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Socioeconomic position, health behaviors, and racial disparities in cause-specific infant mortality in Michigan, USA

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ABSTRACT

Objectives. Studies about racial disparities in infant mortality suggest that racial differences in socioeconomic position (SEP) and maternal risk behaviors explain some, but not all, excess infant mortality among Blacks relative to non-Hispanic Whites. We examined the contribution of these to disparities in specific causes of infant mortality.

Methods. We analyzed data about 2,087,191 mother–child dyads in Michigan between 1989 and 2005. First, we calculated crude Black–White infant mortality ratios independently and by specific cause of death. Second, we fit multivariable Poisson regression models of infant mortality, overall and by cause, adjusting for SEP and maternal risk behaviors. Third, Crude Black–White mortality ratios were compared to adjusted predicted probability ratios, overall and by specific cause.

Results. SEP and maternal risk behaviors explained nearly a third of the disparity in infant mortality overall, and over 25% of disparities in several specific causes including homicide, accident, sudden infant death syndrome, and respiratory distress syndrome. However, SEP and maternal risk behaviors had little influence on disparities in other specific causes, such as septicemia and congenital anomalies.

Conclusions. These findings help focus policy attention toward disparities in those specific causes of infant mortality most amenable to social and behavioral intervention, as well as research attention to disparities in specific causes unexplained by SEP and behavioral differences.

Introduction

Black infants in the United States are nearly three times more likely to die before their first birthday than are non-Hispanic White infants (Scribner, 1991; Salihu et al., 2005; Mathews and MacDorman, 2010; Lu and Halfon, 2003; Anachebe and Sutton, 2003; Anachebe, 2006). It is clear that socioeconomic position (SEP) and maternal demographic and behavioral factors, such as birth out of wedlock, maternal age <20 years, alcohol use during pregnancy, and access to prenatal care are important predictors of infant mortality (Khanani et al., 2010). Some risk factors are more prevalent among Black mothers, such as lower SEP, out-of-wedlock pregnancy, and lower access to prenatal care. However, the black–white infant mortality disparity remains substantial even upon adjusting for differences in maternal SEP and behaviors (Singleton et al., 2009; Kitsantas and Gaffney, 2010a; Hessol and Fuentes-Afflick, 2005; Byrd et al., 2007; Bureau of Health Information 2001; Alio et al., 2010).

Substantial resources have been invested in attempting to narrow Black–White gaps in infant mortality on the state and federal levels (CDC, 2013). For example, reducing such disparities remain an important aim of "Women, Infants, and Children," a federal program to provide support and care for pregnant mothers and children. However, despite these efforts, these disparities persist and in some cases, are widening (Khanani et al., 2010; Carmichael and Iyasu, 1998; Alexander et al., 2008). Therefore, a better understanding of the mechanisms that produce racial disparities in infant mortality is needed to guide interventions that may effectively reduce these disparities.

A notable gap in the literature in this area relates to studies about specific causes of infant death. It is plausible, perhaps even likely, that SEP and maternal behavior are not comparably associated with all causes of infant mortality. To date, however, studies about the influence of SEP and maternal demographic, behavioral, and access-related risk factors have not considered the influences of these factors on specific causes of infant death, and therefore cannot clarify the particular causes of death most amenable to social and behavioral interventions (Link

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et al., 1998). To address this limitation in the literature we assessed the differential contribution of SEP and maternal demographic, behavioral, and health access factors to Black–White disparities across specific causes of infant mortality.

Methods

Data

We obtained data about all live singleton births from the Birth Registry of the state of Michigan between January 1989 and December 2005, as well as data about all deaths among them from the Death Registry of the state of Michigan compiled by the Michigan Department of Community Health (MDCH). Using a unique MDCH statewide identifier, data about all deaths in Michigan to infants under 1 year of age during the study period were matched to births; <1% of deaths did not have suitable matches among births and were not included in the analysis.

Our analysis was restricted to infants born to both Hispanic and non-Hispanic Black (N = 420,636) or non-Hispanic White mothers (N = 1,666,555) without missing data. Data were collected about infant mortality, defined as death prior to one completed year of life. Data were also collected about primary causes of infant death using International Classification of Disease (ICD) codes defined by the World Health Organization, and are listed in ICD10/ICD9 Comparability Ratios for 113 Selected Causes of Death (Bureau of Health Information et al.). Of the 113 Selected Causes of Death, 20 causes are used for cases of infant mortality. Note that comparability ratios were used to compare deaths coded with ICD-9 (1990–1998) and ICD-10 (1999–2007). We used the following categories (ICD-9-CM codes) for infant death: certain gastro-intestinal diseases (520–579), septicemia (038), remainder of infectious and parasitic diseases (001–037, 039–139), meningitis (320–322), pneumonia and influenza (480–487), congenital anomalies (740–759), newborn affected by maternal complications of pregnancy (761), newborn affected by complications of placenta, cord and membranes (762), disorders relating to short gestation and unspecified low birthweight (765), birth trauma (767), intrauterine hypoxia and birth asphyxia (768), respiratory distress syndrome (RDS) (769), other respiratory conditions (770), infections specific to the perinatal period (771), all other and ill-defined conditions originating in the perinatal period (779), SIDS (798), accidents (E800–E869, E880–E929), homicides (E960–E969), and all other causes of infant death.

Other covariates of interest included maternal race (non-Hispanic White, Black); SEP (as measured by socioeconomic factors routinely available on birth certificate data: maternal education [<12 years vs. general equivalency diploma or higher education] and hospital payment source [private insurance vs Medicaid, self-pay or other]), maternal risk behaviors (maternal smoking and alcohol consumption during pregnancy [coded as yes vs. no]), demographic risk factors (as measured by parity [0 previous births, 1 previous births, 2 or more previous births], maternal marital status at parturition [married vs. unmarried], maternal age at parturition [<20 years, 20–35 years, >35 years], and maternal birthplace [US vs. foreign]). All covariates were derived from self-reported information from infant birth certificates. None of the covariates in which we were interested had greater than 2% missing. Therefore, observations with missing variables were ignored.

This study was reviewed and approved by the Institutional Review Board of the MDCH and the Health Science Institutional Review Board of the University of Michigan.

Statistical analyses

First, we calculated descriptive statistics for all covariates and overall infant mortality (death prior to one completed year of life) and conducted two-tailed bivariate chi-square tests between maternal race and all other covariates ($\alpha < 0.05$). We also used two-tailed chi-square tests to assess bivariate relations between all explanatory covariates and infant mortality ($\alpha < 0.05$). Second, we calculated overall and cause-specific infant mortality ratios among Black relative to non-Hispanic White infants using infant mortalities rates calculated over the course of our study period.

Third, we fit multivariable Poisson regression models with overall infant mortality as the outcome and SEP, maternal risk behaviors, demographic risk factors, and access to prenatal care (all described above) simultaneously entered as predictors. We also fit multivariable Poisson regression models of each specific cause of infant mortality independently and SEP, maternal risk behaviors, demographic risk factors, and access to prenatal care simultaneously entered as predictors. This allowed us to determine the disparity in infant mortality by specific cause of death when variance associated with SEP, maternal risk behaviors, demographic risk factors, and access to prenatal care was factored out of the model.

Fourth, these adjusted predicted probability ratios (from each specific multivariable Poisson model specified above) for infant mortality overall and for each specific cause of death among Black relative to non-Hispanic White infants were compared to crude rate ratios to assess the proportion of the disparities in infant mortality by cause explained by differences in SEP, maternal risk behaviors, demographic factors, and access to prenatal care.

SAS 9.3 was used to carry out all statistical analyses.

Results

There were 2,087,191 live singleton births in Michigan from 1989 to 2005 to non-Hispanic White and Black mothers. Of these, 15,826 died before one completed year of life. Table 1 shows descriptive statistics and bivariate analyses between maternal race and all explanatory covariates. All covariates of interest were associated with maternal race ($p < 0.001$). Blacks had a greater infant mortality rate (IMR) (15.5 vs 5.6 per 1000 live births) than non-Hispanic Whites. Black mothers were less likely than non-Hispanic Whites to receive adequate prenatal care (58.6% vs 80.5%), to be married at parturition (25.5% vs 78.0%), to

Table 1
Descriptive statistics and bivariate chi-square tests between explanatory covariates and maternal race and infant mortality among live, singleton births to Black and non-Hispanic White mothers in Michigan, 1989–2005.

	Overall	Non-Hispanic White	African–American	
	(n = 2,087,191)	(n = 1,666,555)	(n = 420,636)	p-values
	%	%	%	
Infant mortality rate (per 1000 live births)	7.6	5.6	15.5	<0.001
Preterm birth				<0.001
Yes	7.9	6.6	13.1	
No	92.1	93.4	86.9	
Prenatal care*				<0.001
Adequate	76.1	80.5	58.6	
Inadequate	24.0	19.6	41.4	
Parity				<0.001
0 previous	31.6	32.6	27.4	
1 previous	28.8	30.1	23.6	
2+	39.7	37.3	49.1	
Marital status				<0.001
Unmarried	32.6	22.0	74.5	
Married	67.5	78.0	25.5	
Maternal age				<0.001
<20	11.7	8.9	22.7	
20–35	80.4	82.6	71.6	
36+	8.0	8.6	5.7	
Education				<0.001
<12 years	17.2	13.5	32.0	
12 years	36.2	35.8	37.8	
>12 years	46.6	50.7	30.2	
Payment source				<0.001
Private insurance	66.7	72.8	42.8	
Medicaid, self-pay, other	33.3	27.2	57.2	
Mother US born				<0.001
Yes	95.6	95.0	98.2	
No	4.4	5.0	1.8	
Alcohol use				<0.001
None	98.3	98.4	97.7	
Yes	1.7	1.6	2.3	
Smoking				<0.001
None	81.3	80.7	83.4	
Yes	18.8	19.3	16.6	

* The Kessner/Institute of Medicine Adequacy of Prenatal Care Index (Kessner et al., 1973) was calculated and analyzed as a binary variable denoting adequate vs. inadequate prenatal care.