Published in final edited form as:

Matern Child Health J. 2011 November ; 15(8): 1249–1256. doi:10.1007/s10995-010-0704-6.

Does Maternal Birth Outcome Differentially Influence the Occurrence of Infant Death among African Americans and European Americans?

Saba W. Masho, MD, MPH, DrPH and

Associate Professor, Department of Epidemiology and Community Health, Virginia Commonwealth University

Phillip W. Archer, M.A., Ph.D.

Associate Professor, Department of Natural Sciences and Director, Minority Health Research Institute and Initiative, Virginia Union University, Affiliate Associate Professor, Department of Epidemiology and Community Health, Virginia Commonwealth University

Abstract

Background—The United States continues to have one of the highest infant mortality rates (IMR). Although studies have examined the association between maternal and infant birth outcomes, few studies have examined the impact of maternal birth outcome on infant mortality. This study was designed to examine the influence of maternal low birth weight and preterm birth on infant mortality.

Methods—The 1997–2007 Virginia birth and infant death registry was analyzed. The infant birth and death data was linked to maternal birth registry data using the mother's maiden name and date of birth. From the mother's birth registry data, the grandmother's demographic and pregnancy history was obtained. Logistic regression modeling was used to estimate adjusted odds ratios and their 95% confidence intervals.

Results—There was a statistically significant association between maternal birth outcome and subsequent infant mortality. Infants born from a mother who was low birth weight were 2.3 times more likely to have an infant die within the first year of life. Similarly, infants born from a mother born preterm were 2.2 times more likely to have an infant die. Stratification by race showed that there was no statistical association between maternal birth weight and infant death among Whites. However, a strong association was observed among Blacks.

Conclusion—Maternal birth outcomes may be an important indicator for infant mortality. Future longitudinal studies are needed to understand the underlying cause of these associations.

Introduction

Infant mortality is a major public health problem in the United States. Prematurity and low-birth-weight (LBW) are major risk factors for infant mortality (IM) and continue to be a health challenge in the United States. LBW newborns are those weighing less than 2,500 grams, either because they were born premature (less than 37 weeks' gestational age) or growth restricted prior to birth (birth-weight less than the 10th percentile for gestational age). Nearly 70 percent of all IM is associated with LBW and prematurity, as are about one-third of all congenital malformations. LBW babies are more likely to die within their first

month of life than normal birth weight babies. Data from the National Center for Health Statistics has shown that prematurity and LBW are the second and third leading causes of infant death in the US; however, they are the leading causes of death for African American infants. Over 13% of African American babies are categorized as being born of LBW and 18.2% are born premature [1-3].

Many studies have shown that traditional risk factors alone do not explain the disproportionate occurrence of prematurity, LBW and consequent infant mortality among African American women compared to other racial/ethnic groups [4-8]. Efforts to identify the underlying factors and mechanism(s) responsible for these birth outcomes have centered on the idea that pregnancy is a relatively acute condition. As such many attempts to understand preterm birth and LBW have been narrowed to factors that relate to the time course of pregnancy and to that of the perinatal period. Yet there is growing evidence that suggests that factors and conditions that pre-date pregnancy are important determinants of pregnancy outcomes [9].

Substantial evidence is accumulating to suggest that intergenerational factors play an important role in determining the quality of birth outcome [10-17]. Intergenerational factors may be defined as those factors, including exposures and experiences that signify the health of one generation that may influence the growth and development of subsequent generations [12-18]. Intrauterine experiences that relate to maternal social interactions as well as genetic and/or environmental factors that potentially influence nutritional status, growth and subsequent development of the fetus have been associated with poor birth outcomes. Mother's health prior to conception, in addition to social and environmental circumstances that mothers were exposed to during childhood, have been suggested to influence reproductive outcome [12-18].

Several chronic diseases affecting women are also risk factors for poor pregnancy outcomes. These factors may have hereditary and environmental predispositions that affect women across generations. Barker et al. identified an inverse relationship between fetal/placental size and hypertension and ischemic heart disease [19,20]. Other investigators have found an association between birth weight and hypertension [21], breast cancer [22] and insulin resistance [23]. Similarly, others have identified an association with pre-term birth and stress [24-26]. Stressors of different types to include psychological, biological, environmental and/or socio-economical have been suggested to be influential in the occurrence of disproportionate numbers of poor birth outcomes among African American women [27-29]. Social disadvantage or inequalities like racism and racial discrimination have been studied and recognized to negatively impact health across ethnic groups and have been suggested, in part, to explain the unequal distribution of premature and LBW African American infants compared to European American infants. [29-37].

Over the years, it has been reported that the health of the mother during childhood influences subsequent birth outcomes [12,15-17,38]. Studies have shown that the health of the mother (which also includes the social and environmental conditions under which the mother spent her childhood) is an important determinant of her reproductive experience [12,17]. Additionally the mother's fetal experiences should also be taken into account when trying to predict subsequent pregnancy outcomes. Considerable evidence exists to strongly suggest that the intrauterine conditions of the mother are extremely important for her own growth and development during childhood and that of subsequent offspring [9,12]. Studies have shown that women tend to produce offspring of similar birth-weight and gestational age characteristics independent of maternal age, birth order, and complications of pregnancy, labor or delivery [12].

Several investigators have reported that women who were themselves born of LBW are more likely to have offspring who are LBW [11-13,16,38,39]. Studies reported that maternal LBW influences infant LBW independent of adequacy of prenatal care and other socio-demographic factors. They also have reported that there were a disproportionately greater percentage of African American LBW infants (compared to European American infants) whose mothers were LBW. Additionally, studies have shown a persistent racial disparity among non-LBW mothers whose infants were LBW [15,16,38]. While it has been shown that the disproportionate occurrence of LBW among African Americans compared to European Americans may be attributable to maternal LBW, the racial differences in LBW offspring continues among non-LBW mothers. Studies of the Illinois birth cohort (1989-1991) by race and maternal birth weight (1956-1975) have shown that former non-LBW mothers who received sufficient pre-natal care and who were college educated, experienced a larger incidence of poor birth outcomes among African American than among European American infants [17]. Other investigators have reported that maternal LBW influences subsequent infant LBW and is not confounded by traditional risk factors – maternal age, education, marital status and prenatal care [11,14,38,40,41]. Although maternal LBW has been shown to be a major risk factor for the offspring LBW there may be only moderate risk for infant prematurity [38,42]. For example Klebonoff et al., 1987, in the Tennessee birth cohort (1979-1984) linked by birth certificates for mothers (born 1959-1966), has shown that maternal LBW was moderately associated with infant gestational age but strongly associated with small for gestational age (SGA) delivery [38].

Although studies have examined the association between maternal and infant birth outcomes, few studies have examined the association of maternal birth outcome on infant mortality. This study was designed to examine the influence of maternal LBW and preterm birth on infant mortality. The conceptual framework for this study is built on previous landmark research by Susser that seeks to understand health disparities in a complex set of contextual environments [43]. In addition to genetic factors, this model examines environmental, behavioral and social factors, all of which, may influence poor birth outcome across generations.

Methods

Data source and settings

This study utilized the 1997-2007 Virginia birth and infant death registry data collected by the office of the Director for Health Statistics (DHS), Virginia Division of Health Statistics. The infant birth and death data was linked to maternal birth registry data using the mother's maiden name and date of birth. All infant deaths (cases) and randomly selected infant births (controls) occurring during this time were linked to maternal birth registry data using the mother's name and date of birth. From the mother's birth registry data, the grandmother's demographic and pregnancy history was obtained. The dataset included infant deaths (n=1,131) and randomly selected infants who survived the first year of life (n=1,200).

This study excluded multiple plurality births (n= 270 infants) and mothers who were not born in Virginia or whose birth record was not found in the Virginia Birth Registry (N=1319). This resulted in a final sample of 414 singleton infant deaths and 328 live infants whose data was linked to maternal birth registry dataset. Compared to Mother-infant pairs whose records were found, those infants with missing grandmother's information were more likely to survive the first year of life, older (27.9 vs. 26.9 years old), White (56.1% vs. 46.1%) and have some college or more education (11.6% vs 8.9%).

Definitions

The main outcome variable, infant death was defined as death of a live born infant occurring before the first birthday. The main independent variables examined in this study included maternal preterm birth and LBW. Gestational age was categorized as preterm birth (gestational age < 37 weeks) and term birth (gestational age $\geq$ 37 weeks). Birth weight was categorized as LBW (< 2,500 grams) and normal birth weight ($\geq$ 2,500). Covariates examined included race/ethnicity, age, education, marital status, adequacy of prenatal care (Kotelchuck index), tobacco use during pregnancy (yes/no), alcohol use during pregnancy (yes/no), illicit drug use during pregnancy (yes/no), and methods of payment. Maternal race and ethnicity data were combined into a single variable with four categories: non-Hispanic White, non-Hispanic black, Hispanic and other. However, due to the small numbers of Hispanic and other groups, the analysis was focused on the Non-Hispanic White and Black data. Maternal age was grouped into six categories: 19 yrs and under, 20-24 yrs, 25-29 yrs, 30-34 yrs, 35-39 yrs, and 40 yrs and older. Maternal education reflected the highest level attained at the time of birth and was categorized into three levels: <12 years, 12 years, and >12 years. Marital status was categorized as married and unmarried, which included the single, divorced, widowed and separated groups. Illicit drug use was coded “Yes” if a mother indicated that she had used any of the following drugs during their pregnancy: heroin, marijuana, cocaine, or amphetamines. Method of payment was coded as either Medicaid, private insurance, or self-pay.

Data Analysis

Preliminary unadjusted analysis was conducted to examine the association between infant death and maternal birth weight and gestational age at births. Additionally, factors affecting infant mortality were also examined. Logistic regression modeling was used to estimate adjusted odds ratios and their 95% confidence intervals for maternal LBW and preterm births. OR and 95%CI were also calculated to examine the association between infant and maternal birth weights and infant and maternal gestational age. All data analyses were generated using SPSS software.

Results

Characteristics of the study population are described in Table 1. The study showed that there was a statistically significant difference between infants who died in the first year of life and those who were alive. Mother's of infants who died were more likely to be younger, born from a younger mother, have lower mean birth weight and gestational age at birth. Infant who died were also more likely to have LBW and born preterm.

Table 2 shows factors associated with infant death. Categorical analysis of age showed that women who were 20-24 years of age were 5.3 times more likely to have infant deaths compared to those who had their babies between 30-34 years of age.

Grandmother's age was also statistically associated with infant deaths. A mother who was born from a teen grandmother was 2.7 times more likely to have an infant death compared to those who had their babies when they were 25-29 years of age. Compared to White women, Black women were 3.7 times more likely to have an infant death. However, having a Black grandmother was protective. Women who had high school or less education were nearly 6 times more likely to have an infant die within the first year of life compared to women who had college education. Tobacco and illicit drug use were significantly associated with infant deaths. Although not statistically significant, women who reported self-pay for prenatal and birth related services were 1.2 times more likely to have infant deaths compared to those who had Medicaid. Additionally, infant's gestational age and birth weight were significantly

associated with infant death. Compared to infants who had normal birth weight, those with LBW were nearly 25 times more likely to die in their first year of life. Similarly, infants who were born before 37 weeks of pregnancy were nearly 16 times more likely to die as infants compared to those born after 37 weeks of pregnancy.

There was a statistically significant association between mother's birth weight and infant death (Table 2). Women who were born with LBW were 2.4 times more likely to have infant deaths. Similarly, mother's gestational age at her birth was also associated with infant death. Women whose gestational age at birth was less than 37 weeks were 2.6 times more likely to have an offspring that resulted in an infant death. When the data was adjusted for grand mothers age at birth of the mother these associations remained significant (Table 3). Compared to women who were born with normal birth weight, those born with LBW were 2.3 times more likely to have an offspring that resulted in an infant death. Maternal gestational age was also significantly associated with infant death. When compared to women who were born at or more than 37 weeks of pregnancy, those who were born before 37 weeks of gestation were 2.2 times more likely to have an offspring that resulted in an infant death.

Stratification by race showed that there was no statistical association between maternal birth weight and infant death among Whites (Table 3). However, a strong association was observed in Blacks. Black infants born from mothers with LBW were nearly 3 times more likely to die compared to those born from mothers with normal birth weight. Although no statistically significant association was found between maternal gestational age and infant deaths among Whites, there was a nearly three times risk of infant death for Blacks who were born early (< 37 weeks).

Discussion

This study reported a statistically significant association between infant mortality, maternal birth weight and gestational age. The study also showed a racial difference in this association. Although there was no statistically significant association between infant mortality and maternal birth weight and gestational age among Whites, this study found a statistically significant association among Blacks. Consistent with the literature, this study affirmed that LBW, preterm births, maternal age, race, education, number of prenatal visit, and insurance status were significant risk factors for infant mortality [3].

Limited studies have explored the impact of maternal birth weight and gestational age on infant mortality. In this study maternal LBW and gestational age have been shown to be risk factors for infant LBW and subsequent infant death, particularly among African American's. Previous studies have suggested that the contribution of mother's early inutero exposures, early developmental and overall life-long experiences markedly influence her reproductive potential and subsequent pregnancy outcome [12,18,40]. Racial differences in birth outcomes of infants born to LBW mothers may be explained by differential exposures to biological, psychological, environmental and/or socio-economical factors over the life course of these mothers. Some studies suggest that LBW mothers with adequate and reliably reported gestational ages may be smaller as a result of diminished intrauterine growth [11,14,38,41-44]. Emanuel suggested that diminished intrauterine growth may be due to smaller organ size resulting from less individual cell cytoplasm as opposed to a fewer numbers of cells [45]. As such, he and others proposed that intrauterine growth rate deficits may be associated with a non-genetic transmission component of intergenerational effects on birth weight [39-45].

Environmental and social factors that lead to chronic stress have been linked to poor birth outcomes [24-26]. It is postulated that stress may affect the offspring directly through the release of natural chemicals such as cortisol into the bloodstream, or indirectly by increasing negative health behaviors as a reaction to stressors [46]. Those women who experience a great deal of stress, perhaps due to socioeconomic status, behaviors, or environment, are more likely to have preterm deliveries, or give birth to LBW infants. Additionally, animal studies indicate that high levels of stress during pregnancy are associated with poor birth outcomes [47]. The associations in this study may also be explained by the existence of a genetic predisposition to poor birth outcomes.

Several chronic diseases affecting women are also risk factors for poor pregnancy outcomes. These factors may have hereditary or environmental predispositions that affect women across generations [19-21,23]. It is also possible that there may be considerable genetic and environmental interactions that cause poor birth outcomes. Studies have also reported that social support and coping strategies lead to better birth outcomes, emphasizing the role of environmental over genetic influences [48,49]. Several studies have reported that LBW women tend to have LBW offspring that may be associated with intergenerational effects [11-17,38,39-42].

This study examined the influence of maternal birth outcome on infant mortality using intergenerational birth outcome data. Despite its strengths in examining this complex issue, this study has a number of limitations. One of the major limitations is the lack of potential confounding variables in the birth certificate data. As a result, this study was unable to control for environmental, social and biological influences affecting these associations. Additionally, a significant proportion of the data was excluded due to lack of matching maternal records. It is possible that many of the mother's were not Virginia residents; however, it is also possible that the data was more complete for infant deaths due to improved data reporting or collection methodologies for infant deaths. As a result, this study may have selection bias. Mothers with the missing intergenerational records were more likely to be White and educated. Since these factors are associated with improved birth outcome, it is possible that the findings in this study were overestimated.

In conclusion, this study reported a statistically significant association between infant mortality, maternal birth weight and gestational age. Considering infant mortality is a major problem disproportionately affecting African Americans, this study provides the hypothesis that intergenerational influences may play a significant role. In this study, LBW and premature African American mothers were much more likely to produce infants that were LBW and premature as well and subsequently die within their first year of life. These findings also suggest that there exists a strong fetal component associated with African American LBW mothers that contributes to the racial disparity in subsequent infant LBW, prematurity and death. These findings substantiate and expand the reports of earlier investigators that there are maternal *in utero* elements that contribute to the poor reproductive outcomes of African American infants [8,12,16,17]. However it is recognized that the overall impact of intergenerational influence on poor birth outcomes of African Americans may be summarily due to factors related to genetic influences, lifelong environmental stressors and the resultant disproportionate exposure to disadvantaged and inequitable conditions [8,17]. Public health workers, program planners and policy makers should be aware of these potential influences in allocating resources for research and public health programs.

Future studies should involve conceptual models that include larger cohorts that would allow for further stratification across race of traditional variables but also variables that

would include residential living conditions and other environmental influences on infant mortality.

Acknowledgments

We would like to recognize Mr. Calvin Reynolds, Director of Health Statistics, Virginia Department of Health for assistance in linking this intergenerational data for this analysis.

References

1. Kung, HC., et al. E-stat deaths: preliminary data for 2005 health E-stats. US Department of Health and Human Services, CDC; Hyattsville, MD: 2007. Available at <http://www.cdc.gov/nchs/products/pubs/pubd/hestats/prelimdeaths05/prelimdeath s05.htm>
2. Mathews, TJ.; MacDorman, MF. [Accessed 1/21/2010] Infant mortality statistics from the 2005 period linked birth/infant death data set. Natl Vital Stat Rep. 2008. Available at http://www.cdc.gov/nchs/data/nvsr/nvsr57/nvsr57_02.pdf
3. Institute of Medicine Committee on Understanding Premature Birth and Assuring Healthy Outcomes, Board on Health Sciences Policy, Institute of Medicine. Preterm Birth: Causes, Consequences, and Prevention. Behrman, RE.; Stith-Butler, A., editors. National Academies Press; Washington, DC: 2006. 2006
4. Collins JW Jr, David RJ. The differential effect of traditional risk factors on infant birthweight among blacks and whites in Chicago. Am J Public Health. 1990; 80:679–81. [PubMed: 2343949]
5. McGrady GA, Sung JF, Rowley DL, et al. Preterm delivery and low birth weight among first born infants of Black and White college graduates. Am J Epidemiol. 1992; 136:266–76. [PubMed: 1415148]
6. Kotelchuck M. The Adequacy of Prenatal Care Utilization Index: its US distribution and association with low birthweight. Am J Public Health. 1994; 84:1486–9. [PubMed: 8092377]
7. Goldenberg RL, et al. Medical, psychosocial and behavioral risk factors do not explain the increased risk for low-birth weight among black women. AM J Obstet Gynecol. 1996; 174:1317–1359. [PubMed: 8942508]
8. Pallotto EK, et al. Enigma of maternal race and infant birth weight: a population-based study of US-born Black and Caribbean-born Black women. Am J Epidemiol. 2000; 151:1080–5. [PubMed: 10873132]
9. Lu MC, Halfon N. Racial and ethnic disparities in birth outcomes: A life-course perspective. Maternal and Child Health Journal. 2003; 7:13–30. [PubMed: 12710797]
10. Kermack WD, et al. Death rates in Great Britain and Sweden. Some general regularities and their significance. International Journal of Epidemiology. 2001; 30:678–683. [PubMed: 11511582]
11. Hackman, et al. Maternal birth weight and subsequent pregnancy outcome. J.Am.Med.Assoc. 1983; 250:2016–2019.
12. Emanuel I. Maternal Health during Childhood and Later Reproductive Performance. Annals New York Academy of Sciences. 1986; 477:27–39.
13. Emanuel I, et al. Intergenerational studies of human birth weight from the 1958 birth cohort. Evidence for a multigenerational effect. Br J Obstet Gynaeco. 1992; 99:67–74.
14. Klebanoff MA, et al. Low birth weight across generations. J.Am.Med.Assoc. 1984; 252:2423–2427.
15. Sanderson M, et al. The intergenerational relationship between mothers birthweight, infant birthweight and infant mortality in black and white mothers. Paediatric Perinatal epidemiology. 1995; 9:391–405.
16. Coutinho R, David RJ, Collins JW Jr. Relation of Prenatal Birth Weights to Infant Birth Weight among African Americans and Whites in Illinois. American Journal of Epidemiology. 1997; 148:804–809. [PubMed: 9384200]
17. Collins JW Jr. et al. Low Birth weight Across Generations. Maternal and Child health Journal. 2003; 7:229–237. [PubMed: 14682500]

18. Collins JW, et al. Differing Intergenerational Birth Weights among the Descendents of US-born and Foreign-born Whites and African Americans in Illinois. *Am J Epidemiol.* 2002; 155:210–16. [PubMed: 11821245]
19. Barker DJ, et al. Weight in infancy and death from ischemic heart disease. *Lancet.* 1989; ii:577–80. [PubMed: 2570282]
20. Barker DJ, et al. Fetal and placental size and risk of hypertension in adult life. *BMJ.* 1990; 301:259–262. [PubMed: 2390618]
21. Law C, Shiell A. Is blood pressure inversely related to birth weight? The strength of evidence from systematic review of the literature. *J Hypertens.* 1996; 94:3246–3250.
22. Michels K, et al. Birth-weight as a risk factor for breast cancer. *Lancet.* 1996; 348:1542–1546. [PubMed: 8950880]
23. Rich-Edwards JW, et al. Birth weight and the Risk for Type 2 Diabetes Mellitus in Adult Women. *Ann Intern Med.* 1999; 130:278–284. [PubMed: 10068385]
24. vale W, et al. Characterization of a 41-residue ovine hypothalamic peptide that stimulates secretion of corticotrophin and beta-endorphin. *Science.* 1981; 213:1394–7. [PubMed: 6267699]
25. Paarlberg KM, et al. Psychosocial factors and pregnancy outcome: A review with emphasis on methodological issues. *J Psychosom Res.* 1995; 39:563–595. [PubMed: 7490693]
26. Wadhwa PD, et al. Stress and Preterm Birth: Neuroendocrine, Immune/Inflammatory, and Vascular Mechanisms. *Maternal and Child Health Journal.* 2001; 5:119–125. [PubMed: 11573837]
27. Lazarus, RS.; Folkman, S. Cognitive theories of stress and the issues of circularity. In: Appley, MH.; Trumbull, R., editors. *Dynamics of stress: Physiological, psychological and social perspectives.* Plenum Press; New York, NY: 1986. p. 63-80.
28. Dunkel-Schetter, C.; Gurung, R.; Lobel, M.; Wadhwa, PD. Stress processes in pregnancy and birth: Psychological, biological and sociological influences. In: Baum, A.; Revenson, T.; Singer, T., editors. *Handbook of health psychology.* Erlbaum; Hillsdale, NJ: 2000. p. 495-518.
29. Goodman AH. Why genes don't count (for racial differences in health). *Am J Public Health.* 2000; 90:1699–702. [PubMed: 11076233]
30. Darity WA Jr. Employment discrimination, segregation, and health. *Am J Public Health.* 2003; 93:226–31. [PubMed: 12554574]
31. Paradies Y. A systematic review of empirical research on self-reported racism and health. *Int. J. Epidemiol.* 2006; 35:888–901. [PubMed: 16585055]
32. Krieger N. Does racism harm health? Did child abuse exist before 1962? On explicit questions, critical science, and current controversies: an ecosocial perspective. *Am J Public Health.* 2003; 93:194–9. [PubMed: 12554569]
33. Nazroo JY. The structuring of ethnic inequalities in health: economic position, racial discrimination, and racism. *Am J Public Health.* 2003; 93:277–84. [PubMed: 12554585]
34. Ford ME, Kelly PA. Conceptualizing and categorizing race and ethnicity in health services research. *Health Serv Res.* 2005; 40:1658–75. [PubMed: 16179001]
35. Ahmed AT, et al. Racial discrimination & health: pathways & evidence. *Indian J Med Res.* 2007; 126:318–27. [PubMed: 18032807]
36. Geronimus A. African American/White differences in the relationship of maternal age to birthweight: A population-based test of the weathering hypothesis. *Soc Sci Med.* 1996; 42:589–597. [PubMed: 8643983]
37. Jones CP. Levels of racism: a theoretic framework and a gardener's tale. *Am J Public Health.* 2000; 90:1212–1215. [PubMed: 10936998]
38. Klebanoff MA, Yip R. Influence of Maternal Birth Weight on Rate of Fetal Growth and Duration of Gestation. *Journal of Pediatrics.* 1987; 111:287–92. [PubMed: 3612405]
39. Ramakrishnan U, et al. Role of Intergenerational Effects on Linear Growth. *J Nutr.* 1999; 129:544S–549S. [PubMed: 10064328]
40. Owusu-Ansah AK, David RJ. Mortality Risk of Small Infants Varies with their Mother's Birth Weight and Race. *Paediatric and Perinatal Epidemiology.* 2008; 22:145–154.
41. Ounstead M, Ounstead C. Rate of intrauterine growth. *Nature.* 1968; 220:599–600. [PubMed: 5693768]

42. Toth P, et al. Maternal regulation of fetal growth. *Acta Paediatr hung.* 1983; 24:37–48. [PubMed: 6613574]
43. Susser M, Susser E. Choosing a future for epidemiology: II. From black box to Chinese boxes and eco-epidemiology. *Am J Public Health.* 1996; 86:674–7. [PubMed: 8629718]
44. Alexander GR, et al. Racial Differences in the Relation of Birth Weight and Gestational Age to Neonatal Mortality. *Public Health Rep.* 1985; 100:539–47. [PubMed: 3931169]
45. Emanuel I. Intergenerational factors in pregnancy outcomes. Implications for teratology? *Issues Rev. Teratol.* 1993; 6:47–83.
46. Copper RL, Goldenberg RL, Das A, et al. The preterm prediction study: Maternal stress is associated with spontaneous preterm birth at less than thirtyfive weeks' gestation. *American Journal of Obstetrics and Gynecology.* 1996; 175:1286–1292. [PubMed: 8942502]
47. Welberg LAM, Seckl JR. Prenatal stress, glucocorticoids and the programming of the brain. *Journal of Neuroendocrinology.* 2001; 13:113–128. [PubMed: 11168837]
48. Gurung RAR, et al. Psychosocial predictors of prenatal anxiety. *Journal of Social and Clinical Psychology.* 2005; 24:497–519.
49. Feldman PJ, et al. Maternal social support predicts birth weight and fetal growth in human pregnancy. *Psychosomatic Medicine.* 2000; 62:715–25. [PubMed: 11020102]

Table 1

Characteristics of the Intergenerational Study Population

Characteristics	Infant death (% or SE)	Infant Alive (% or SE)	P-Value
Mean Mother's Age	25.2 (0.30)	29.0 (0.35)	<0.0001
Mean Grandmother's age	23.2 (0.25)	24.7 (0.28)	<0.0001
Mean Infant Birth Weight	1647.3 (60.8)	3296.6 (32.0)	<0.0001
Mean Infant Gestational Age	29.8 (0.37)	38.4 (0.10)	<0.0001
Mean Mother's Birth Weight	3112.6 (27.5)	3263.9 (27.6)	<0.0001
Mean Mother's Gestational Age	38.9 (0.11)	39.4 (0.15)	<0.01
Sex of Infant			
Male	243(58.7)	178 (54.3)	>0.05
Female	171(41.3)	150 (45.7)	

Note: This analysis shows birth outcome data on the infant, its mother and grandmother

Table 2

Factors Associated with Infant Death: Unadjusted Odds Ratio

Characteristics	Infant Deaths n(% or SE)	Infant Alive n(% or SE)	Unadjusted OR (95% CI)
Maternal Age [†]			
≤ 19	74 (17.9)	40 (12.2)	3.18 (1.95-5.18)
20-24	144 (34.8)	47 (14.3)	5.26 (3.37-8.22)
25-29	95 (22.9)	60 (18.3)	2.72 (1.75-4.23)
30-34	67 (16.2)	115 (35.1)	1.0
35+	34 (8.2)	66 (20.1)	0.88 (0.25-0.58)
Grandmother's Age [†]			
≤ 19	127 (30.7)	56 (17.1)	2.70 (1.76-4.14)
20-24	149 (36.0)	114 (34.8)	1.56 (1.07-2.27)
25-29	84 (20.3)	100 (30.5)	1.0
30-34	41 (9.9)	44 (13.4)	1.11 (0.66-1.86)
35+	13 (3.1)	14 (4.3)	1.11 (0.49-2.48)
Maternal Race [†]			
White	133 (32.1)	208 (63.3)	1.0
Black	281 (67.9)	118 (36.2)	3.72 (2.74-5.06)
Maternal Education [†]			
High School or Less	276 (68.7)	131 (39.9)	5.95 (3.29-10.74)
1-4 Years of College	109 (27.1)	149 (45.4)	2.07 (1.13-3.79)
5+ Years of College	17 (4.2)	48 (14.6)	1.0
Adequacy of Prenatal Care (Kotelchuck Index) [†]			
Inadequate	70 (17.3)	16 (4.9)	6.14 (3.39-11.12)
Intermediate	40 (9.9)	35 (10.7)	1.60 (0.96-2.68)
Adequate	114 (28.2)	160 (48.8)	1.0
Intensive (Adequate Plus)	180 (44.6)	117 (35.7)	2.16 (1.55 (3.02)
Tobacco use [*]	65 (15.7)	31 (9.5)	1.78(1.13-2.81)
Illicit Drug Use [*]	2 (0.6)	12 (2.9)	4.49 (2.22-9.14)
Method of payment [†]			
Medicaid	185 (45.0)	65 (19.9)	1.0
Private	185 (45.0)	250 (76.5)	0.26 (0.19-0.37)
Self pay	41 (10.0)	12 (3.7)	1.20 (0.60-2.42)
Infant's Birth Weight [†]			
Low Birth Weight (< 2,500 g)	277 (67.2)	25 (7.6)	24.89 (15.75-39.27)
Mother's Birth Weight [†]			
Low Birth Weight (< 2,500 g)	46 (11.1)	16 (4.9)	2.44 (1.36-4.40)
Infant's Gestational Age [†]			

Characteristics	Infant Deaths n(% or SE)	Infant Alive n(% or SE)	Unadjusted OR (95% CI)
<37 Weeks	275 (66.6)	37 (11.3)	15.57 (10.45-23.19)
Mother's Gestational Age [†]			
<37 Weeks	52 (12.6)	17 (5.2)	2.62 (1.48-4.62)

*
<0.05

[‡]
<0.01

[†]
< 0.0001

Table 3

Association between Maternal Birth Outcomes and Infant Death Stratified by Maternal Race

Maternal Birth Outcomes	All Races OR (95%CI)	White OR (95%CI)	Black OR (95%CI)
Mother's Birth Weight < 2,500 grams	2.28 (1.26-4.14) [‡]	0.96 (0.35-2.64)	2.91 (1.19-7.11) [*]
Mother's Gestational Age at Birth < 37 Weeks	2.25 (1.26-4.00) [‡]	1.10 (0.42-2.90)	2.81 (1.22-6.48) [*]

Models adjusted for grandmother's age

^{*} < 0.05[‡] < 0.01[‡] < 0.0001