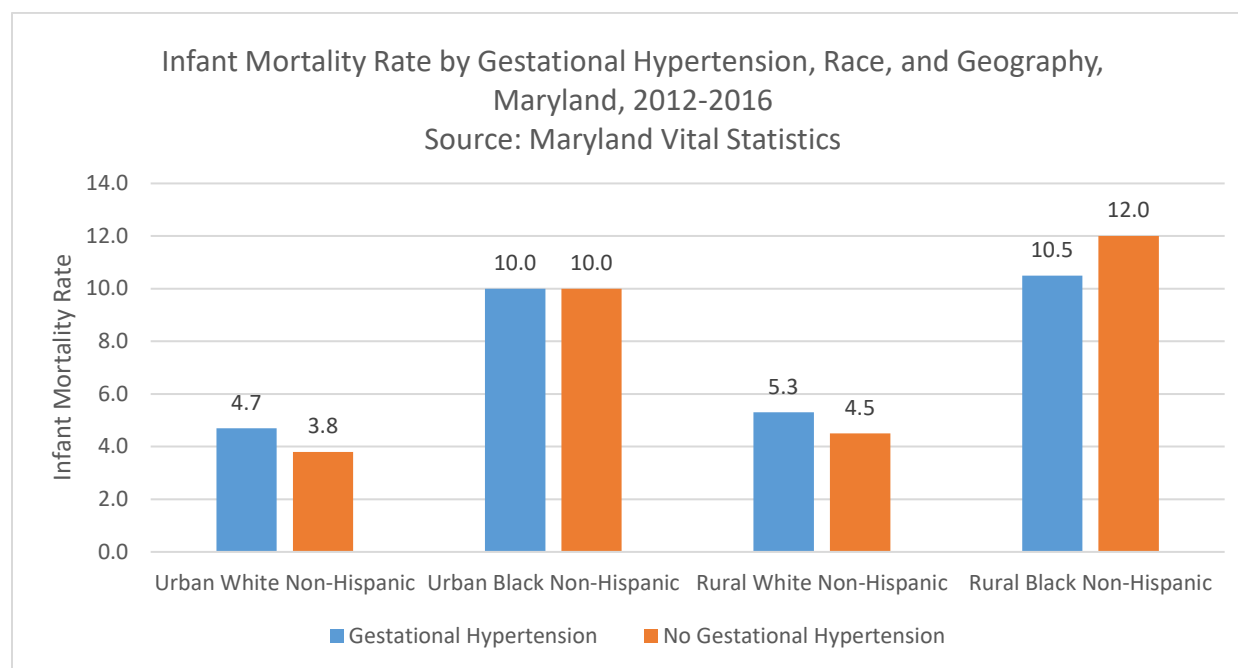
Gestational hypertension is more common in Black Non-Hispanic women⁶ Gestational hypertension risk increases with maternal age.⁷ Other confounding variables that were not identified in this study may also impact these results.

⁵ ACOG Practice Bulletin No. 202: Gestational Hypertension and Preeclampsia, Obstetrics & Gynecology: January 2019 - Volume 133 - Issue 1 - p e1-e25, doi: 10.1097/AOG.0000000000003018

⁶ Ghosh, G., Grewal, J., Männistö, T., Mendola, P., Chen, Z., Xie, Y., & Laughon, S. K. (2014). Racial/ethnic differences in pregnancy-related hypertensive disease in nulliparous women. *Ethnicity & disease*, 24(3), 283–289.

⁷ Dietl, Anna and Juliane Farthmann, "Correspondence: Gestational hypertension and advanced maternal age", *The Lancet*, Vol 386-10004, p. 1627-1628, Oct 24, 2015, DOI:https://doi.org/10.1016/S0140-6736(15)00532-2

Figure 8: Infant Mortality Rate by Gestational Hypertension, Race, and Geography, Maryland, 2012-2016



Gestational Diabetes

In the Maryland Linked Birth-Infant Death Cohort data for 2012-2016 births, gestational diabetes (i.e. diabetes that develops during pregnancy) is not associated with poor infant mortality rates (Figure 9). This is likely because this condition is controllable once it is identified. The lower infant mortality rates for mothers with gestational diabetes likely reflects close monitoring of the mother and infant with the condition before and after delivery.

Table 4: Relative Risk of Infant Mortality, No Gestational Diabetes v. Gestational Diabetes, Infant Mortality, Maryland, 2012-2016

Source: Maryland Vital Statistics

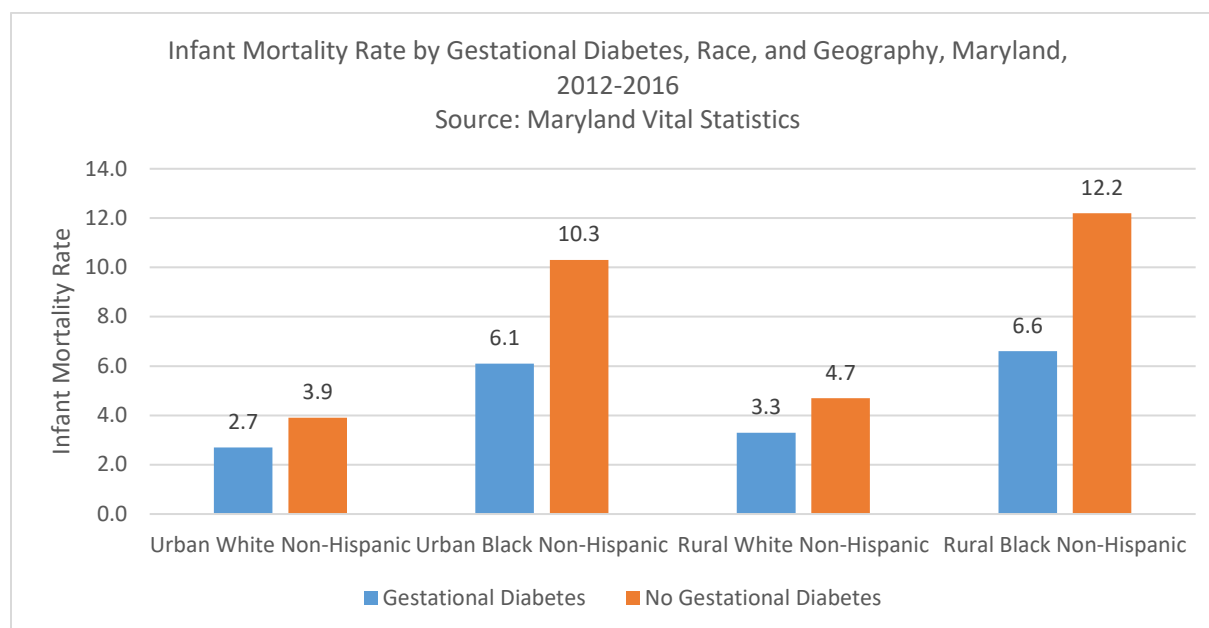
	Rural	Urban
Black Non-Hispanic	1.85	1.69
White Non-Hispanic	1.42	1.44

According to the CDC, gestational diabetes is associated with a higher risk of C-section, pre-term birth, and risk that the mother will develop type 2 diabetes later in life.⁸

⁸ Centers for Disease Control and Prevention, "Gestational Diabetes", <https://www.cdc.gov/diabetes/basics/gestational.html>, Accessed Oct. 11, 2019.

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Figure 9: Infant Mortality Rate by Gestational Diabetes, Race, and Geography, Maryland, 2012-2016



Pre-pregnancy BMI

In the Maryland Linked Birth-Infant Death Cohort data for 2012-2016 births, higher body mass index (BMI) (i.e. diabetes that develops during pregnancy) is with higher infant mortality rates (Figure 10). Body mass index, a measure of weight and height (e.g. obesity), is a commonly used proxy for health status and health risk. This measure was included in the study due to an interest in the impact on preconception health on outcomes. While obesity does appear to be associated with elevated infant mortality risk, relative to a normal body weight, the impact is relatively small, compared to some other measures included in this study.

Table 5: Relative Risk of Infant Mortality, Pre-pregnancy BMI=Obese v. Pre-pregnancy BMI=Normal, Infant Mortality, Maryland, 2012-2016		
Source: Maryland Vital Statistics		
	Rural	Urban
Black Non-Hispanic	0.70	0.79
White Non-Hispanic	0.85	0.53

Obesity is more common for in the Black Non-Hispanic Population than the White Non-Hispanic Population.⁹ Obesity is more common as people age.¹⁰ Obesity is less common in higher income women in the United States and less common in women with college educations than lower educations for both White Non-Hispanic and Black Non-Hispanic populations.¹¹

⁹ <https://nccd.cdc.gov/CKD/detail.aspx?QNum=Q144&Strat=Race%2FEthnicity%2C+BMI>

¹⁰ <https://nccd.cdc.gov/CKD/detail.aspx?Qnum=Q144&Strat=Age%2c+BMI#refreshPosition>

¹¹ <https://www.cdc.gov/mmwr/volumes/66/wr/mm6650a1.htm>

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Figure 10: Infant Mortality Rate by Pre-pregnancy BMI, Race, and Geography, Maryland, 2012-2016

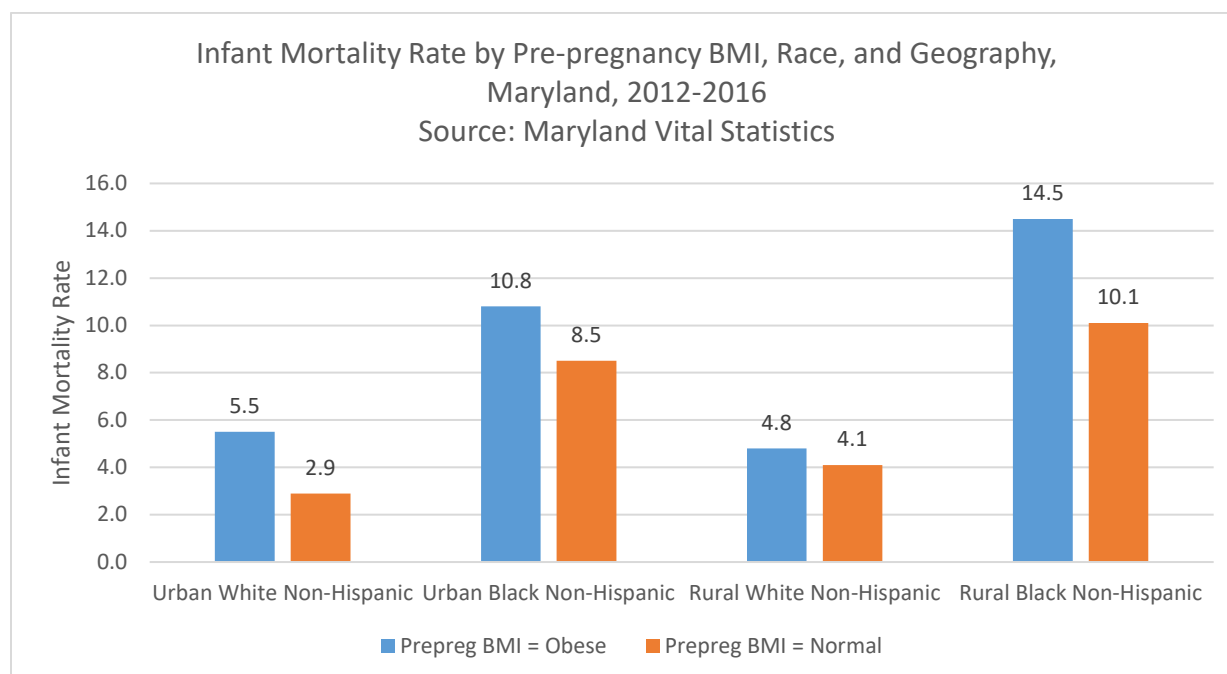


Table 6: Number of Infant Deaths by BMI, Race, and Geography, Linked Birth-Infant Death Cohort 2012-2016, Maryland

Source: Maryland Vital Statistics

	Prepregnancy BMI = Obese	Prepregnancy BMI = Normal
Urban White Non-Hispanic	94	148
Urban Black Non-Hispanic	360	287
Rural White Non-Hispanic	77	126
Rural Black Non-Hispanic	86	52

Smoking

In the Maryland Linked Birth-Infant Death Cohort data for 2012-2016 births, maternal smoking is associated with higher infant mortality rates than non-smoking (Figure 11). This finding is supported by findings from the national literature review (Appendix C). For White Non-Hispanic infants, maternal smoking is associated with a doubling of the risk of infant mortality (Table 7). Smoking is associated with less of an impact on outcomes for Black Non-Hispanic infants. It is important to note that this association may be related to confounding

Table 7: Relative Risk of Infant Mortality, Non-Smoking v. Smoking during pregnancy, Infant Mortality, Linked Birth-Infant Death Cohort 2012-2016, Maryland

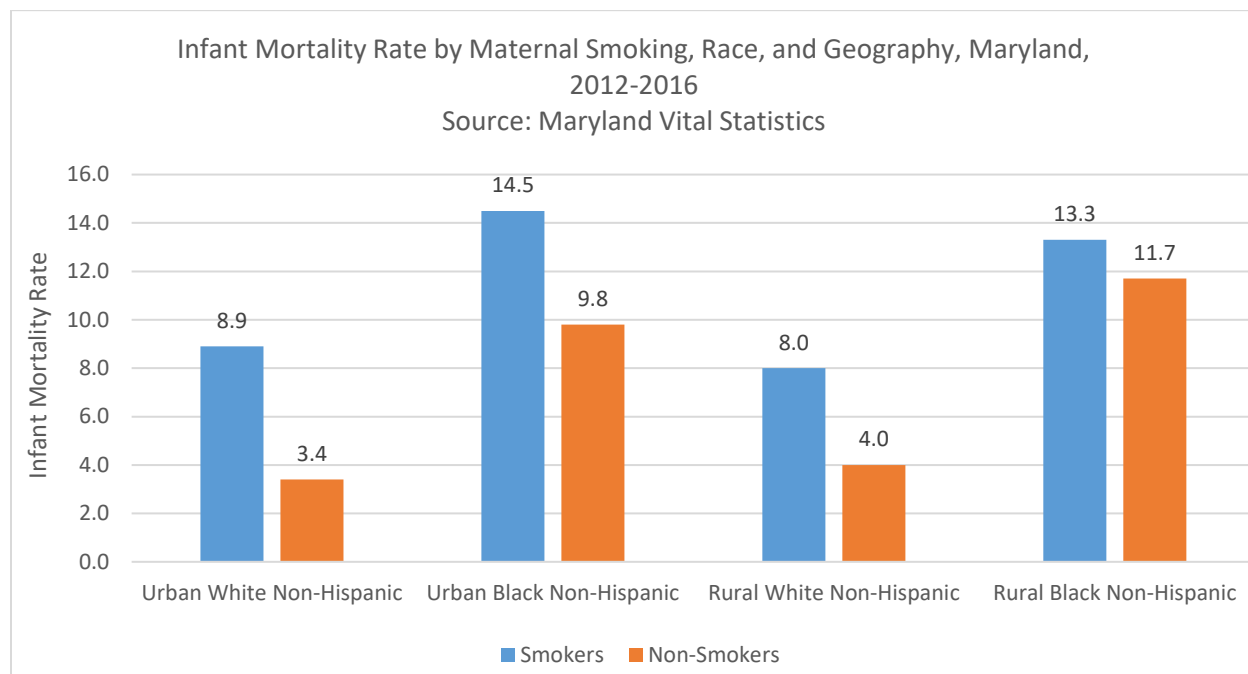
Source: Maryland Vital Statistics

	Rural	Urban
Black Non-Hispanic	0.88	0.68
White Non-Hispanic	0.50	0.38

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factors that are themselves associated with smoking, such as education level, income, marital status (a proxy for social support), source of health insurance coverage, and serious psychological distress.¹²

Figure 11: Infant Mortality Rate by Maternal Smoking, Race, and Geography, Maryland, 2012-2016



In Maryland, smoking is more common among White Non-Hispanic pregnant women than Black Non-Hispanic pregnant women. In the 2012-2016 cohort used for this study, 10 percent of White Non-Hispanic mothers reported smoking during pregnancy, compared with 6 percent of Black Non-Hispanic mothers. Smoking is also more common in rural areas in the State. Twelve percent of mothers from rural communities reported smoking during pregnancy, compared to 5 percent of mothers from non-rural jurisdictions.¹³ For comparison, 12 percent of adult women in the United States (regardless of pregnancy status) smoke.¹⁴ It is important to note that, although the risk of infant mortality is higher for mothers who smoke during pregnancy, by absolute numbers, more infants with non-smoking mothers die during infancy because there are more non-smoking mothers (Table 8).

¹² Centers for Disease Control and Prevention, "Current Cigarette Smoking among Adults in the United States" (2017 data), https://www.cdc.gov/tobacco/data_statistics/fact_sheets/adult_data/cig_smoking/index.htm, accessed October 11, 2019.

¹³ Maryland Vital Statistics Linked Birth-Infant Death Cohort data for 2012-2016 Births.

¹⁴ Centers for Disease Control and Prevention, "Current Cigarette Smoking among Adults in the United States" (2017 data), https://www.cdc.gov/tobacco/data_statistics/fact_sheets/adult_data/cig_smoking/index.htm, accessed Oct. 11, 2019.

Table 8: Number of Infant Deaths by Maternal Smoking, Race, and Geography, Linked Birth-Infant Death Cohort 2012-2016, Maryland		
Source: Maryland Vital Statistics		
	Smoker	Non-Smoker
Urban White Non-Hispanic	62	304
Urban Black Non-Hispanic	82	941
Rural White Non-Hispanic	76	232
Rural Black Non-Hispanic	21	172

Other Factors

In addition to the maternal health factors above, a number of other factors were studied in this analysis, including breast feeding, utilization of prenatal care, interpregnancy interval, source of health insurance, maternal education level, and marital status.

Breastfeeding

In the Maryland Linked Birth-Infant Death Cohort data for 2012-2016 births, breastfeeding before hospital discharge at birth is associated with much lower infant mortality rates than not breastfeeding (Figure 12). The infant mortality rates for Black women who do not breast feed before hospital discharge are some of the highest in this study (30.5 for urban Black women and 26.6 for rural Black women), while the infant mortality rates for Black women who do breast feed are some of the lowest in the study. Potential confounding variables include age and income.¹⁵ A further limitation of this analysis is that it only includes breastfeeding that occurs before hospital discharge at birth. Some women may begin breastfeeding after discharge from the hospital, and would not be captured in these figures. In addition to “ever” breastfeeding, duration of breast feeding is important, and is not captured by this analysis.

Table 9: Relative Risk of Infant Mortality, No Breast Feeding v. Breast Feeding, Infant Mortality, Maryland, 2012-2016		
Source: Maryland Vital Statistics		
	Rural	Urban
Black Non-Hispanic	0.15	0.11
White Non-Hispanic	0.13	0.08

The Centers for Disease Control and Prevention’s Health People 2020 initiative sets a goal that at least 81.9 percent of infants in the U.S. are ever breast fed.¹⁶ Among this cohort, 81 percent of Non-Hispanic White mothers breastfed prior to discharge while 73 percent of non-Hispanic Black mothers breastfed prior to discharge. This is similar to disparities in breast feeding at the national level.¹⁷ Among rural

¹⁵ U.S. Department of Health and Human Services, Health Resources Administration, Maternal and Child Health Bureau. The Health and Well-Being of Children in Rural Areas: A Portrait of the Nation 2007. Rockville, MD: US Department of Health and Human Services; 2011:51.

<https://mchb.hrsa.gov/nsch/07rural/moreinfo/pdf/nsch07rural.pdf>. Accessed May 12, 2019.

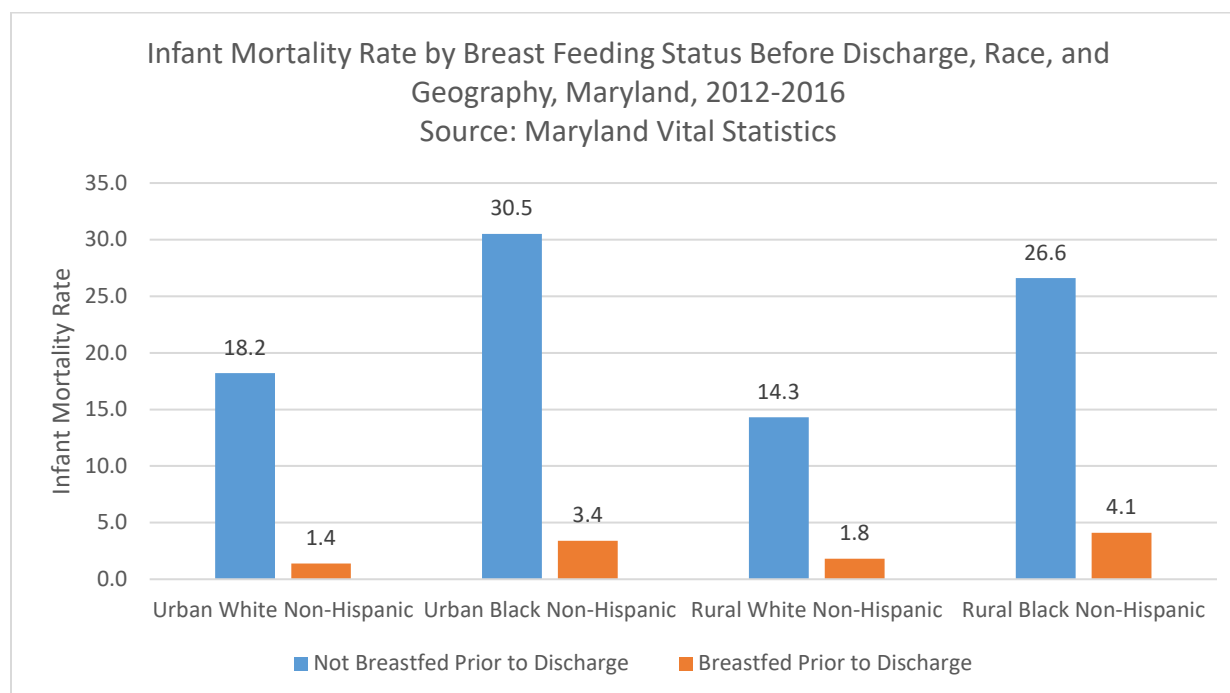
¹⁶ CDC, Breastfeeding Facts, <https://www.cdc.gov/breastfeeding/data/facts.html>

¹⁷ “Fewer non-Hispanic black infants (74.0%) are ever breastfed compared with non-Hispanic white infants (86.6%) and Hispanic infants (82.9%).” CDC, Breastfeeding Facts, <https://www.cdc.gov/breastfeeding/data/facts.html>

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mothers in this Maryland cohort 75 percent breastfed prior to discharge, compared with 83 percent of urban mothers. National studies have similarly found lower rates of breastfeeding in rural areas.¹⁸

Figure 12: Infant Mortality Rate by Breast Feeding Status before Discharge, Race, and Geography, Maryland, 2012-2016



Utilization of Prenatal Care

Pregnant women are encouraged to seek prenatal care early, ideally in the first trimester, and continue prenatal care throughout the pregnancy. In the Maryland Linked Birth-Infant Death Cohort data for 2012-2016 births, early prenatal care is associated with improved outcomes (Figure 13). The difference in outcomes based on the timing of prenatal care utilization is largest for White Non-Hispanic infants, compared to Black Non-Hispanic infants, regardless of geography (Table 10).

Table 10: Relative Risk of Infant Mortality, Early PNC v. Late or No PNC, Infant Mortality, Maryland, 2012-2016

Source: Maryland Vital Statistics

	Rural	Urban
Black Non-Hispanic	0.76	0.71
White Non-Hispanic	0.38	0.35

In Maryland, approximately 82 percent of Black Non-Hispanic mothers start prenatal care in the first trimester, and approximately 93 percent of White Non-Hispanic mothers start prenatal care in the first

¹⁸ U.S. Department of Health and Human Services, Health Resources Administration, Maternal and Child Health Bureau. The Health and Well-Being of Children in Rural Areas: A Portrait of the Nation 2007. Rockville, MD: US Department of Health and Human Services; 2011:51.
<https://mchb.hrsa.gov/nsch/07rural/moreinfo/pdf/nsch07rural.pdf>. Accessed May 12, 2019.

trimester.¹⁹ Because of this high rate of prenatal care utilization, more infants who had early prenatal care die in the first year of life (Table 11).

Figure 13: Infant Mortality Rate by Utilization of Prenatal Care, Race, and Geography, Maryland, 2012-2016

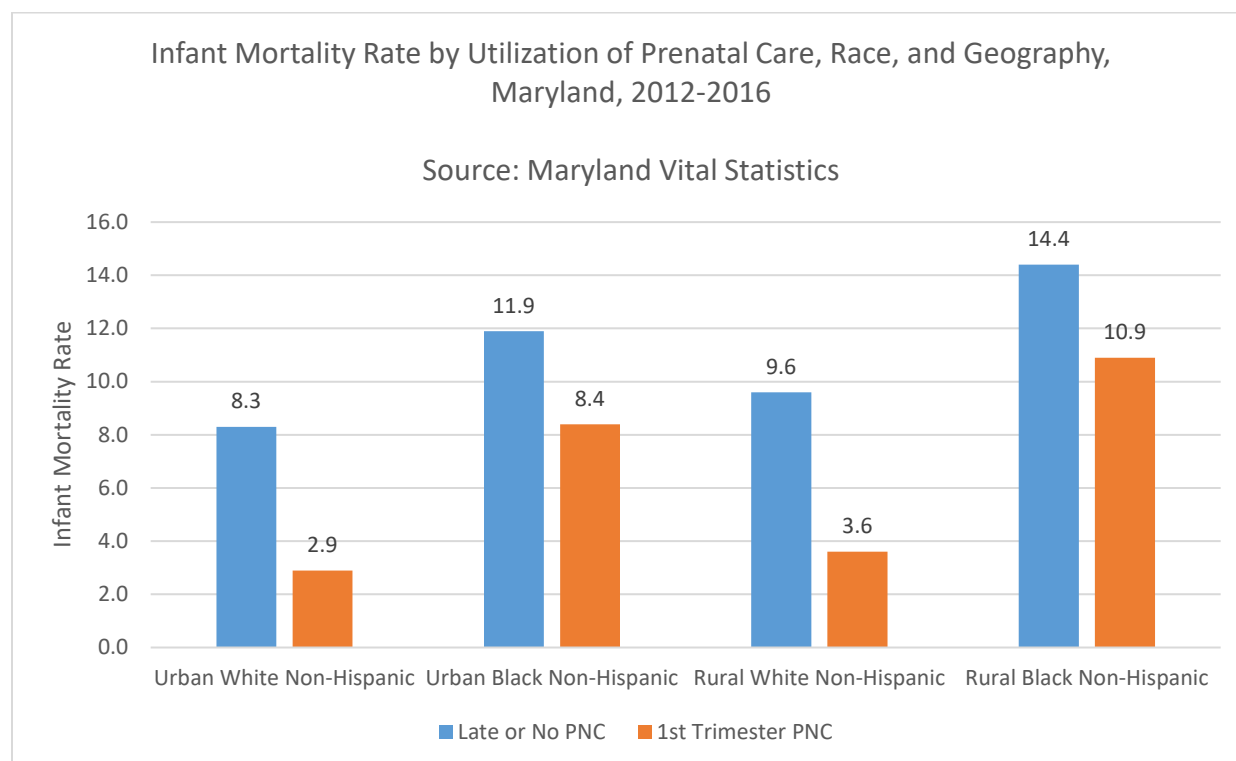


Table 11: Number of Infant Deaths by Prenatal Care Utilization, Race, and Geography, Linked Birth-Infant Death Cohort 2012-2016, Maryland

Maryland Vital Statistics		
	Late or No PNC	1st Trimester PNC
Urban White Non-Hispanic	46	201
Urban Black Non-Hispanic	144	453
Rural White Non-Hispanic	32	184
Rural Black Non-Hispanic	23	114

¹⁹ Live Birth Data, Maryland Vital Statistics, Annual Reports for 2012-2016.

<https://health.maryland.gov/vsa/Pages/reports.aspx> Accessed Oct. 11, 2019. Note that this data includes all races and ethnicities. Additional data analysis by MHCC.

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Inter-pregnancy Interval

In the Maryland Linked Birth-Infant Death Cohort data for 2012-2016 births, an interpregnancy interval of less than one year is associated with higher infant mortality than an interpregnancy interval of greater than two years for women with a prior birth (Figure 14).

The apparent protective effect (relative risk) of longer intervals between pregnancies was relatively similar for all women studied (*Table 12*). The absolute number of infants who die is higher for infants who are at least two year younger than their older sibling, compared to less than one year younger, because longer birth intervals are more common (*Table 13*).

Table 12: Relative Risk of Infant Mortality, Inter-pregnancy Interval <1year v. Inter-pregnancy Interval > 2 years, Infant Mortality, Maryland, 2012-2016

Source: Maryland Vital Statistics

	Rural	Urban
Black Non-Hispanic	0.31	0.29
White Non-Hispanic	0.31	0.37

Figure 14: Infant Mortality Rate by Interval between Pregnancies, Race, and Geography, Maryland, 2012-2016

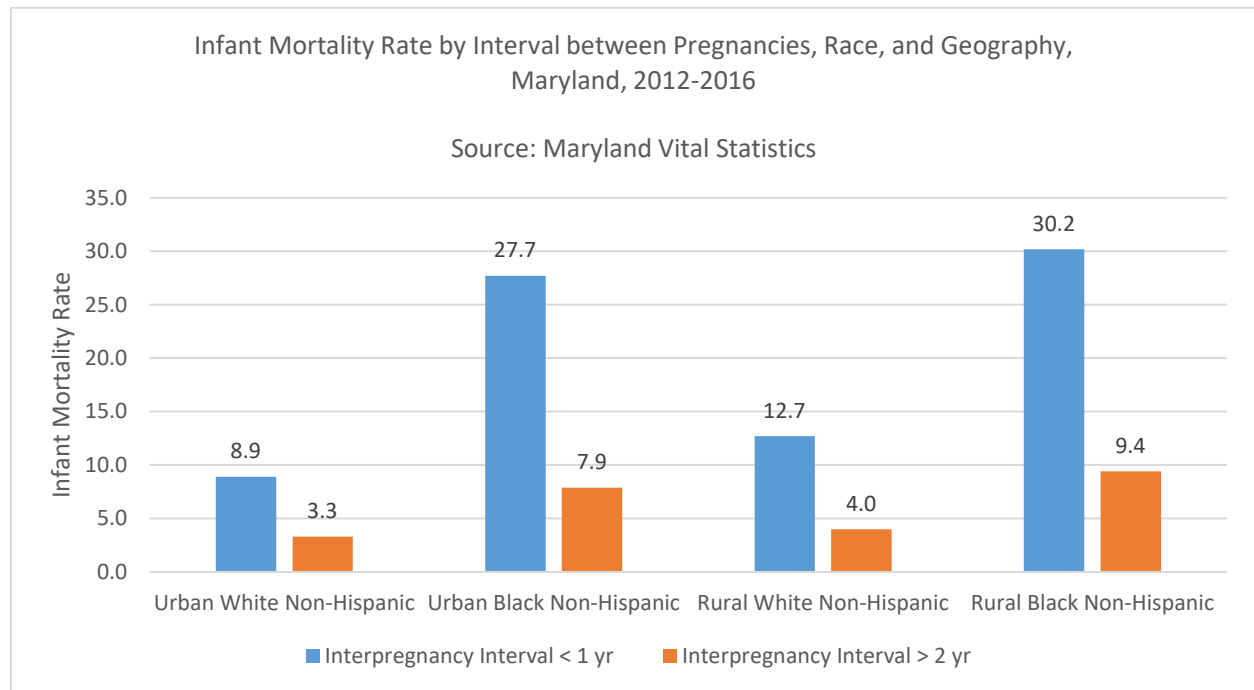


Table 13: Number of Infant Deaths by Prenatal Care Utilization, Race, and Geography, Linked Birth-Infant Death Cohort 2012-2016, Maryland

Source: Maryland Vital Statistics

	Interpregnancy Interval < 1 year	Interpregnancy Interval > 2 years
Urban White Non-Hispanic	37	113
Urban Black Non-Hispanic	121	307
Rural White Non-Hispanic	40	111
Rural Black Non-Hispanic	26	64

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Insurance Source

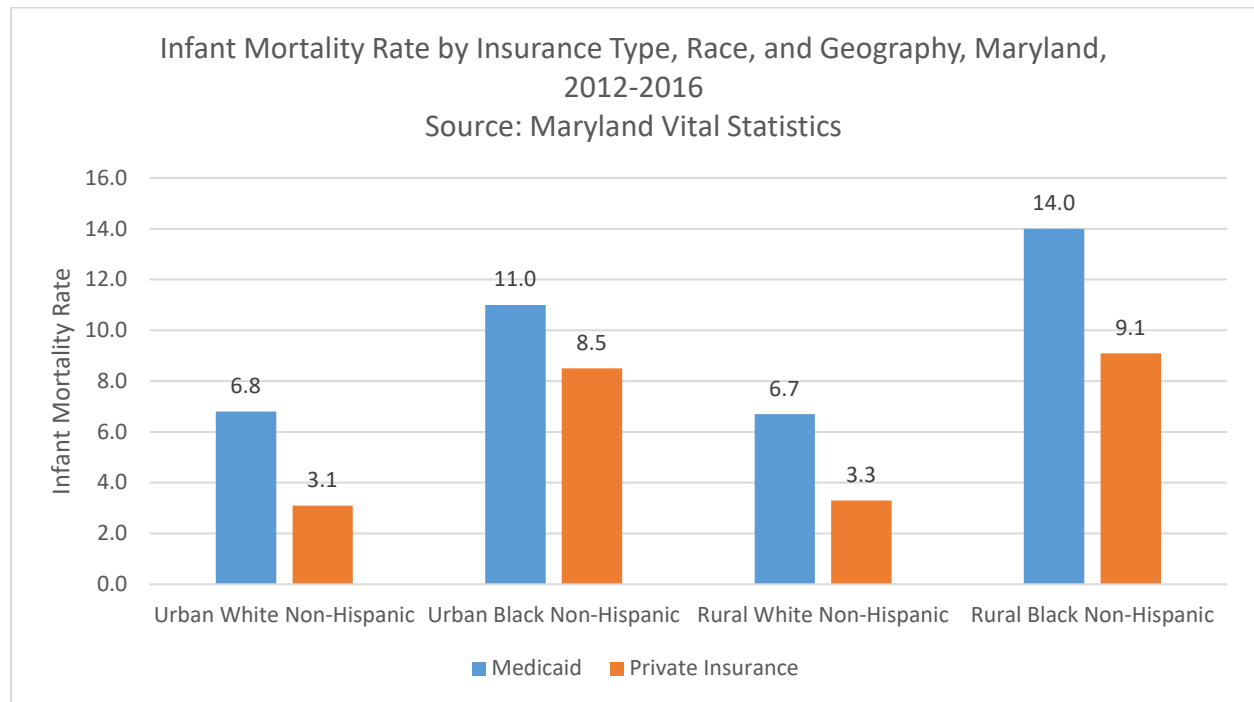
In the Maryland Linked Birth-Infant Death Cohort data for 2012-2016 births, infant mortality rates are higher for mothers with Medicaid than for mothers with private insurance (Figure 15). The difference in outcomes associated with insurance source seems to be larger for White Non-Hispanic women than Black Non-Hispanic Women, regardless of geography (*Table 14*). This finding is supported by the findings in the national literature review (Appendix C). Insurance source is correlated with income, race, and employment status, potential important confounding variables.

Table 14: Relative Risk of Infant Mortality, Private Insurance v. Medicaid, Infant Mortality, Maryland, 2012-2016

Source: Maryland Vital Statistics

	Rural	Urban
Black Non-Hispanic	0.65	0.77
White Non-Hispanic	0.49	0.46

Figure 15: Infant Mortality Rate by Insurance Type, Race, and Geography, Maryland, 2012-2016



Medicaid is an important source of payment for births in Maryland. As of 2017, 43 percent of births in Maryland were financed through Medicaid.²⁰

Table 15: Number of Infant Deaths by Insurance Source, Race, and Geography, Linked Birth-Infant Death Cohort 2012-2016, Maryland		
Source: Maryland Vital Statistics		
	Medicaid	Private Insurance
Urban White Non-Hispanic	104	208
Urban Black Non-Hispanic	527	324
Rural White Non-Hispanic	128	133
Rural Black Non-Hispanic	127	47

Maternal Education

In the Maryland Linked Birth-Infant Death Cohort data for 2012-2016 births, maternal education at less than a high school level is associated with higher infant mortality rates than maternal education levels at or above a college degree (Figure 16). This is an association that is reflective of results in the national literature review (Appendix C), but that may also reflect the impact of confounding factors like age, poverty level, and other factors that affect birth outcomes.

Table 16: Relative Risk of Infant Mortality, += College Education compared to < High School Graduate, Infant Mortality, Maryland, 2012-2016		
Source: Maryland Vital Statistics		
	Rural	Urban
Black Non-Hispanic	0.64	0.71
White Non-Hispanic	0.40	0.32

The difference in outcome based on higher education levels is more pronounced for White Non-Hispanic women than for Black Non-Hispanic women (Table 16), a result which also corresponds to findings in the national literature that suggest that higher education is less protective for Black women than for White women.²¹

It is important to note that, although the risk of infant mortality is higher for mothers with lower levels of education (Table 16), by absolute numbers, more infants of mothers with college degrees die during infancy than infants of mothers with less than a high school education (because more infants are born to mothers with college degrees than mothers with less than high school educations) (Table 17).

²⁰ Vital Statistics Administration, Maryland Department of Health. Live Birth Data: 2017. Baltimore, MD: 2018. Available from:

https://health.maryland.gov/vsa/Documents/Reports%20and%20Data/Live%20Births/Live_Birth_2017.pdf

²¹ Subramanian SV, Chen JT, Rehkopf DH, Waterman PD, Krieger N. Racial disparities in context: a multilevel analysis of neighborhood variations in poverty and excess mortality among black populations in Massachusetts. Am J Public Health. 2005;95(2):260-265. doi:10.2105/AJPH.2003.034132

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Figure 16: Infant Mortality Rate by Maternal Education Level, Race, and Geography, Maryland, 2012-2016

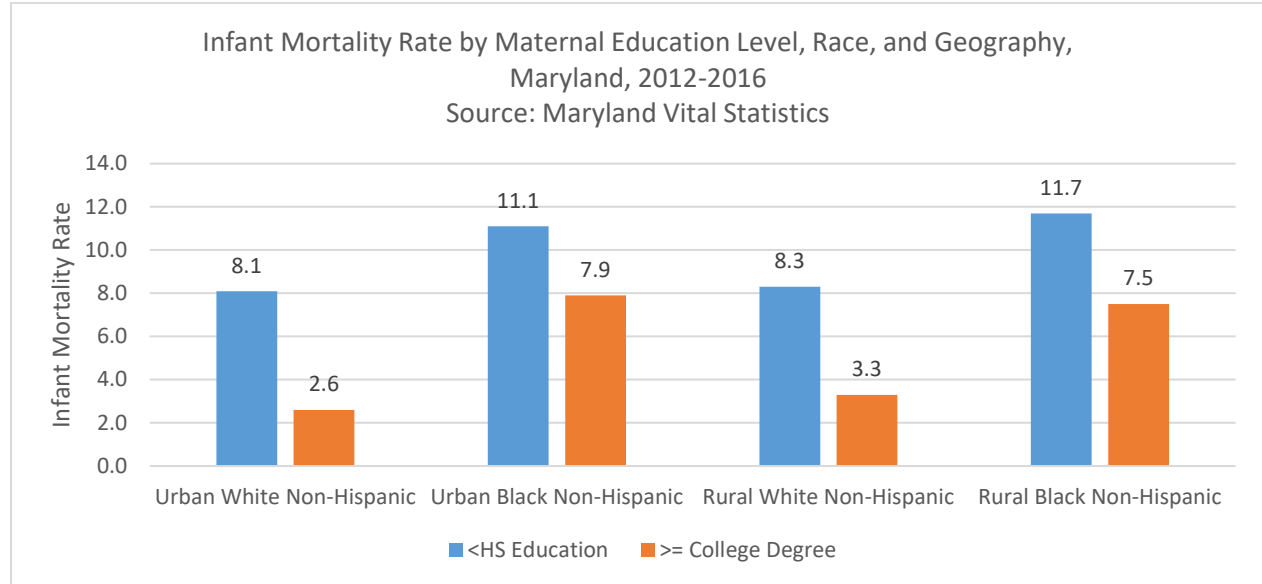


Table 17: Number of Infant Deaths by Maternal Education, Race, and Geography, Linked Birth-Infant Death Cohort 2012-2016, Maryland

Source: Maryland Vital Statistics

	<HS Education	>= College Degree
Urban White Non-Hispanic	35	155
Urban Black Non-Hispanic	117	226
Rural White Non-Hispanic	40	84
Rural Black Non-Hispanic	23	25

Parental Marital Status

Parental marital status was selected as a factor for study as the best available, but imperfect, proxy for maternal and infant social supports available in the vital statistics data (i.e. do mothers and infants have the network of support from friends and family that they need to succeed?).

In the Maryland Linked Birth-Infant Death Cohort data for 2012-2016 births, infant mortality rates are higher for unmarried parents than for married parents (Figure 17).

This finding is supported by the findings in the national literature review (Appendix C). What is interesting in the Maryland data is the difference in the size of the impact by race and geography, with rural Black Non-Hispanic infants experiencing the largest

Table 18: Relative Risk of Infant Mortality, Married v. Unmarried Parents, Infant Mortality, Maryland, 2012-2016

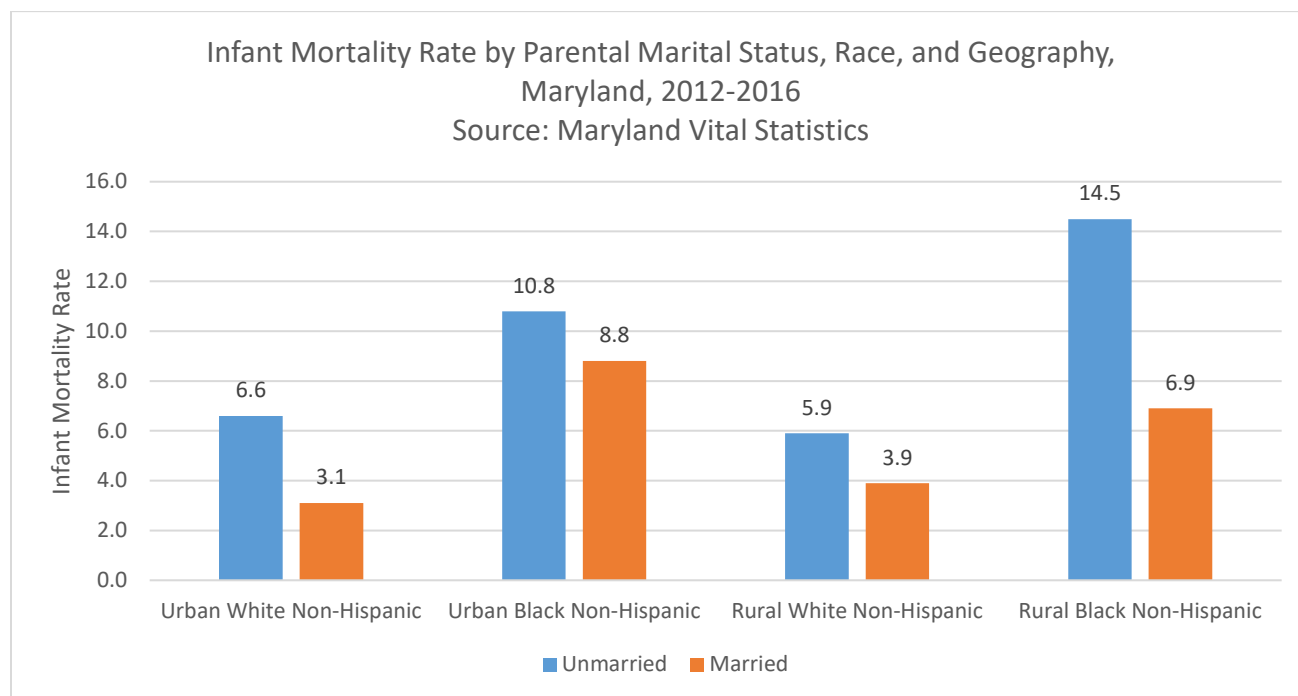
Source: Maryland Vital Statistics

	Rural	Urban
Black Non-Hispanic	0.48	0.81
White Non-Hispanic	0.66	0.47

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difference in infant mortality rates based on parental marital status (Figure 17). In the U.S. population, marital status varies by age, income, education level, and race, important potential confounding factors that could influence this data.²²

Figure 17: Infant Mortality Rate by Parental Marital Status, Race, and Geography, Maryland, 2012-2016



In Maryland, approximately 40 percent of infants were born to unmarried parents in 2012-2016.²³ Approximately 57 percent of infant deaths were in families with unmarried parents (Table 19).

Source: Maryland Vital Statistics		
	Unmarried	Married
Urban White Non-Hispanic	127	236
Urban Black Non-Hispanic	673	348
Rural White Non-Hispanic	128	178
Rural Black Non-Hispanic	154	39

²² Joint Economic Committee, U.S. Congress, "The Class Divide in Marriage", Nov. 8, 2017, <https://www.jec.senate.gov/public/index.cfm/republicans/2017/11/the-class-divide-in-marriage>, accessed Oct. 11, 2019; Parker, Kim, and Renee Stepler, "As the U.S. marriage rate hovers to 50%, education gap in marital status widens", Pew Research Center, Sept. 14, 2017, <https://www.pewresearch.org/fact-tank/2017/09/14/as-u-s-marriage-rate-hovers-at-50-education-gap-in-marital-status-widens/>, accessed Oct. 11, 2019.

²³ Live Birth Data, Maryland Vital Statistics, Annual Reports for 2012-2016. <https://health.maryland.gov/vsa/Pages/reports.aspx> Accessed Oct. 11, 2019. Note that this data includes all races and ethnicities. Additional data analysis by MHCC.

Combined Table of Infant Mortality Rate by Risk Factor, Race, and Geography

Table 20: Infant Mortality Rate by Risk Factor, Race, and Geography, Maryland, 2012-2016

Source: Maryland Vital Statistics

	Urban White Non-Hispanic	Urban Black Non-Hispanic	Rural White Non-Hispanic	Rural Black Non-Hispanic
<HS Education	8.1	11.1	8.3	11.7
>= College Degree	2.6	7.9	3.3	7.5
Among Smokers	8.9	14.5	8.0	13.3
Non-Smokers	3.4	9.8	4.0	11.7
Unmarried	6.6	10.8	5.9	14.5
Married	3.1	8.8	3.9	6.9
Medicaid Payment	6.8	11.0	6.7	14.0
Private Insurance Payment	3.1	8.5	3.3	9.1
Late or No PNC	8.3	11.9	9.6	14.4
1st Trimester PNC	2.9	8.4	3.6	10.9
Chronic Hypertension	8.2	14.3	7.7	26.1
No Chronic Hypertension	3.7	9.8	4.5	11.2
Gestational Hypertension	4.7	10.0	5.3	10.5
No Gestational Hypertension	3.8	10.0	4.5	12.0
Gestational Diabetes	2.7	6.1	3.3	6.6
No Gestational Diabetes	3.9	10.3	4.7	12.2
Not Breastfed Prior to Discharge	18.2	30.5	14.3	26.6
Breastfed Prior to Discharge	1.4	3.4	1.8	4.1
Interpregnancy Interval < 1 yr	8.9	27.7	12.7	30.2
Interpregnancy Interval > 2 yr	3.3	7.9	4.0	9.4
Prepreg BMI = Obese	5.5	10.8	4.8	14.5
Prepreg BMI = Normal	2.9	8.5	4.1	10.1

Discussion of findings related to other poor birth outcomes

This study is focused on infant mortality. However, other poor birth outcomes, including low birth weight and preterm birth are important, in part because infants who experience these outcomes are at higher risk for infant mortality and because these infants face other long term health, educational, and economic risks.

In the cohort of 2012-2016 births in Maryland, 1.6 percent of births to rural families and 2.0 percent of births to urban families were very preterm (<32 weeks). 1.3 percent of Non-Hispanic White infants were very preterm and 3.0 percent of Non-Hispanic Black Infants were very preterm.

About 1.8% of infants living in urban areas are born with a very low birthweight (<1500 grams) compared to 1.4% of infants living in rural families. Only about 1.1 percent of Non-Hispanic White Infants are born very low birthweight, compared to 2.9 percent of Non-Hispanic Black infants.

Conclusions related to infant mortality

Based on the data above, it appears that developing programs targeted on breastfeeding, inter-pregnancy intervals, and, perhaps, chronic hypertension, have the largest potential to improve outcomes for Black Non-Hispanic infants and infants in rural communities. Additional data analysis could clarify the impact of confounding variables.

[Attachment 1: Factors identified in 2011 Study of Infant Mortality](#)

In 2011, the State conducted a study of Infant Mortality generally (with no focus on specific populations). This study resulted in two reports:

- [2011 Plan for Reducing Infant Mortality in Maryland](#)
- [2011 Maryland Infant Mortality Epidemiology Work Group Findings from Data Analysis and Overall Recommendations](#)

The Epidemiology Work Group Findings focused on 8 priority risk factors for intervention:

- Priority Chronic Conditions Before and During Pregnancy Maryland PRAMS Data
 - Hypertensive disorders during pregnancy (11% prevalence) and chronic hypertension before pregnancy (4% prevalence)
 - Other medical conditions such as gestational diabetes and pre-pregnancy diabetes, heart disease, obesity, and asthma as well as tobacco use, binge drinking, intimate partner violence and depression
- Fertility Treatment Maryland PRAMS Data
- Infant Sleep Position, Co-sleeping, Postpartum Maternal Tobacco Use Maryland PRAMS Data
- Timing And Effectiveness of Prenatal Care Vital Statistics data
- Maternal age
- Prior Pre-term Birth Vital Statistics data
- Birth Hospital Level of Care, if Very Low Birth Weight (VLBW) Vital Statistics data
- Early Term Deliveries (37-38 weeks gestation) Vital Statistics data

Attachment 2: Factors and Data Elements Identified for Potential Study in 2019

Access to care	Marital Status
Assistance program	Maternal Age
Birthweight	Maternal Chronic Disease
Breastfeeding duration	Maternal Drug Use
Care process (rural v. Urban)	Maternal Mental health
Community-level factors	Maternal Stress
Dental Care	Nutrition
Diabetes developed during pregnancy	Parity
Diabetes pre- pregnancy	Paternal Acknowledgement
Domestic Violence/Intimate Partner Violence- Maternal	Patient experience
Elective Early Birth	Plurality
Environmental Exposure	Preconception Health
Ethnicity	Prenatal Care
Fertility RX	Prior Pre-term Birth
Gestational Age at Birth	Service Gaps (rural v. Urban)
Health services and social services utilization	SES factors (Education, Income, Employment, etc.)
Hospital Level of Care	Smoking during pregnancy
Hypertension developed during pregnancy	Social Support
Hypertension pre-pregnancy	Structural Racism & Bias
Immigrant/US born	Time in hospital (infant)
Infant sleep position (not on back)	Time in Hospital (Maternal)
Insured Status	Time since last birth
Intended Pregnancy	Transportation Access
Jurisdiction of Residence	Trauma/ACE Score
Justice Involvement / Incarceration Status	