

Degrees of Improvement? The Relationship between Maternal Educational Attainment, Race, and Infant Mortality

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Abstract: The relationship between maternal education and infant mortality is not uniform across racial/ethnic groups. Many studies of this relationship find that increasing maternal education is not necessarily associated with lower infant mortality for non-Hispanic Blacks as it is for non-Hispanic Whites. Previous research on this topic has only been able to measure maternal education in number of years of schooling, however recent changes to the U.S. birth certificates allow us to examine maternal education in terms of highest degree earned. With these new data, we can theorize the relationship between education and infant mortality in a different way, and examine whether the actual completion of a diploma or degree improves infant mortality outcomes. I use cohort data from the 2004 NCHS Linked Birth/Infant Death Files for seven states that have the new reporting of maternal education in degrees to explore infant mortality rates across levels of education and race.

Introduction

Racial disparities in infant mortality in the United States are often interpreted as a measure of general social inequality. Over the past 40 years, infant mortality rates in the United States have decreased substantially for all groups (Gortmaker and Wise 1997). However, this absolute decline has been accompanied by an increase in disparities between blacks and whites (Gortmaker and Wise 1997; Singh and Yu 1995). Although education is often touted as a mechanism through which cycles of disadvantage can be broken, research shows that the largest gaps in black/white infant mortality rates exist between women with the lowest risk, including those with higher education (Hummer 1993). Studies of college-educated women find that even controlling for risk factors, black mothers consistently have higher likelihood of infant mortality and low birth weight than similarly educated white mothers (Kleinman and Kessel 1987; McGrady et al. 1992; Schoendorf et al. 1992).

Recent changes to the U.S. Standard Certificate of Live Birth allow us to examine maternal education by degree obtained, opening a new avenue to explore the maternal education/infant mortality relationship. I aim to investigate the relationship between race, maternal education and infant mortality in detail, and use these new data to provide an extension to previous research on the racial gap in infant health.

Background

Racial Disparities in Infant Mortality

One of the most consistent disparities in the United States exists between infants born to non-Hispanic black mothers as compared to non-Hispanic white mothers. On average, African-American infants have higher incidence of death as well as worse health outcomes than white infants (MacDorman and Mathews 2008; Wise 2003). Unfortunately, non-Hispanic black infants have had the highest infant mortality of any racial group in the U.S. over time, and the gap remains persistent (Mathews and MacDorman 2010). Research suggests that these patterns may in part occur because African American women are more likely to have characteristics associated with higher infant mortality

than white women. For example, Hummer (1993) found that when considering sociodemographic factors, maternal health and health care, the racial gap for exogenous and endogenous causes of infant mortality is reduced by 75% and 52% respectively. However, even when considering these risk factors, a persistent gap still remains (Hummer 1993).

Maternal Education and Infant Mortality

In general, infant mortality rates decrease as maternal education increases, with this relationship holding over time (Singh and Kogan 2007). Controlling on other risk factors of infant mortality, mothers with a college degree are significantly less likely to experience infant death than those with lower levels of education (Singh and Kogan 2007).

Although the relationship between maternal education and infant mortality may be intuitive, the possible mechanisms through which this relationship functions are varied and complicated. At a basic level, education may be simply an indicator for the economic status of the mother (measured by income and occupation), which is related to infant mortality (Finch 2003; Kramer et al. 2000). Babies born to mothers in poverty have a higher risk of negative health outcomes and death (Gortmaker 1979). Additionally, higher SES status may indicate access to better health care and/or private insurance.

Even when considering income, researchers still find health benefits for individuals with higher education, suggesting the education/infant mortality relationship may not be solely attributable to economic situation (Cutler and Lleras-Muney 2010; Mirowsky and Ross 1998). Higher educated mothers are more likely to be married and have supportive relationships (Mirowsky and Ross 1998; Ross and Van Willigen 1997). Those with higher levels of education also have more knowledge of general health, which may lead to having better health behaviors such as exercising or not smoking (Cutler and Lleras-Muney 2010; Kenkel 1991).

Race, Maternal Education and Infant Mortality

Deeper investigation of the maternal education/infant mortality relationship reveals that higher levels of education are not similarly beneficial across all groups—especially when focusing on racial/ethnic comparisons. Specifically, research has shown that postsecondary education may not be related to lower infant mortality for black mothers as it has been found to be for white mothers (Din-Dzietham and Hertz-Picciotto 1998).

In addition to the different effects of education within each race, the infant health and mortality differences between African Americans and whites are most striking for infants born to women with the highest levels of education (Hummer 1993; Kleinman and Kessel 1987; Singh and Yu 1995). McGrady et al. (1992) used survey data of black and white female college graduates from four Atlanta colleges, and found that black women experienced higher rates of preterm delivery, low birthweight and infant mortality. Even controlling for other possible risk factors, black mothers were more likely to have a preterm birth (OR= 1.95) and more likely to have a low birth weight baby (OR=2.32). Another study with similar aims by Shoendorf et al (1992) used national data from years 1983 to 1985, also limiting the sample to infants born to college educated parents. These authors find that there is an increased risk of infant death to black parents as compared to white parents. However, their analyses show that this gap may be completely due the higher incidence of deaths as a consequence of low birth weight for black college-educated parents.

Measurement of Maternal Education

Despite previous research on the topic of race, maternal education and infant mortality, there is much variation in how the maternal education measure is conceptualized and applied. Many health surveys, as well as the 1989 revised birth certificate asked maternal education as a question of the number of years of schooling. Researchers often group years of education in order to approximate degrees. However, a measure of actual degree earned is more precise. Also, research focusing on maternal education and infant mortality often has not looked at education in much detail. With the new

maternal education variable, we are able to make more nuanced distinctions regarding education level; such as being able to separate out having some college education or actually earning an associate's ,bachelor's or advanced degree.

Research Questions and Analytic Plan

With the availability of new maternal education measures, my aim for this paper is largely descriptive. I would like to investigate two aspects of the relationship between race, maternal education and infant mortality. First, what is the general relationship between education and infant mortality within each race? Second, what is the relationship between race and infant mortality among women with the same level of education? Within both of these questions I will take various infant mortality risk factors into account to investigate whether the relationship between maternal education and infant mortality is partly accounted for by these well-known predictors.

The first question will be explored through general infant mortality rates, as well as logistic regressions run separately for blacks and whites. I will look closely at the coefficients for the maternal education variables as risk factors are added to the model to see if and how higher education lowers the likelihood of infant death. Finally I will run logistic regression predicting infant death for each of the levels of education. For these models we will look at the coefficients for black mothers as compared to white mothers with the same level of education.

Data and Methods

Data

The following analyses use cohort data from the NCHS Linked Birth/Infant Death Files for the year 2004. This file includes a total of 4,118,956 birth certificates and 27,763 infant deaths across the United States. In 2003, NCHS revised the U.S. Standard Certificate of Live Birth. The revisions include many additions to questions about health behaviors during pregnancy and maternal health; however a specific update relevant to this research is a change in the reporting of educational attainment of the mother. The revised birth certificate asks the mother her highest level of educational attainment,

whereas the previous version asked for number of years of completed education. Unfortunately adoption of the new standards among U.S. states was far from universal by the beginning of 2004. Only 7 states (PA, WA, ID, KY, and NY— excluding New York City, SC and TN) collected information of mother's highest level of educational attainment instead of years of education beginning in January, 2004. Two more states, FL and NH, began utilizing the revised birth certificate during 2004. For this reason, the following analyses include information only from the 7 states that adopted the revised birth certificate by 2004, as well as the births recorded in FL and NH using the revised birth certificate.

The analytic sample only includes mothers 23 or older in order to capture those who have had time to enter into post secondary education and to limit the number of mothers who are still “in process” of completing their education. Also, I exclude foreign-born mothers since there is no way to measure whether they were educated in the United States or abroad. The final sample for this analysis includes mothers who identified as non-Hispanic white or non-Hispanic black, and excludes any record missing on the maternal education question or race. With these filters, the current sample includes 417,349 records of birth and 2,527 infant deaths. In 2004, 98.9% of all infant deaths could be linked to their corresponding birth certificates. To correct for any bias in the percent of records linked, all analyses use a record weight provided in the linked files.

Measures

The two key variables of interest for these analyses are maternal race and maternal educational attainment. Both of these indicators are collected from birth certificates. The education variable is taken from a question on the revised birth certificate asking the highest level of schooling completed at the time of delivery. Eight categories are given: 8th grade or less; 9th-12th grade no diploma; High School Graduate or GED completed; some college credit but no degree; Associate degree; Bachelor's degree; Master's degree; Doctorate or Professional degree. Because the current analysis only includes 9 states, and we are dividing the analysis by race, it was necessary to combine the highest and lowest categories

to retain a sufficient number of observations for statistical analyses. This analysis uses six total categories in which 8th grade or less and 9th-12th grade no diploma are combined into a “no HS diploma” category, and Master’s degree and Doctorate or Professional degree are combined into an “advanced degree” category. Table 2 reports the number of observations by race within each of these education categories.

Background variables. In an effort to control for high-risk maternal ages, I include an indicator of whether the mother was over the age of 35. Because the sample is already limited to women who were age 23 or older, no control for younger high risk ages is necessary. An indicator for whether the mother was unmarried at the time of the birth is also included in the models. High parity may also be a risk factor for infant death. For this reason I created an indicator used by Kleinmann and Kessell (1987) for high parity that uses both maternal age and number of live births. The observation is given a value of one if the mother is 25 or younger and has had 3 or more births (including the current birth). If the mother is older than 25, they are considered being of high parity if they have experienced 4 or more births (also including the current birth).

Maternal Health and Behaviors. Three measures of maternal health are also considered in the adjusted analyses. First we include whether the mother was a smoker. The quality of prenatal care received is also considered using the Kotelchuck Index. Inadequate care, intermediate care and adequate plus are all compared to the reference category of adequate prenatal care. Finally I include whether the amount of weight gained during the pregnancy was less than 16 pounds. Each of these variables had a missing rate of at least over 7% (with smoking having the highest percentage missing: 18%), so in order to avoid deletion of these cases, each of the maternal health and behaviors measures include an indicator for whether the value is missing.

Infant Health. The analyses also include whether the baby was born low birth weight (less than 2500 grams) or whether he or she was born preterm (less than 23 weeks gestation). Although these

measures are very predictive of infant death, it has been argued that some of the higher infant mortality rate for higher educated mothers may be only within low birth weight babies (Schoendorf et al. 1992). By including these measures we will be able to consider this finding and see whether it may still hold true with our measures of maternal education.

Results

Descriptive Findings

Table 1 presents the overall infant mortality rates for our final sample by race and maternal education level. At first glance we see that within every level of education, the infant mortality rate is higher for black mothers. Probably the most striking finding when comparing these two groups is that the highest educated black mothers, those with an advanced degree, actually have a higher IMR than the white mothers without a high school degree (10.6 compared to 8.5 respectively). Also, for whites, we see that there exists a fairly consistent decrease in the IMR as maternal education increases. However, the pattern is not as straight-forward for black mothers. There is a decrease from HS diploma to some college (15.2 to 12.6) and from BA degree to advanced degree (12.7 to 10.6), however no general decline for each degree earned as is apparent for white mothers.

[Table 1 about here]

Table 2 shows a breakdown of certain risk factors by race and maternal education level. Within race, we see that there is a general decline in risk factors as maternal education increases. The exception to this pattern is the proportion of women over 35, which, not surprisingly, increases with level of education for each race. As seen in previous research, a higher proportion of black mothers exhibit risk factors than white mothers. However, they are less likely to smoke and less likely to be ages 35 or older. These patterns seem to hold across education level. Even among women with bachelor's or advanced degrees, black mothers have higher percentages of being unmarried, receiving inadequate health care, gaining less than 16 pounds during the pregnancy and having a preterm or low birth weight baby than white women with the same education.

[Table 2 about here]

Regression Findings

Next, I attempt to explore the relationship of education and infant mortality within each race. Table 3 reports the findings from logistic regressions predicting infant mortality separately for blacks and whites. The left side of the table shows the odd ratios for infants born to white mothers for our sample in 2004. Model 1 includes only maternal education measures with each level of education compared to the reference category of having a bachelor's degree in an attempt to gauge the general baseline pattern between maternal education and infant mortality. White women without a high school diploma are over two times more likely to experience infant death than white women with a bachelor's degree. The findings are similar for women with a high school diploma, however the odds ratio is under two (1.74). Women with bachelor's degrees even have a benefit over those with some college but no degree, with the some college group being about 30% more likely to experience infant death than those with a degree. The odds of infant mortality do not differ significantly between women with an associates and bachelors degree or between those with an advanced degree and bachelor's degree. Model 2 includes background characteristics of the mother at the time of the birth, including whether she was over the age of 35, unmarried, or was considered to have high parity. All three of these indicators are statistically significant and related to increased odds of infant death. However, the maternal education patterns seen in model 1 remain steady, although the odds ratios do decrease somewhat. Model 3 adds maternal health factors to the analysis. The addition of these variables decreases the odds ratios for no high school diploma and high school diploma, and renders the difference between some college and bachelor's degree insignificant. The final model (Model 4) adds two indicators of infant health—whether the baby had a low birth weight, and whether it was born premature. Even though these factors are highly predictive of infant death, there still exists an association between maternal education and infant death. In fact, the odds ratios for no HS diploma and HS diploma slightly increase, and the OR for some

college becomes statistically significant again. Even when controlling for whether the infant was born low birth weight and/or premature, higher maternal education still seems to be a benefit for white mothers.

The right side of table 3 reports the odds ratios for infants born to black mothers in our sample. Unlike the regression for whites, we don't see any significant difference in the odds of infant death for any education level compared to mothers with a Bachelor's degree¹. None of the following models result in any significance to the education indicators. This somewhat mimics the patterns seen in Table 1 in that the infant mortality rates did not seem to have a clear pattern. In general this shows that attaining higher levels of education is not associated with a benefit with regard to infant mortality for black mothers.

[Table 3 about here]

Finally, table 4 shows the odds ratios of infant mortality for black mothers compared to white mothers within each level of education. Model 1 only includes race, model 2 adds background characteristics, model 3 includes maternal health and the final model adds infant health. The black coefficient shows the odds of infant death for an infant born to a black mother compared to an equally educated white mother. Beginning with mothers without a high school diploma, we see that although there is an initial higher odds for black mothers, once infant health is considered, there is not a significant difference between the two races. The HS diploma and some college regressions show similar patterns for race in that with each addition of risk factors, the odds ratio for blacks compared to whites decreases. However, net of background, maternal and infant health, the odds of infant death are about 30% higher for blacks than whites.

¹ Additional analyses not shown here re-ran the regressions with each level of education as the reference category separately. The education coefficients were non-significant in all of the analyses for black mothers.

All levels of postsecondary degrees have similar patterns, with each model reducing the race odds ratio. However, controlling on all factors included in the models, blacks are still more likely to have an infant death. Most striking in this table is that the OR for black mothers compared to white mothers in model 4 increases as maternal education increases. Among mothers with an associate's degree, black mothers experience a 65% increased odds of infant death. Black mothers with a BA are 80% more likely than similarly educated white mothers to experience an infant death, while those with an advanced degree are two times more likely than white mothers with an advanced degree.

[Table 4 here]

Discussion

These results are striking in two ways. The separate regressions by race in table 3 show that there is not a benefit of higher education for black mothers with regard to infant mortality. Among black mothers in our sample, no level of education showed to have higher or lower odds of infant death. However, for white mothers, having a bachelor's degree is associated with a lower likelihood on infant death as compared to high school graduates and even those with some college. Another interesting finding is that for white mothers, there does not seem to be a more beneficial effect of having an advanced degree versus having a bachelor's degree. The positive effect of postsecondary education for whites seems to lie in having any type of postsecondary degree.

Second, we find that the racial disparity in infant mortality, when controlling on infant health, increases as maternal education increases, with black women with advanced degrees having over two times the likelihood of infant death than white women with advanced degrees. This effect is similar to findings in previous research (Hummer 1993; Kleinman and Kessel 1987; McGrady et al. 1992; Schoendorf et al. 1992), however this analysis shows these disparities in a more nuanced measurement of education. Specifically, we are able to see that as the postsecondary degree increases in level, there are progressively larger odds of infant death for black mothers.

One possibility that may contribute to our findings of the association between education and infant mortality by race, is the differential returns that black and white students receive from higher education. For example, black college graduates have lower median earnings, and are also more likely to be unemployed than their white counterparts (Baum and Ma 2007). Our analyses do not include measures of income, as this question is not recorded on the certificate of live birth. The differing effect of age on infant health outcomes for black and white mothers may also be a factor that contributes to our education findings. Geronimus (1996) finds that black women show signs of deteriorating health at younger ages than white women, leading to greater risk of low birth weight and very low birth weight. Because education is so closely tied to age, the idea of weathering may add an additional dimension to the explanation of the larger race gaps at the higher levels of education.

Research shows that interpersonal and institutional racism may also contribute to the black/white infant mortality gap. The mother's perception of racism may lead to higher levels of stress in expectant black mothers (Hogue and Bremner 2005). In fact, exposure to racism has been found to be related to negative infant health outcomes (Mustillo et al. 2004), and its effects may differ by level of education. Using face to face interviews of African American mothers delivering in a Cook County hospital, Collins et al. (2004) investigated the relationship between the mother's exposure to interpersonal racism and infant health outcomes. They found that although in general black mothers who delivered a very low birth weight child were more likely to report exposure to racism, this association was strongest among college educated women.

As new years of cohort data are released, it will not only allow for more robust findings, but also an investigation of maternal education and infant mortality for native-born Latinos. These data only contain information from a select number of states, however, it does provide us with a glimpse of the race/education patterns in infant mortality using a more detailed measurement of education.

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Table 1: Infant Mortality Rates per 1000 Live Births
by Maternal Education Level and Race

	All	White	Black
No Diploma/GED	11.3	8.5	14.9
HS Diploma/GED	8.5	6.5	15.2
Some College	6.2	4.9	12.6
Associates Degree	4.9	3.8	12.8
Bachelor's Degree	4.3	3.7	12.7
Advanced Degree	3.8	3.4	10.6

Table 2: Percentage Distributions of Risk Factors for Infant Mortality by Maternal Education Level and Race

	All Levels		No Diploma/GED		HS Diploma/GED		Some College		Associates Degree		Bachelor's Degree		Advanced Degree	
	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White	Black	White
Observations	53,078	366,798	8,449	24,955	18,232	82,574	13,995	76,495	4,293	42,134	5,760	93,458	2,349	47,182
Maternal Age														
35 or older	0.10	0.15	0.07	0.08	0.08	0.12	0.10	0.12	0.13	0.15	0.16	0.18	0.20	0.23
Marital Status														
Unmarried	0.62	0.17	0.84	0.44	0.72	0.30	0.60	0.22	0.49	0.13	0.34	0.05	0.19	0.03
Parity														
High Parity	0.30	0.13	0.56	0.41	0.36	0.18	0.23	0.13	0.19	0.09	0.07	0.06	0.05	0.04
Smoking														
Smoker	0.10	0.12	0.22	0.36	0.12	0.23	0.08	0.14	0.05	0.08	0.02	0.02	0.01	0.01
Missing	0.30	0.17	0.31	0.18	0.34	0.19	0.25	0.17	0.30	0.18	0.27	0.17	0.26	0.13
Prenatal Care														
Inadequate	0.20	0.09	0.32	0.27	0.22	0.13	0.18	0.10	0.13	0.06	0.10	0.05	0.07	0.04
Intermediate	0.09	0.11	0.10	0.10	0.09	0.11	0.09	0.11	0.08	0.11	0.09	0.12	0.09	0.12
Adequate Plus	0.33	0.34	0.25	0.28	0.31	0.35	0.35	0.36	0.37	0.36	0.37	0.33	0.38	0.33
Missing	0.12	0.07	0.13	0.08	0.13	0.07	0.11	0.07	0.13	0.07	0.11	0.08	0.13	0.08
Maternal Weight Gain														
Less than 16 lbs.	0.22	0.12	0.26	0.18	0.23	0.15	0.22	0.13	0.22	0.12	0.19	0.08	0.17	0.07
Missing	0.10	0.07	0.13	0.09	0.11	0.07	0.09	0.07	0.09	0.07	0.08	0.07	0.08	0.07
Gestational Age														
Preterm (< 37 weeks)	0.19	0.12	0.21	0.14	0.20	0.13	0.19	0.12	0.18	0.12	0.17	0.10	0.15	0.10
Birth Weight														
Low	0.14	0.07	0.17	0.10	0.15	0.08	0.13	0.07	0.14	0.07	0.12	0.06	0.11	0.06

Table 3: Odds ratios from logistic regression predicting infant death for whites and blacks

	White (n=366,798)				Black (n=53,078)			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
Maternal Education Level (Ref: Bachelor's Degree)								
No HS Diploma	2.274***	1.973***	1.457***	1.426***	1.18	1.039	0.906	0.836
HS Diploma/GED	1.742***	1.619***	1.321***	1.314***	1.203	1.109	1.004	0.968
Some Coll/no degree	1.312***	1.257**	1.098	1.158~	0.999	0.953	0.899	0.904
Associate Degree	1.031	1.011	0.926	0.925	1.011	0.979	0.905	0.885
Advanced Degree	0.923	0.916	0.941	0.894	0.839	0.849	0.863	0.903
Maternal Age (Ref: Under 35)								
35 or older		1.353***	1.297***	1.107		1.296*	1.203	1.037
Marital Status (Ref: Married)								
Unmarried		1.282***	1.150*	1.008		1.144	1.113	1.022
Parity (Ref: low or normal parity)								
High Parity		1.217**	1.129~	1.102		1.186*	1.105	1.066
Smoking (Ref: Nonsmoker)								
Smoker			1.421***	1.088			1.098	0.854
Missing			1.052	1.002			1.12	1.07
Prenatal Care (Ref: Adequate)								
Inadequate			2.516***	1.467***			2.187***	1.193
Intermediate			1.178	1.178			0.599*	0.600*
Adequate Plus			3.088***	1.106			2.655***	0.906
Missing			3.528***	1.558***			2.696***	1.252
Maternal Weight Gain (16 + lbs.)								
Less than 16 lbs.			2.867***	2.175***			2.701***	2.099***
Missing			2.224***	1.798***			2.414***	1.945***
Gestational Age (Ref: Term)								
Preterm				3.320***				4.157***
Birth Weight (Ref: Normal)								
Low				10.332***				8.340***
Constant	0.004***	0.003***	0.001***	0.001***	0.013***	0.012***	0.004***	0.002***

*** p<0.001, ** p<0.01, * p<0.05, ~p<0.1

Table 4: Selected Odds Ratios of black compared to white infant death by maternal education

	Model 1	Model 2	Model 3	Model 4
No HS diploma	1.771***	1.659***	1.500**	1.111
HS Diploma	2.356***	2.050***	1.828***	1.345**
Some College	2.598***	2.337***	1.924***	1.342*
Associate's Degree	3.346***	3.055***	2.424***	1.645***
Bachelor's Degree	3.412***	3.403***	2.547***	1.804***
Advanced Degree	3.104***	3.088***	2.405***	2.012**

*** p<0.001, ** p<0.01, * p<0.05, ~p<0.1