Toward an Earlier Measure of Opportunity: Trends in Inequality of Infant Health

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Abstract

Infant health is fundamental to subsequent outcomes and has drastic consequences for inequality, both through health in later life and because effects on cognitive development, education, and income accumulate over time. To provide an earlier and more inclusive measure of unequal opportunity, this study uses 1969-2015 NVSS birth certificate data and calculates several measures of health inequality by maternal education and race. Tracking these inequalities over time reveals a nonlinear pattern, with an inflection point at 1986 when the threshold for Medicaid coverage was allowed to rise above the limits for AFDC receipt. Trends since the early 2000s, when many states cut Medicaid and SCHIP funding, show rising inequality of infant health, which has implications for future educational and labor market inequality.

Keywords: education; health; inequalities; social mobility; demography

Introduction

Efforts to understand and achieve equality of opportunity typically focus on how strongly children's education, occupation, or income is associated with characteristics of their parents. These estimates are missing a more foundational aspect of intergenerational inequality: health. Child health is fundamental to subsequent outcomes and can have drastic consequences for inequality, both through health in later life and because effects on cognitive development, education, and income accumulate over time (Blackwell et al. 2001; Currie and Stabile 2006; Palloni 2006; Black et al. 2007; Bleakley 2007; Fletcher and Wolfe 2008; Oreopoulos et al. 2008; Currie 2009; Palloni et al. 2009; Royer 2009; Smith 2009; Almond and Currie 2011; Reyes 2015; Aizer et al. 2016). Public investments in child health have a higher rate of return (Belli et al. 2005) and are more strongly associated with decreases in educational inequality (Aizer 2014) than investments in education. Birth weight, for example, has implications for health, behavior, IQ, educational achievement and attainment, and earnings later in life (Conley et al. 2003; Royer 2009; Black et al. 2007). If we seek to increase equality of opportunity, we need to focus more on intergenerational inequality of health, particularly early in life.

The unequal distribution of health by socioeconomic status (SES) is so well established that recent studies refer to it simply as "the gradient" (Link and Phelan 1995; Lynch et al. 2000; Case et al. 2002; Currie et al. 2007; Dowd 2007). Health inequality by race and ethnicity is equally well established, at birth and throughout the life course (David and Collins 1997; Williams 2012; Williams and Sternthal 2012; Kawachi et al. 2005). We know less about cohort trends in the extent of these inequalities, particularly at birth (see Aizer and Currie 2014 for an exception). Furthermore, the causes of these inequalities are debated, partly because parental health may be a key driver of both SES and child health (Khanam et al. 2009; Wadsworth and

Kuh 1997; Evans et al. 2012; Pelkowski and Berger 2004; Case et al. 2005; Cutler and Lleras-Muney 2006; Smith 2009; Thompson and Conley 2016). This raises questions about the potential of policy to improve equality of infant health. If inequality trends clearly follow changes to Medicaid access for pregnant women, for example, that would suggest health policies that provide access to health care and services may have the potential to reduce inequality of infant health and opportunity. Medicaid is expensive, making up the second largest state expense after education (Snyder and Rudowitz 2015). To efficiently direct public investments and improve equality of child health and opportunity, we require more information about inequality of infant health and how it has changed over time.

Methodologically, health measures allow estimation of intergenerational inequality much earlier in the life course than most research on intergenerational mobility (e.g., Solon 1992, 2002; Chetty et al. 2014a, 2014b). Policy interventions to address adult inequality are expensive and hold limited potential, while child policies based on adult inequality miss multiple cohorts. Furthermore, because health measures are widely available, this approach estimates inequality for everyone, regardless of labor market participation. For example, Beller (2009) notes the exclusion of women from most estimates of intergenerational inequality. Intergenerational inequality research also excludes those who are incarcerated, do not survive to adulthood, or in the case of administrative tax data, do not submit a tax return (e.g., Chetty et al. 2014a, 2014b). Because incarceration and earlier mortality are more likely among those from disadvantaged backgrounds (Western 2006; Western and Pettit 2010; Adler and Newman 2002), the extent of intergenerational inequality may be underestimated and trends may appear flatter than they would if more complete data were available (e.g., Hout 2017).

Linked administrative income tax return data provide accurate measures for parents and children who can be linked in the Internal Revenue Service (IRS) data. However, the IRS (1996:22) identified 88 million individuals who did not file a timely income tax return in 1988 (a year close to the child cohorts examined by Chetty et al. 2014a, 2014b). These non-filers include a substantial proportion who were not required to file a return because their income falls below the filing threshold. Estimates of income mobility using IRS data could be biased by excluding those not required to file an income tax return because they are disproportionately low-income individuals and households. For example, Figure A22 shows the number of income tax returns per employees by county in 1990. This is a flawed estimate of the proportion of non-filers, but the map suggests a potential correlation with county mobility estimates using IRS data (Chetty et al. 2014b). Furthermore, non-filing rates may have increased with rising income inequality (Stone et al. 2017; Piketty and Saez 2014), which could bias estimates of trends in intergenerational income mobility (Chetty et al. 2014a). By examining inequality of child health, which includes everyone regardless of labor force participation, incarceration, longevity, and income tax filing, this study could hint at potential consequences of using more exclusive measures in mobility research.

To provide a more inclusive and earlier measure or intergenerational inequality, this study estimates intergenerational inequality of health at birth by parental education (a measure of SES) and race and to compare the extent of these inequalities over cohorts. To achieve these aims, this project poses two research questions:

1) To what extent is infant health unequal by parental education and race?
2) How have these measures of intergenerational inequality changed from 1969 to 2015?

Theoretical and Empirical Background

The theoretical motivation for the focus on health at birth is that early childhood is critical for successful development, later health, and socioeconomic outcomes in adulthood (Heckman and Masterov 2007; Heckman 2006; Blackwell et al. 2001; Currie and Stabile 2006; Palloni 2006; Black et al. 2007; Bleakley 2007; Fletcher and Wolfe 2008; Oreopoulos et al. 2008; Currie 2009; Palloni et al. 2009; Smith 2009; Almond and Currie 2011; Reyes 2015; Aizer et al. 2016). For example, the fetal origins hypothesis suggests that multiple aspects of adult health stem from fetal growth restriction due to nutritional deprivation (Barker 1989, 1995). Because health is critical for cognitive development, education, and income (Blackwell et al. 2001; Currie and Stabile 2006; Palloni 2006; Black et al. 2007; Bleakley 2007; Fletcher and Wolfe 2008; Oreopoulos et al. 2008; Currie 2009; Palloni et al. 2009; Royer 2009; Smith 2009; Almond and Currie 2011; Reyes 2015; Aizer et al. 2016), the fetal origins hypothesis could apply to other aspects of later life as well. Birth weight, for example, has implications for health, behavior, IQ, educational achievement and attainment, and earnings later in life (Conley et al. 2003; Royer 2009; Black et al. 2007). At the bottom of the birth weight distribution, children born weighing less than 2,500 grams (low birth weight) have lower academic and cognitive test scores (Cheadle and Goosby 2010; Hack et al. 2002), slower growth in those scores (Goosby and Cheadle 2009; Boardman et al. 2002), and a higher likelihood of behavioral problems and failing a grade in school (McCormick et al. 1990; Klebanov et al. 1994a, 1994b). I focus on children at birth because health at the "starting gate" is critical for later childhood outcomes (Conley et al. 2003; Royer 2009). To increase equality of opportunity, improving equality of infant health is critical.

Intergenerational inequality is the extent to which child outcomes (e.g., income, health) depend on parental characteristics; higher dependence or larger differences by parental SES or race indicate lower mobility and individual opportunity. Compared to decades of research on intergenerational inequality of education, income, or occupational status (Blau and Duncan 1967; Featherman and Hauser 1975; Hout 1988; Solon 1992, 2002; Shavit and Blossfeld 1993; Breen and Jonsson 2005; Rauscher 2016), we know less about the extent to which child health depends on parental characteristics in the general U.S. population (i.e. not limited to twins) and how this has changed over time.

Research on intergenerational inequality of health is growing, however. In developing countries, studies have estimated the correlation between maternal height, body mass index (BMI), and anemia on one hand, and infant survival, birth weight, and height on the other (Bhalotra and Rawlings 2011; Venkataramani 2011; Thomas et al. 1990). Kim and colleagues (2015) estimated the transmission of several measures among older adults in Indonesia. In developed countries, research has focused on birth weight, finding substantial intergenerational transmission (Currie and Moretti 2007; Royer 2009; Conley et al. 2003; Emanuel et al. 1992). Recently, research in developed countries has begun to examine other health measures, including self-rated health and BMI (Coneus and Spiess 2012; Trannoy et al. 2010; Classen 2010). However, surprisingly little research has compared the extent to which infant health varies by parental SES or race and traced these measures of inequality over time.

Aizer and Currie (2014) provide a valuable exception. Examining trends in intergenerational inequality of infant health, they find that the gap between infants of advantaged and disadvantaged mothers declined in the 1990s, but has remained relatively stable since then. Aizer and Currie (2014) suggest this stability, despite rising economic inequality, may reflect improvements in health care. However, their comparison combines multiple aspects of social inequality: race, education, and marital status. Specifically, they compare the likelihood of low birth weight (less than 2,500 grams) for mothers in two groups: 1) unmarried, African American women with less than a high school education; and 2) married, non-Hispanic white women with a college education. It is unclear, therefore, whether racial, educational, or marital inequality drives these trends or if the stability since 2000 reflects offsetting trends in inequality by those characteristics. For example, as births to unmarried parents become more common, inequality by parental marital status could have declined while inequality by education increased due to rising income inequality and returns to education (Goldin and Katz 2008; Piketty and Saez 2014). Furthermore, Aizer and Currie (2014) examine trends from 1989 to 2011. Inequality has increased since 2011 (Stone et al. 2017) and policy changes prior to 1989 motivate examining changes in inequality of infant health from an earlier point. For example, perhaps Medicaid expansion through OBRA-86 or -87 (the Omnibus Budget Reconciliation Acts of 1986 and 1987) reduced inequality of infant health.

Rossen and Schoendorf (2013) examine changes in racial and ethnic inequality of infant health over time, finding that the disparity in infant mortality rates increased while inequality of preterm birth rates declined. Because they focus on one dimension of inequality, their findings provide clear and valuable information about inequality trends by race and ethnicity. However, their analyses examine change between two time points and over a limited time: from 1989-1990 to 2005-2006. Examining annual measures of inequality over a wider time range would provide more information about how infant inequality has changed with various policy interventions (e.g., OBRA-86/87 and the State Children's Health Insurance Program or SCHIP).

Mare (1997, 2011) highlights the importance of incorporating unequal fertility into research on intergenerational inequality. That is, because fertility differs by education (Brand and Davis 2011; Maralani 2013), retrospective analyses of intergenerational mobility can overestimate the extent of intergenerational inequality (Breen and Ermisch 2017; Song and Mare 2015). However, whether unequal fertility presents a problem depends on the question of interest (Song and Mare 2015). In this case, the interest is on the extent to which child opportunity is unequal. Therefore, children (infants) are the population of interest in these analyses, rather than adults who could potentially have children, and unequal likelihood of fertility among parents is not directly relevant to the research questions.

Although the research questions posed here focus explicitly on the child generation, Mare's important incorporation of demography into intergenerational inequality research is valuable for this study because it highlights processes that precede and contribute to inequality in the child generation. For example, beyond unequal likelihood of fertility among parents based on education and race (Mare and Maralani 2006; Maralani 2013; Brand and Davis 2011), inequality during the gestational period – at any point from conception to birth – may yield important intergenerational consequences as well. We know, for example, that maternal education has critical implications for infant health (Currie and Moretti 2003) and prenatal maternal stress has negative consequences for a variety of infant health measures (Persson and Rossin-Slater forthcoming; Dancause et al. 2011; Torche 2011; Torche and Kleinhaus 2011; Beijers et al. 2010).

Thus, while we may think of birth as the "starting gate," intergenerational inequalities during the gestational period generate unequal opportunity among children from birth (Conley et al. 2003; Royer 2009; Black et al. 2007). This project advances understanding of intergenerational inequality by examining health at birth. Health provides a more inclusive estimate of intergenerational inequality than most research and, by systematically examining its inequality at birth, this study will inform efforts to increase opportunity. Inequality rose drastically since the 1970s (Piketty and Saez 2014) and infant health gaps by parental SES or race may have increased as well. Alternatively, as Aizer and Currie (2014) note, expanded access or improvements in health care may have prevented similar trends in inequality of infant health.

Methods

Data

I use 1969-2015 National Vital Statistics System (NVSS) Birth Data, which provide administrative birth information for the population of live births in the U.S. in each year. The years 1969-1994 and 2011-2015 include information about both maternal and paternal education. While most research on intergenerational inequality examines paternal characteristics (e.g., Hout 1988; Solon 1992, 2002; Shavit and Blossfeld 1993; Breen and Jonsson 2005; Rauscher 2016) and research on infant inequality typically examines maternal characteristics (e.g., Aizer and Currie 2014), these data allow an informative comparison of intergenerational inequality by both maternal and paternal characteristics.

Because these data include a large sample of the population of births and are based on administrative records, they provide the most complete and accurate information about births in the U.S. The number of observations included in NVSS data would overwhelm most personal computers and, because they include the population of births, statistical inference techniques do not apply. To increase feasibility and allow statistical inference, analyses are conducted on a 10% random sample of births in each year. Results are similar when using complete data in each year.

Measures

Health is a complex outcome with a continuum of potential measures ranging from general to specific indicators (Lynch et al. 2004). I focus on birth weight, which research indicates has critical implications for later life (Conley et al. 2003; Royer 2009). However, to include measures throughout the general-specific continuum, I also examine gestational weeks, as well as low birth weight and premature or pre-term delivery (specific measures).

Birth weight is measured in grams and I create an indicator for low birth weight (less than 2,500 grams). Gestational length is measured continuously in weeks from the first day of the last normal menstrual period (LMP) and ending with the day of birth. Although obstetrician estimate of gestational length is available in later years, the LMP measure of gestational length is available in all years of NVSS data and I use that measure for consistency. An indicator for pre-term delivery identifies infants with less than 37 weeks of gestation.

Maternal SES is measured by years of education completed and highest education level completed. From 1969 to 2002, NVSS includes years of education completed. Beginning in 2003, they also include educational categories, with mothers in some states reporting years completed and those in others reporting their highest level completed. From 2009, NVSS includes only educational categories. To accommodate this change, I create measures of years and categories for all years and assess inequality using both years and categories. I assign each of the categories the equivalent number of years (in parentheses): 8th grade or less (8 years), 9th-12th grade with no high school diploma (11 years), high school graduate or GED (12 years), some college but no degree (13 years), Associate's degree (14 years), Bachelor's degree (16 years), Master's degree (17 years), and Doctorate or professional degree (19 years). To examine gaps by SES, I create indicators for whether the mother has less than a high school degree (less than 12 years), completed any college (13 years or more), or completed a bachelor's degree (16 years or more). I create the same measures for paternal education in the years it is available.

Race is based on parental response and categories include white, black, Native American, and Asian. Beginning in 2004, some states allowed multiracial identification. The NVSS creates a single "bridged" race category for those who report more than one race. Specifically, NVSS imputes a single race based on the parent's racial and ethnic identification, sex, and age (Division of Vital Statistics [DVS] 2004). If maternal race is missing, NVSS assigns the race of the father, if available. If race is not available for either parent, mother's race is imputed based on the race of the mother of the preceding birth in that location (DVS 2004). This imputation is conducted for a small proportion of births (e.g., 0.7% in 2004; DVS 2004:17). I use the NVSS bridged and imputed measures of race for consistency of categories across years and because they provide the best estimate of maternal race. Hispanic ethnicity is available from 1978 and includes those who identify as Mexican, Puerto Rican, Cuban, Central or South American, and other or unknown Hispanic origin. Gaps are examined by maternal race and ethnicity.

In most cases, the proportion of births with missing data is small. For example, the proportion of births missing birth weight is always less than 1%. The proportion missing gestational length is typically about 1% after 1988 and is slightly higher before that (4%) 1981-1988. In earlier years, gestational length is missing at higher rates, ranging from 20% in 1980 to 41% in 1969. Given higher rates of missing data and variability over time, trends in gestational age are not as reliable as trends in birth weight. I therefore focus on birth weight and rates of low birth weight as the primary measure in this study. Missing rates for maternal education also vary over time. From 1992 to 2008, only 1% of births are missing maternal education. From 1969 to 1991, missing rates vary from 38% to 3%, with higher rates in the earliest years before 1975.

Missing rates rise to 33% in 2009 and 24% in 2010, but then vary from 15% to 3% from 2011 to 2015. This variability means that trends in inequality by maternal education are most valid 1992-2008.

The key assumption for inequality estimates is that the likelihood of missing data does not differ by infant health and parental education. Reports from NVSS suggest that much of the missing data is due to incomplete state reporting, in which case it would largely be missing at random with respect to individual birth outcomes (e.g., DVS 2004). However, to assess the extent to which the likelihood of missing maternal education differs by infant health, I calculate the correlation between an indicator for missing maternal education and infant health on one hand, and the correlation between maternal education and indicators for missing infant health measures on the other. Shown in Table A2, these correlations reveal a weak relationship between missing rates and maternal education or infant health. Specifically, the correlations of maternal education with missing birth weight range from 0 to -0.01 and with missing gestational length from 0 to -0.08. The correlations of missing maternal education with birth weight and gestational length range from -0.02 to 0.02. Thus, there is a weak relationship between the likelihood of missing data and infant health and maternal education.

Paternal measures have higher rates of missing data, partly due to births to unmarried parents. The proportion of births missing paternal race is 7% in 1969 and rises fairly steadily over time to a high of 19% in 2014. In the years that father's education is available (1969-1994 and 2011-2015), rates of missing paternal education follow a similar pattern to that of maternal education. However, they are consistently higher by about the same proportion missing paternal race. Given the variability of missing data, readers should keep in mind that results are less generalizable for measures with higher missing rates, including gestational length.

Analysis

To address research question 1, I estimate inequality of infant health in several ways. First, I calculate differences in infant health measures by education and race. For example, I calculate the difference in mean infant birth weight between births to white and non-white mothers. To allow comparisons, I calculate the following differences by race and ethnicity: white–non-white, white–black, white–Native American, white–Asian, and white–Hispanic. To examine inequality by education, I calculate the following differences: any college–no college; BA–no BA; and BA–less than high school. I calculate raw differences in the units of the health measure for ease of interpretability (e.g., in grams for birth weight). However, because the distribution of infant health and parental characteristics change over time, I also calculate differences in standard deviation units (Cohen's d). To do so, I divide the raw difference by the pooled standard deviation of the two groups.

Second, I calculate correlation coefficients between infant health and parental education. I use standardized measures for these correlation estimates to adjust for distributional changes over time. I standardize measures within each year of birth so that estimates represent the correlation within each year.

Third, I regress standardized infant health measures on standardized measures of parental education and indicators for race. In regressions, I control for maternal age, because it could be associated with infant health and parental SES or race. I also control for sex of the infant (an indicator for male) and an indicator for a multiple birth (e.g., a twin) for all years 1972-2015 when this indicator is available. Similar to IGE analyses of income (Solon 1992), this approach provides a concise estimate of the strength of the relationship between parent characteristics and child health, controlling for demographic characteristics. I fit regressions separately for each year of birth to allow examination of trends over time. Equation 1 illustrates the approach using birth weight and maternal education.

$$z(\text{Birth Weight}_i) = \alpha + \beta_1 z(\text{Maternal Years of Educ}_i) + \beta_k X_i + \varepsilon_i \quad (1)$$

The coefficient of interest is β_1, which indicates the increase in infant health in standard deviation units for each standard deviation increase in parent education. Because the measures are standardized, β_1 estimates the correlation between maternal education and birth weight, controlling for other factors. Out of methodological concerns about logit and other models that use non-linear link functions (Mood 2010; Ai and Norton 2003; Karaca-Mandic et al. 2012), I use linear probability models when predicting dichotomous health measures. Robust standard errors are clustered by state of birth in all analyses prior to 2005. Beginning in 2005, geographic information is not available in NVSS microdata and standard errors are not adjusted for state-level clustering.

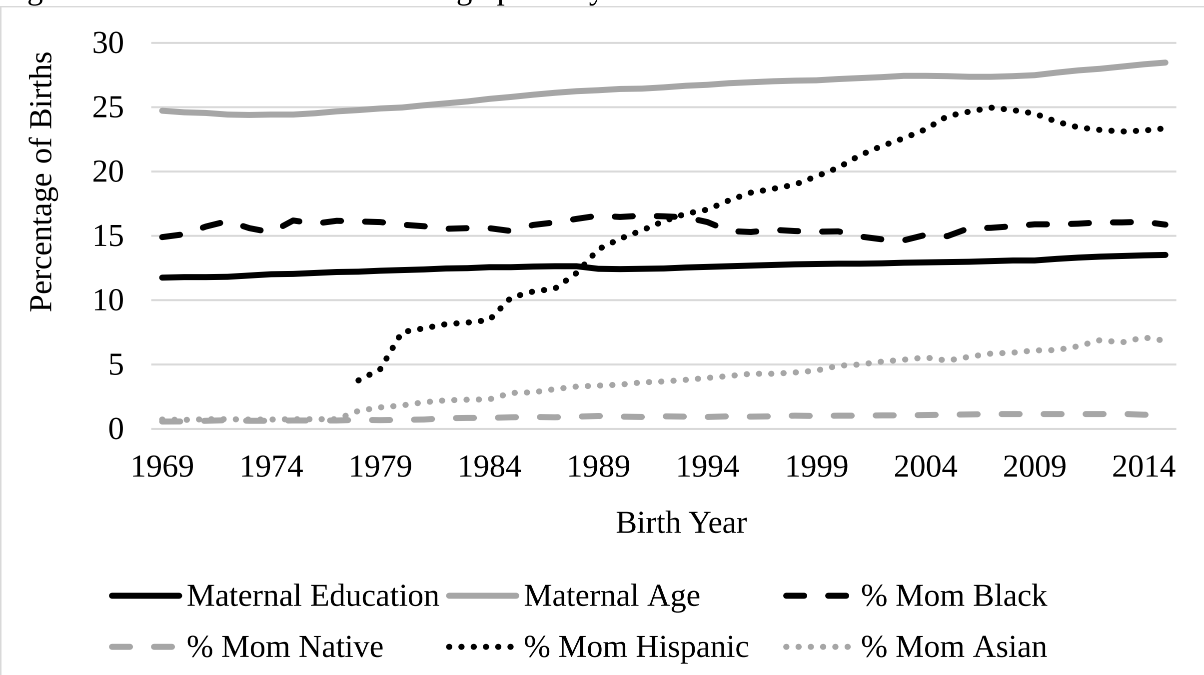
To address research question 2, I compare the above estimates of intergenerational inequality of health by cohort. Specifically, I graph each estimate of infant health across birth years. I compare these trends to the timing of major policy changes (OBRA-86 and -87, SCHIP, and Medicaid cuts in the early 2000s).

Results

Table 1 provides descriptive statistics by year of birth for maternal demographic characteristics. Table A1 in the Appendix provides the equivalent table for paternal characteristics. Figure 1, based on Table 1, shows that maternal demographics have changed over time. The proportion of births to Hispanic and Asian mothers has increased, while the proportion to white mothers has decreased. Average maternal education and age have also increased over time. The demographic trends in Table 1 suggest that, in addition to unadjusted measures of inequality, measures that adjust for demographics should also be examined. The regressions estimate intergenerational inequality of infant health after adjusting for demographics.

[Table 1 about here]

Figure 1: Trends in Maternal Demographics by Birth Year



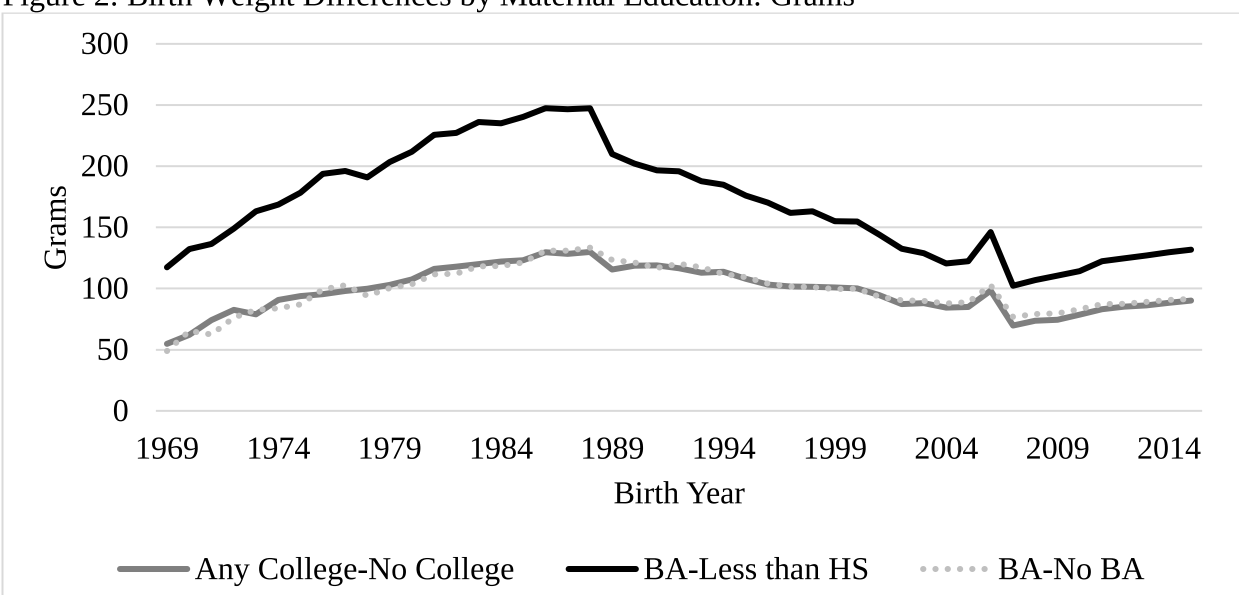
Based on Table 1.

Table 2 provides descriptive information about infant health by birth year. The table shows that average birth weight and gestational length have remained relatively stable over time. Birth weight increased by about 100 grams from 1969 to 1985 and then returned to its earlier level by 2015. However, 100 grams is only about 3.5 ounces. Gestational length decreased by about 1 week from 1969 to 2015. The proportion of preterm births fluctuated a bit, but increased by 3 percentage points from 1974 to 2015. The proportion of low birth weight infants declined until the early 1980s and then increased to a high of 8.25% in 2006. The proportion of male births has remained stable at 51%, while the proportion of multiple births increased from 1.85% in 1972 to 3.5% in 2014. The health trends in Table 2 indicate the need to examine inequality relative to other births in the same year. I standardize measures within each year to allow comparisons over time.

[Table 2 about here]

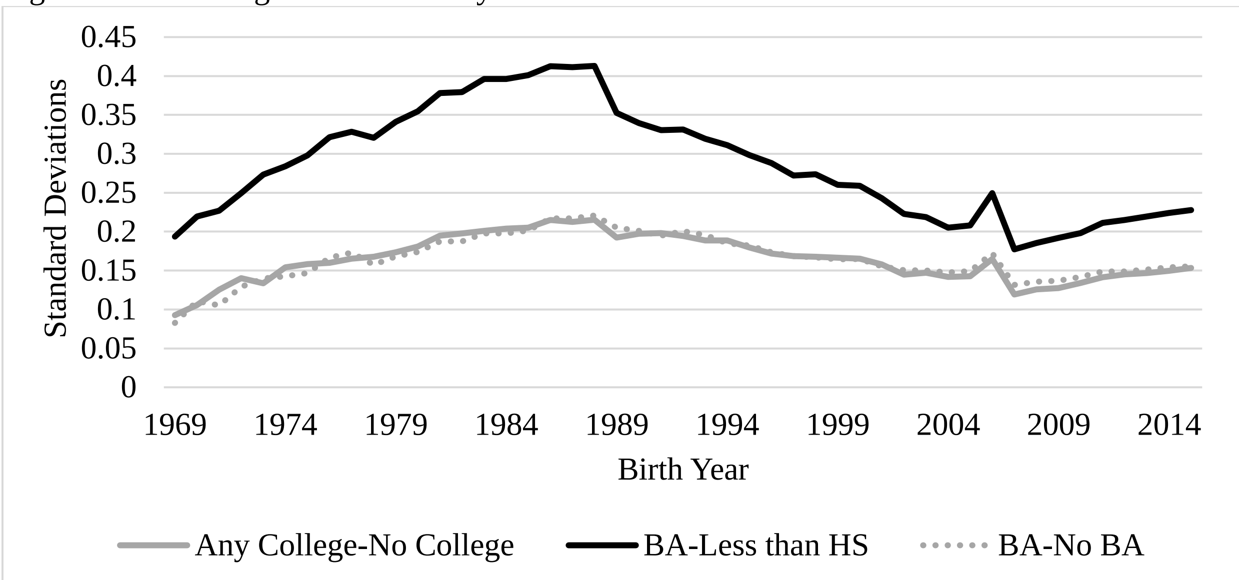
Figures 2-5 show trends in inequality of infant birth weight by parental education. Figure 2 tracks changes in raw differences by education (i.e. measured in grams) and Figure 3 traces changes in standard deviation units. In 1988, the gap between infants born to a mother with a BA and those born to a mother with less than a high school degree was approximately 250 grams. Based on evidence by Royer (2009) and Figlio et al. (2014), this gap predicts a difference of 0.04 years of schooling and a 0.05 standard deviation difference in test scores later in life. Thus, these birth weight gaps have meaningful implications for life chances. Figure 4 shows changes over time in the correlation between (standardized measures of) infant birth weight and both maternal and paternal education. Figure 5 shows correlations over time that have been adjusted for demographics.

Figure 2: Birth Weight Differences by Maternal Education: Grams



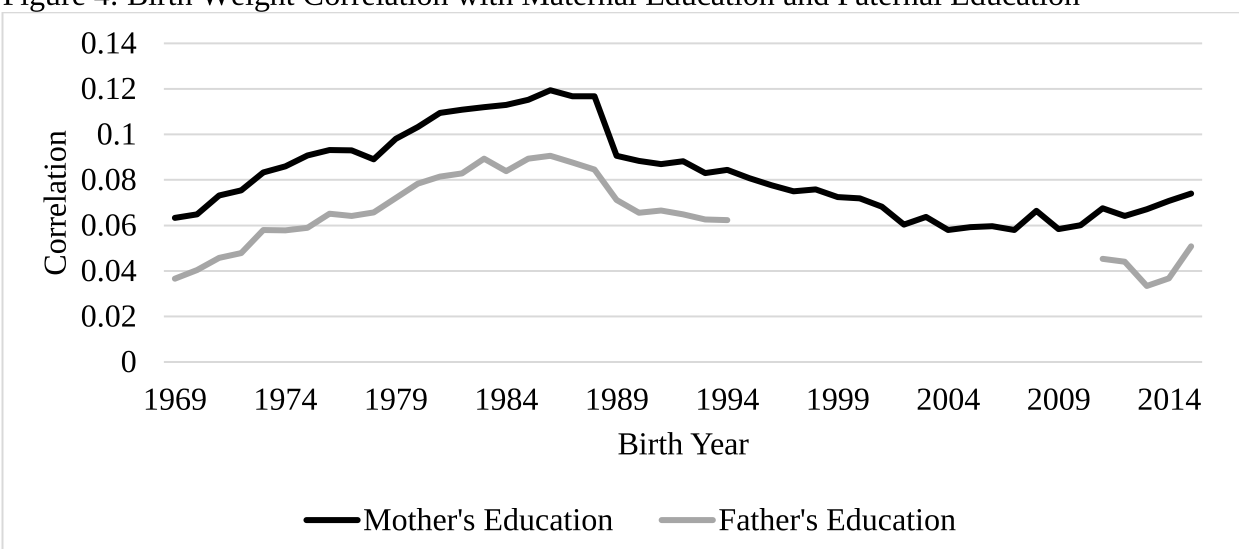
Source: NVSS Birth Data 1969-2015. Mean differences in birth weight by maternal education in each birth year.

Figure 3: Birth Weight Differences by Maternal Education: Standard Deviation Units



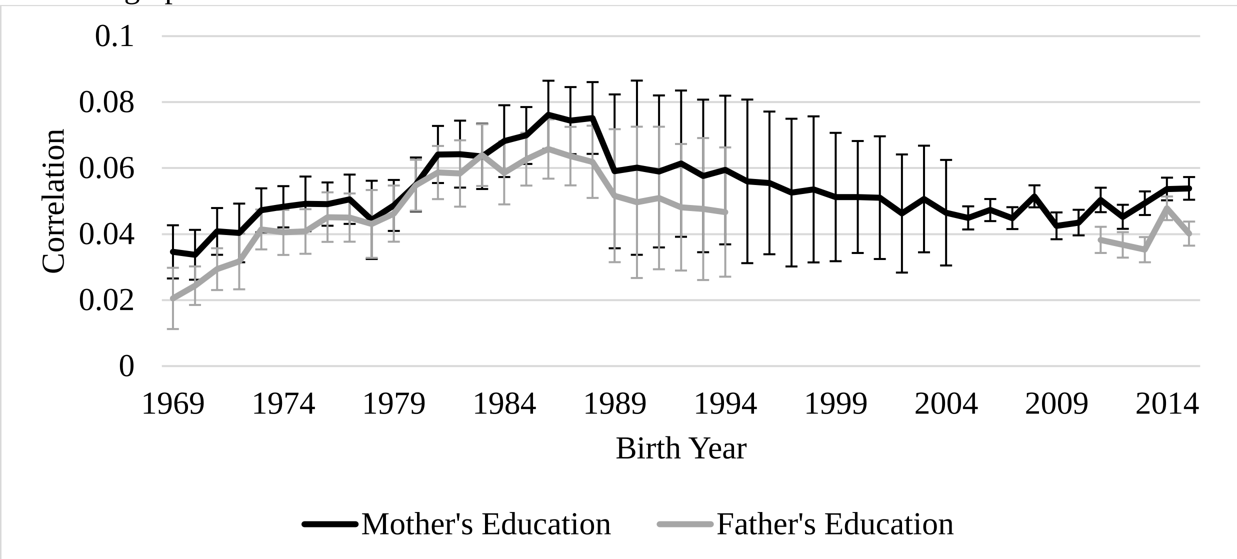
Source: NVSS Birth Data 1969-2015. Mean differences in birth weight by maternal education divided by pooled standard deviations of the two groups in each birth year.

Figure 4: Birth Weight Correlation with Maternal Education and Paternal Education



Source: NVSS Birth Data 1969-2015. Correlation between standardized measures of birth weight and maternal and paternal years of education in each birth year.

Figure 5: Birth Weight Correlation with Maternal Education and Paternal Education: Adjusted for Demographics



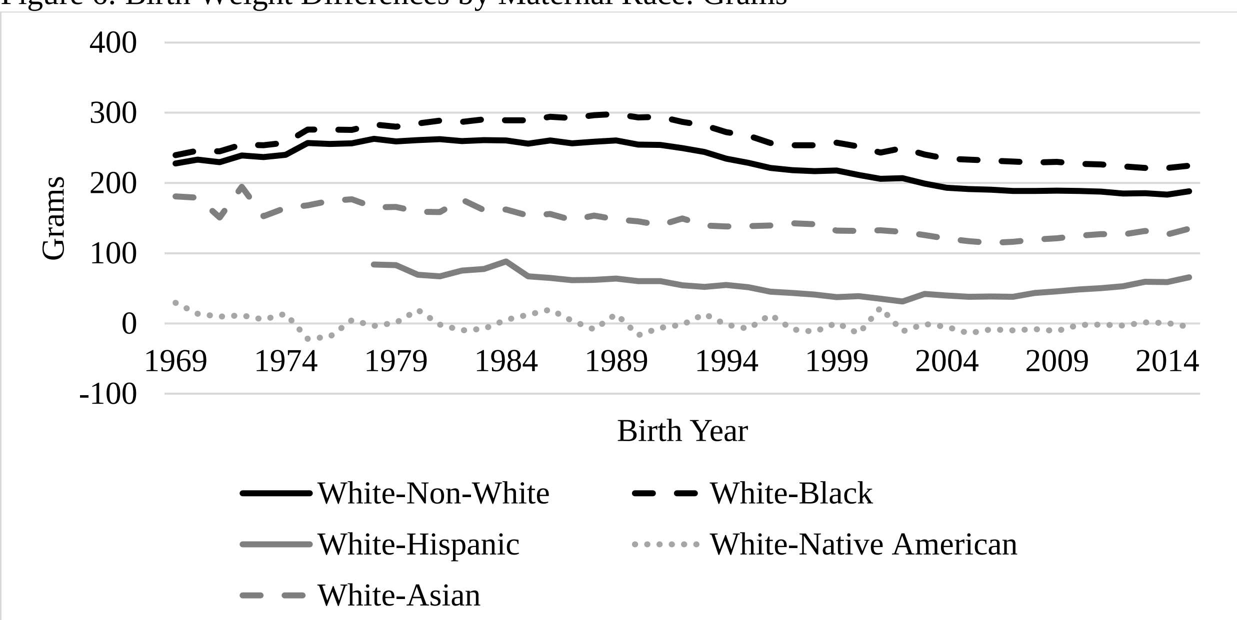
Source: NVSS Birth Data 1969-2015. Coefficient of standardized maternal and paternal years of education when predicting standardized birth weight in each birth year, controlling for maternal race, maternal age, child sex, and multiple birth. Standardized coefficients represent correlations, adjusted for demographic characteristics.

Figures 2-5 show a clear nonlinear relationship between infant birth weight and parental education, regardless of measure or whether examining maternal or paternal education. Rising inequality of birth weight in the 1970s and early 1980s could reflect rising income inequality or returns to education (Goldin and Katz 2008; Piketty and Saez 2014). The inflection point is the late 1980s, when the Omnibus Budget Reconciliation Acts of 1986 (OBRA-86) and 1987 (OBRA-87) allowed states to provide Medicaid coverage to pregnant women, infants, and children based on new income eligibility thresholds. In other words, by allowing higher income eligibility thresholds, above those of AFDC programs, OBRA-86/87 enabled more pregnant women and infants to be covered by Medicaid. Addressing a causal relationship between OBRA-86/87 and inequality of infant health is beyond the scope of this paper. However, the observed pattern is consistent with the possibility that OBRA-86/87 reduced inequality of infant health by parental education.

A more troubling observation is that all four figures show an increase in inequality of infant health from the mid- to late-2000s. This could reflect several changes, including state Medicaid and SCHIP cuts in 2003-4, rising economic inequality, or the economic recession. The rising inequality raises concern about the future of these cohorts.

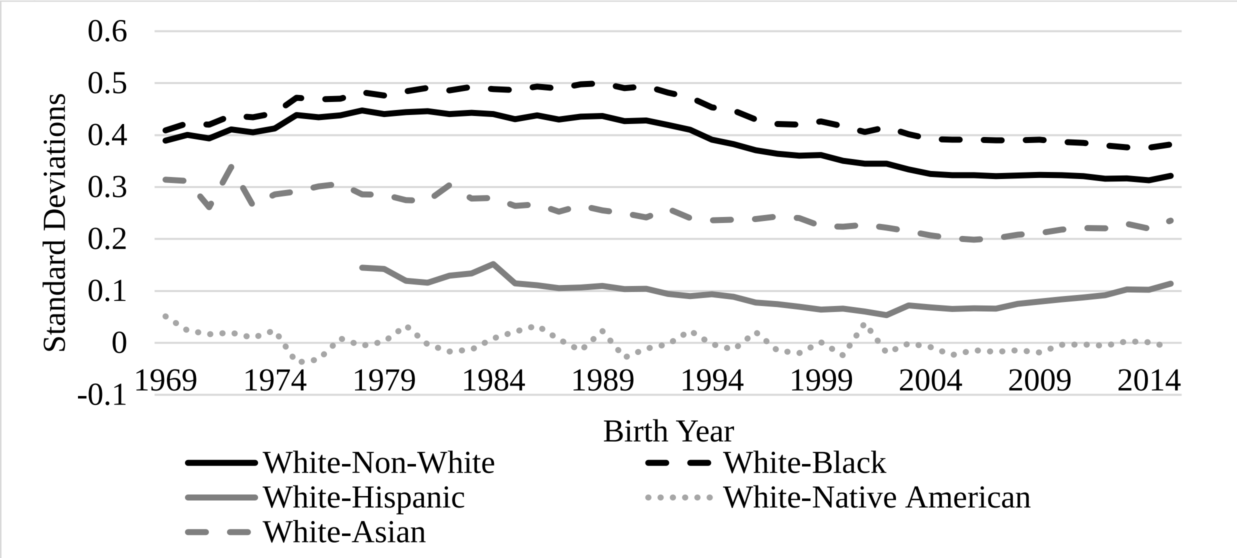
Figures 6-8 illustrate trends in racial inequality of birth weight. Figure 6 shows trends in raw differences in birth weight by race (i.e. measured in grams). Figure 7 shows differences measured in standard deviation units. Figure 8 graphs coefficients for maternal race categories from models predicting standardized birth weight with controls for maternal age, maternal education, child sex, and multiple birth. The coefficients represent the difference from births to white mothers (the omitted category).

Figure 6: Birth Weight Differences by Maternal Race: Grams



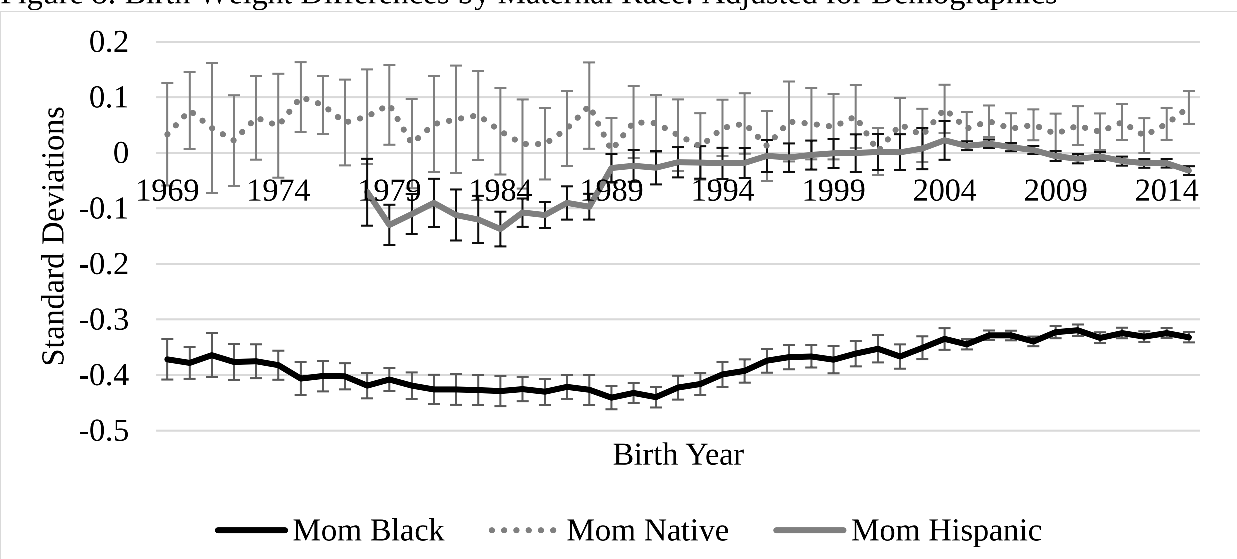
Source: NVSS Birth Data 1969-2015. Mean differences in birth weight by maternal race in each birth year.

Figure 7: Birth Weight Differences by Maternal Race: Standard Deviation Units



Source: NVSS Birth Data 1969-2015. Mean differences in birth weight by maternal race divided by pooled standard deviations of the two groups in each birth year.

Figure 8: Birth Weight Differences by Maternal Race: Adjusted for Demographics



Source: NVSS Birth Data 1969-2015. Coefficient of maternal race indicators when predicting standardized birth weight in each birth year, controlling for maternal education, maternal age, child sex, and multiple birth. Coefficients predicting standardized birth weight represent differences from births to white mothers, adjusted for demographic characteristics.

As with education, trends in inequality by race suggest a decline in inequality following the late 1980s, when OBRA-86/87 increased access to Medicaid for pregnant women. Rather than an increase in the late 2000s, trends in inequality by race remain flat during that period.

Comparing trends in inequality by education and race suggest that changes in the early part of the 21st century increased inequality by maternal education but not race. These different trends are consistent with rising economic inequality contributing to the observed changes in inequality by education.

The Appendix includes graphs of inequality of gestational length by parental education and race. Trends show a similar decline in the late 1980s, although this was the continuation of declining inequality from the 1970s. Gestational age shows a steeper increase in inequality in the 2000s, which heightens concern about equality of opportunity for recent cohorts.

Trends in inequality of low birth weight and preterm birth (shown in Appendix Figures A8-A21) are similar to those for birth weight and gestational length. This pattern suggests the results are robust to focusing on infants who fall in a range considered problematic.

Conclusion

This study seeks to provide an earlier and more inclusive measure of unequal opportunity. Examining inequality of health at birth provides a measure of the extent to which children face unequal opportunity from the moment they are born. Previous research examining trends from 1989 to 2011 found relatively little change in recent years (Aizer and Currie 2014), but conflated three measures of inequality and excluded periods in which we might expect to observe change due to policy changes. Using NVSS birth data from 1969 to 2015, I trace changes in inequality of infant health by parental education and race over time.

Results suggest intergenerational inequality of health at birth has changed over time. Inequality of infant health by maternal education increased in the 1970s and 1980s, which could reflect rising income inequality and returns to education (Goldin and Katz 2008; Piketty and Saez 2014). Inequality by both parental education and race suggest inequality declined from the late 1980s. This pattern is consistent with the timing of expanded access to Medicaid coverage for pregnant women with OBRA-86/87, which allowed the threshold for Medicaid coverage to rise above the limits for AFDC eligibility. State timing of OBRA implementation varied and future research should estimate effects of this policy change on inequality of infant health.

A more troubling finding is that inequality of infant health has risen since the early 2000s. Because infant health is critical for later developmental and economic outcomes (Blackwell et al. 2001; Currie and Stabile 2006; Palloni 2006; Black et al. 2007; Bleakley 2007; Fletcher and Wolfe 2008; Oreopoulos et al. 2008; Currie 2009; Palloni et al. 2009; Royer 2009; Smith 2009; Almond and Currie 2011; Reyes 2015; Aizer et al. 2016), rising inequality of infant health could have drastic consequences for equality of later life outcomes. The timing of this rising inequality is consistent with state cuts to Medicaid and SCHIP funding in 2003-2004. However, other factors including economic inequality and the economic recession could explain this rising inequality as well. Future research should seek to explain this rising inequality.

Limitations of this analysis include missing data and changes in data collection, such as the change from years to level of education completed. However, the relationships between maternal education, infant health, and the likelihood of missing data are weak (see Appendix Table A2) and the inclusion of multiple measures of inequality help address concern about changes in the measure of parental education.

Infant health provides an early and inclusive measure of intergenerational inequality. Trends using more exclusive measures – including labor market measures that frequently exclude women, the incarcerated, those who do not survive to adulthood, and those who do not submit an income tax return – often indicate relative stability in intergenerational inequality (e.g., Chetty et al. 2014a, 2014b). However, exclusive measures may suggest flatter trends than more inclusive measures (e.g., Hout 2017). This analysis of inequality of child health reveals important trends in intergenerational inequality and suggests that using exclusive measures in mobility research may bias results.

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Tables

Table 1: Maternal Demographic Characteristics by Year of Birth

Birth Year	Maternal Education	Maternal Age	% Mom White	% Mom Black	% Mom Native	% Mom Hispanic	% Mom Asian	N
1969	11.76	24.73	83.54	14.92	0.58		0.72	110642
1970	11.79	24.61	83.32	15.13	0.58		0.70	121499
1971	11.81	24.56	82.53	15.72	0.65		0.76	116031
1972	11.83	24.43	82.01	16.15	0.69		0.76	117530
1973	11.92	24.40	82.51	15.61	0.62		0.74	134838
1974	12.03	24.42	82.80	15.28	0.63		0.73	155025
1975	12.05	24.44	81.81	16.20	0.66		0.76	175705
1976	12.12	24.54	82.06	15.95	0.65		0.75	196151
1977	12.19	24.69	81.85	16.17	0.66		0.76	224720
1978	12.22	24.79	81.66	16.13	0.71	3.77	1.40	250471
1979	12.31	24.90	81.50	16.08	0.68	4.65	1.67	262365
1980	12.35	24.98	81.46	15.88	0.72	7.52	1.82	272378
1981	12.41	25.14	81.37	15.74	0.73	7.82	2.08	271277
1982	12.46	25.29	81.34	15.57	0.84	8.14	2.21	275500
1983	12.51	25.46	81.24	15.61	0.85	8.26	2.27	271547
1984	12.56	25.64	81.21	15.60	0.86	8.46	2.29	272877
1985	12.58	25.81	80.84	15.39	0.91	10.21	2.80	286816
1986	12.61	25.96	80.31	15.86	0.93	10.68	2.84	285204
1987	12.65	26.12	79.87	16.05	0.92	10.91	3.09	289302
1988	12.64	26.25	79.34	16.33	0.96	12.13	3.30	280805
1989	12.44	26.32	79.04	16.58	1.00	13.96	3.38	368331
1990	12.42	26.41	79.12	16.48	0.95	14.78	3.45	386901
1991	12.44	26.44	78.87	16.57	0.94	15.42	3.62	398288
1992	12.48	26.56	78.79	16.54	0.98	16.15	3.69	400337
1993	12.54	26.67	78.77	16.46	0.97	16.72	3.81	394374
1994	12.59	26.75	79.01	16.07	0.94	17.05	3.98	390041
1995	12.65	26.86	79.52	15.39	0.97	17.77	4.12	384283
1996	12.70	26.94	79.46	15.31	0.95	18.37	4.28	383862
1997	12.74	27.02	79.25	15.47	0.98	18.67	4.30	382854
1998	12.79	27.06	79.21	15.38	1.02	18.98	4.39	388518
1999	12.82	27.10	79.12	15.34	1.01	19.64	4.54	389952
2000	12.83	27.19	78.69	15.36	1.03	20.29	4.92	400218
2001	12.85	27.27	79.00	14.97	1.03	21.28	5.01	397560
2002	12.87	27.35	78.96	14.74	1.07	22.00	5.24	397168
2003	12.92	27.44	78.90	14.66	1.05	22.59	5.39	404116
2004	12.95	27.45	78.29	15.07	1.09	23.28	5.55	406388
2005	12.97	27.43	78.61	14.99	1.10	24.32	5.30	383566
2006	12.99	27.36	77.65	15.61	1.12	24.67	5.61	421831

2007	13.04	27.37	77.35	15.63	1.16	24.97	5.86	427040
2008	13.09	27.41	77.15	15.74	1.17	24.77	5.93	420237
2009	13.09	27.50	76.81	15.91	1.16	24.51	6.12	277337
2010	13.22	27.69	76.80	15.90	1.17	23.89	6.14	306079
2011	13.32	27.86	76.43	15.96	1.17	23.43	6.43	335826
2012	13.39	27.98	75.89	16.04	1.16	23.24	6.91	345138
2013	13.45	28.15	76.03	16.06	1.17	23.12	6.74	352398
2014	13.48	28.34	75.66	16.10	1.12	23.19	7.12	381012
2015	13.52	28.47	76.15	15.89	1.12	23.38	6.85	379723

Source: NVSS Birth Data 1969-2015.

Table 2: Infant Health and Characteristics by Year of Birth

Birth Year	Birth Weight (grams)	% Low Birth Weight	Gestational Length (weeks)	% Preterm	% Male	% Multiple Birth	N
1969	3267.10	8.10	39.42	9.76	51.21		178446
1970	3273.73	8.03	39.55	9.40	51.38		185037
1971	3286.90	7.73	39.47	9.50	51.44		177068
1972	3290.94	7.60	39.40	9.63	51.24	1.85	173916
1973	3295.10	7.66	39.53	9.19	51.32	1.85	182872
1974	3304.31	7.34	39.69	8.30	51.38	1.86	201791
1975	3306.21	7.44	39.58	8.89	51.30	1.98	222192
1976	3320.89	7.27	39.60	8.89	51.16	1.94	245432
1977	3324.59	7.09	39.56	8.84	51.28	1.89	276666
1978	3327.96	7.12	39.55	8.82	51.25	1.95	285578
1979	3335.36	6.98	39.53	8.90	51.23	1.99	317381
1980	3340.43	6.86	39.53	8.87	51.10	1.96	329825
1981	3340.13	6.81	39.44	9.45	51.19	1.91	330893
1982	3345.06	6.74	39.42	9.45	51.25	1.98	336854
1983	3343.87	6.83	39.39	9.61	51.28	2.08	333019
1984	3348.57	6.78	39.41	9.42	51.19	2.06	335342
1985	3351.15	6.77	39.33	9.77	51.24	2.09	375926
1986	3347.74	6.83	39.29	10.05	51.30	2.15	375448
1987	3345.28	7.01	39.26	10.24	51.22	2.21	380841
1988	3345.32	6.95	39.27	10.16	51.27	2.24	390870
1989	3342.32	7.01	39.15	10.61	51.18	2.28	404037
1990	3341.73	7.08	39.11	10.72	51.39	2.37	415716
1991	3334.71	7.12	39.07	10.84	51.12	2.35	411065
1992	3340.03	7.04	39.06	10.66	51.17	2.44	406438
1993	3331.79	7.19	38.99	10.98	51.16	2.49	399834
1994	3329.38	7.33	38.96	11.04	51.16	2.55	395218
1995	3326.28	7.35	38.95	11.01	51.24	2.63	389834
1996	3325.52	7.37	38.95	11.00	51.11	2.74	389016

1997	3320.92	7.49	38.86	11.30	51.13	2.84	388006
1998	3321.53	7.51	38.81	11.58	51.12	2.98	394020
1999	3315.68	7.61	38.77	11.79	51.29	3.08	395826
2000	3318.10	7.61	38.78	11.68	51.07	3.12	405813
2001	3307.83	7.56	38.72	11.84	51.05	3.14	402762
2002	3298.05	7.87	38.69	12.06	51.11	3.28	402349
2003	3290.54	7.96	38.64	12.33	51.28	3.32	409199
2004	3280.20	8.11	38.61	12.43	51.23	3.43	411796
2005	3272.81	8.20	38.55	12.81	51.32	3.35	388024
2006	3265.59	8.25	38.53	12.76	51.25	3.34	426547
2007	3263.93	8.14	38.54	12.61	51.19	3.38	431697
2008	3263.65	8.15	38.57	12.30	51.19	3.41	424755
2009	3261.83	8.11	38.57	12.07	51.21	3.44	413398
2010	3261.84	8.11	38.59	12.00	51.28	3.41	400179
2011	3265.60	8.08	38.61	11.74	51.14	3.52	395648
2012	3270.49	8.00	38.65	11.52	51.33	3.47	395691
2013	3271.27	8.09	38.65	11.33	51.04	3.48	393629
2014	3272.17	8.07	38.65	11.31	51.29	3.50	399374
2015	3270.60	8.10	38.65	11.30	51.19	3.46	391184

Source: NVSS Birth Data 1969-2015.

Online Appendix

Table A1: Paternal Demographic Characteristics by Year of Birth

Birth Year	Paternal Education	Paternal Age	% Dad White	% Dad Black	% Dad Native	% Dad Hispanic	% Dad Asian	N
1969	12.15	27.99	86.39	12.24	0.50		0.66	100143
1970	12.23	27.85	86.31	12.26	0.52		0.68	109126
1971	12.24	27.76	85.81	12.62	0.55		0.74	104123
1972	12.30	27.66	85.83	12.58	0.60		0.72	104333
1973	12.44	27.63	86.33	12.04	0.56		0.72	118991
1974	12.56	27.58	86.37	11.95	0.56		0.70	137304
1975	12.60	27.61	85.79	12.45	0.61		0.71	153698
1976	12.67	27.71	86.26	12.06	0.56		0.71	171334
1977	12.74	27.84	86.08	12.21	0.56		0.73	195300
1978	12.77	27.97	86.05	11.94	0.61	3.61	1.33	218063
1979	12.85	28.04	85.89	11.90	0.57	4.56	1.58	226962
1980	12.87	28.10	85.71	11.82	0.59	7.38	1.77	235075
1981	12.91	28.27	85.45	11.85	0.60	7.64	2.03	234076
1982	12.95	28.41	85.42	11.70	0.66	7.92	2.18	237212
1983	13.00	28.60	85.40	11.62	0.71	8.02	2.25	233115
1984	13.03	28.80	85.41	11.59	0.71	8.16	2.25	233110
1985	13.04	28.96	84.75	11.64	0.74	10.10	2.81	244021
1986	13.06	29.14	84.32	12.06	0.72	10.45	2.85	240688
1987	13.08	29.31	83.94	12.14	0.73	10.61	3.11	242648
1988	13.08	29.46	83.66	12.18	0.77	12.09	3.33	233062
1989	12.79	29.60	83.74	12.06	0.78	14.45	3.42	309836
1990	12.74	29.62	83.81	11.92	0.74	15.39	3.52	324443
1991	12.75	29.66	83.69	11.93	0.74	16.04	3.64	332002
1992	12.78	29.76	83.32	12.19	0.78	16.75	3.71	334812
1993	12.84	29.84	83.25	12.17	0.75	17.26	3.84	329322
1994	12.88	29.91	83.22	12.04	0.77	17.55	3.97	326501
1995		29.99	83.26	11.86	0.81	18.03	4.07	331248
1996		30.09	82.85	12.08	0.80	18.60	4.27	331875
1997		30.17	82.48	12.37	0.86	18.71	4.30	331865
1998		30.21	82.19	12.56	0.86	19.09	4.38	337953
1999		30.25	81.85	12.78	0.86	19.78	4.51	340853
2000		30.33	81.37	12.83	0.87	20.35	4.93	350415
2001		30.40	81.46	12.67	0.88	21.54	4.99	348924
2002		30.49	81.35	12.51	0.91	22.19	5.23	348575
2003		30.56	81.24	12.53	0.90	22.67	5.33	354712
2004		30.57	80.78	12.74	0.94	23.54	5.54	355965
2005		30.53	80.90	12.82	0.99	24.84	5.28	336342
2006		30.52	79.74	13.58	1.01	25.15	5.66	365719

2007		30.50	79.23	13.71	1.03	25.45	6.03	369935
2008		30.52	78.73	14.10	1.04	25.22	6.13	366116
2009		30.59	78.32	14.29	1.09	24.88	6.31	356125
2010		30.74	78.28	14.29	1.10	24.22	6.33	345410
2011	13.29	30.85	77.80	14.45	1.11	23.73	6.65	286869
2012	13.34	30.95	77.07	14.69	1.12	23.42	7.12	296207
2013	13.39	31.07	77.16	14.80	1.09	23.21	6.95	303241
2014	13.41	31.24	76.67	14.88	1.10	23.21	7.35	327849
2015	13.43	31.30	77.00	14.85	1.08	23.35	7.07	328892

Source: NVSS Birth Data 1969-2015.

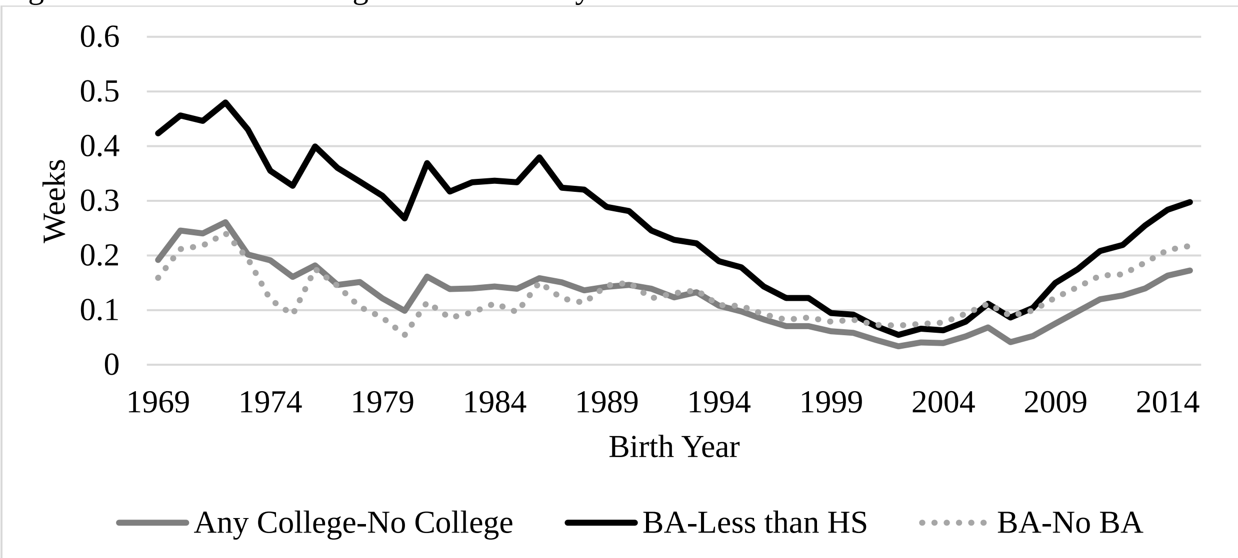
Table A2: Correlations of Missing Data with Infant Health and Maternal Education

Birth Year	Correlation of Maternal Education with: Missing Birth Weight	Correlation of Maternal Education with: Missing Gestational Length	Correlation of Missing Maternal Education with: Birth Weight	Correlation of Missing Maternal Education with: Gestational Length
1969	-0.01	-0.05	0.00	0.01
1970	-0.01	-0.04	0.00	0.01
1971	0.00	-0.05	0.00	0.01
1972	-0.01	-0.05	0.00	0.01
1973	-0.01	-0.06	0.00	0.00
1974	0.00	-0.06	0.01	0.01
1975	0.00	-0.05	0.00	0.01
1976	-0.01	-0.05	0.00	0.01
1977	-0.01	-0.05	0.00	0.01
1978	-0.01	-0.08	0.00	0.01
1979	0.00	-0.07	0.00	0.01
1980	0.00	-0.08	0.01	0.00
1981	-0.01	-0.04	0.01	0.00
1982	-0.01	-0.04	0.00	0.00
1983	0.00	-0.04	0.01	0.00
1984	-0.01	-0.04	0.00	0.00
1985	0.00	-0.04	0.01	0.00
1986	-0.01	-0.04	0.01	0.00
1987	0.00	-0.04	0.01	0.00
1988	-0.01	-0.05	0.02	0.01
1989	0.00	-0.04	0.01	0.01
1990	0.00	-0.05	0.01	0.01
1991	0.00	-0.04	0.00	0.00
1992	0.00	-0.04	-0.02	-0.02
1993	0.00	-0.04	-0.02	-0.02
1994	0.00	-0.04	-0.02	-0.02
1995	0.00	-0.04	-0.02	-0.02
1996	0.00	-0.04	-0.02	-0.02
1997	0.00	-0.04	-0.02	-0.02
1998	0.00	-0.03	-0.02	-0.02
1999	0.00	-0.04	-0.02	-0.01
2000	0.01	-0.04	-0.02	-0.02
2001	0.00	-0.04	-0.02	-0.01
2002	0.00	-0.04	-0.02	-0.01
2003	0.00	-0.04	-0.01	-0.01
2004	0.00	-0.04	-0.02	-0.02
2005	0.00	-0.03	-0.01	-0.01
2006	0.00	-0.03	-0.02	-0.02
2007	0.00	-0.01	-0.01	-0.01

2008	0.00	-0.01	-0.01	-0.01
2009	-0.01	-0.01	0.00	0.00
2010	0.00	-0.02	0.00	0.00
2011	0.00	0.00	-0.01	0.00
2012	0.00	-0.01	-0.01	-0.01
2013	0.00	-0.01	-0.01	-0.01
2014	0.00	-0.01	-0.01	0.00
2015	0.00	-0.01	-0.01	-0.01

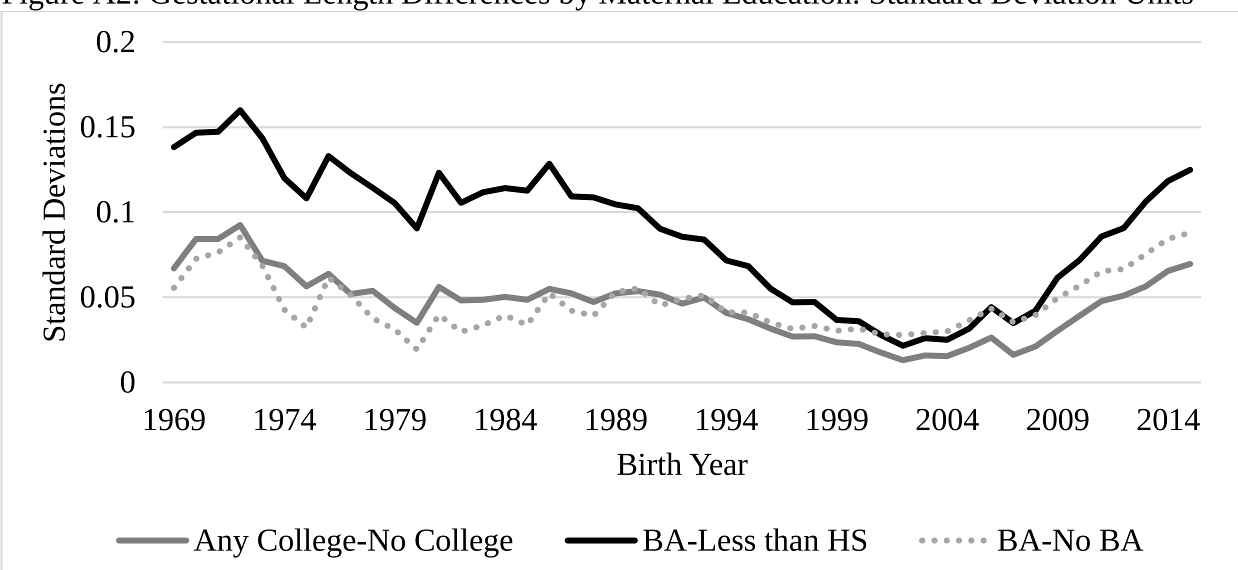
Source: NVSS Birth Data 1969-2015.

Figure A1: Gestational Length Differences by Maternal Education: Weeks



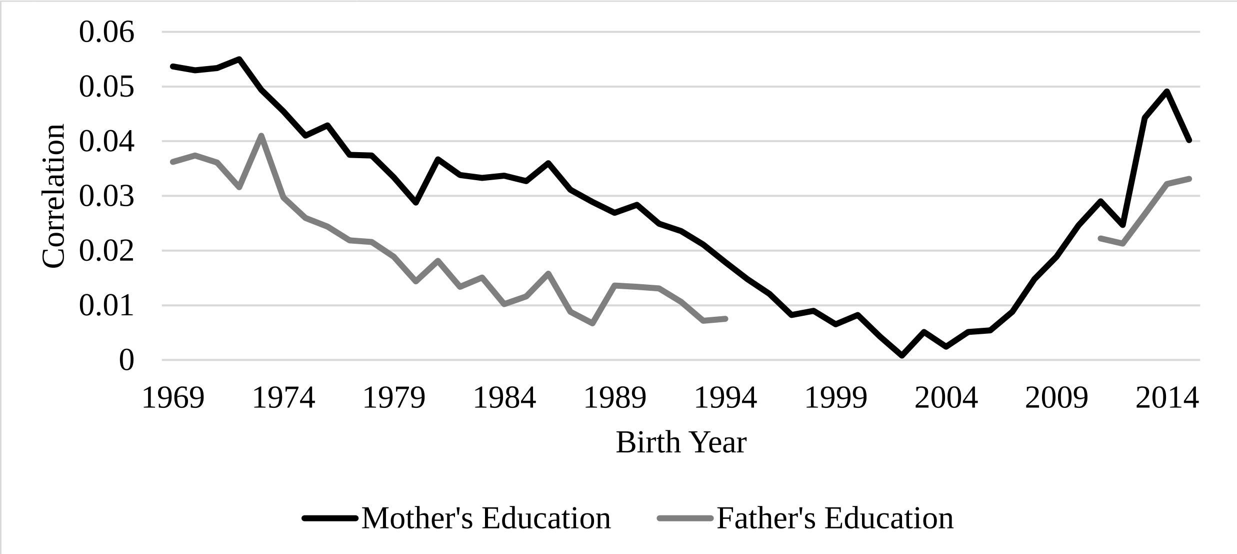
Source: NVSS Birth Data 1969-2015. Mean differences in gestational length by maternal education in each birth year.

Figure A2: Gestational Length Differences by Maternal Education: Standard Deviation Units



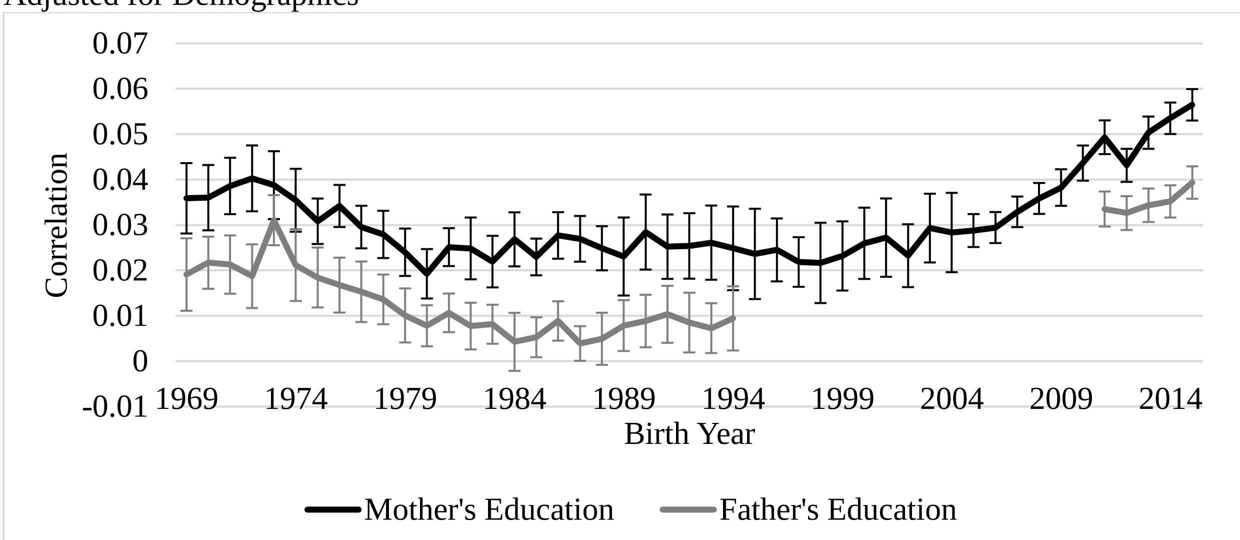
Source: NVSS Birth Data 1969-2015. Mean differences in gestational length by maternal education divided by pooled standard deviations of the two groups in each birth year.

Figure A3: Gestational Length Correlation with Maternal and Paternal Education



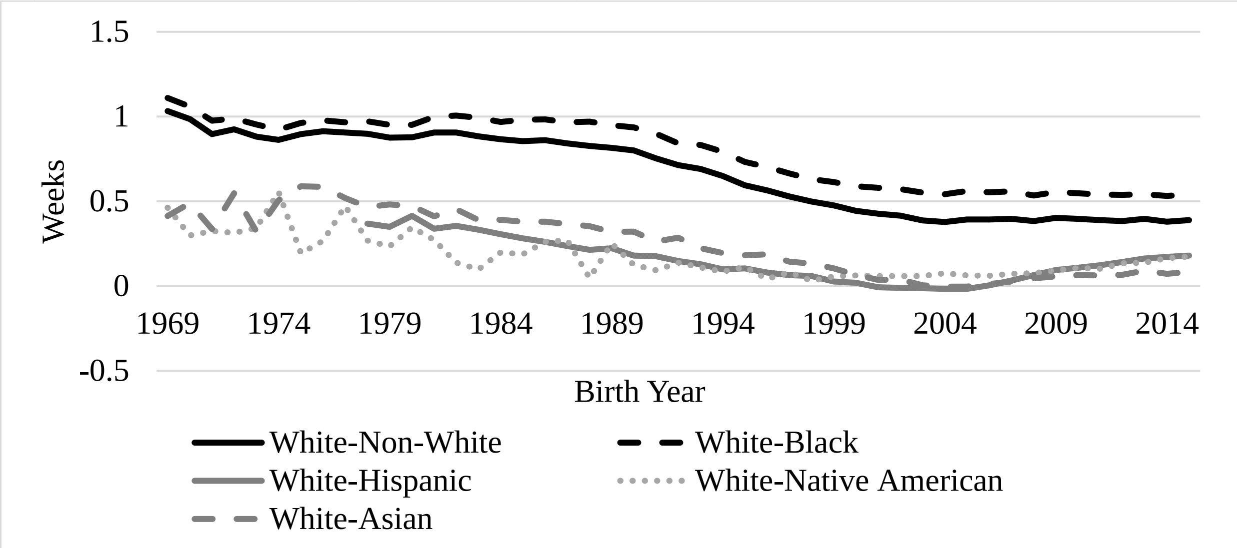
Source: NVSS Birth Data 1969-2015. Correlation between standardized measures of gestational length and maternal and paternal years of education in each birth year.

Figure A4: Gestational Length Correlation with Maternal Education and Paternal Education: Adjusted for Demographics



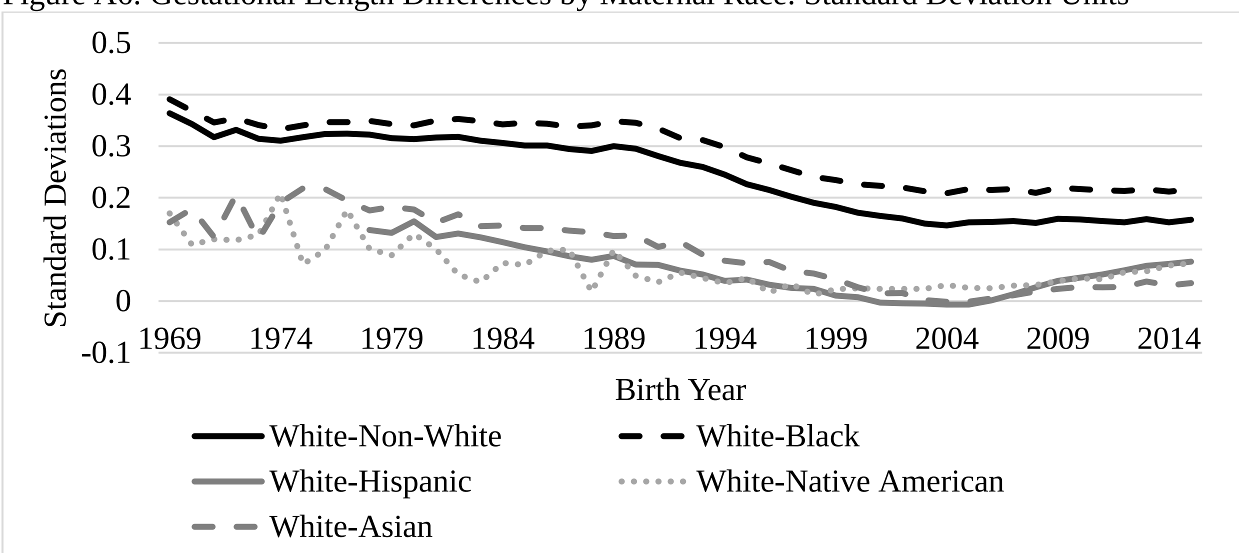
Source: NVSS Birth Data 1969-2015. Coefficient of standardized maternal and paternal years of education when predicting standardized gestational length in each birth year, controlling for maternal race, maternal age, child sex, and multiple birth. Standardized coefficients represent correlations, adjusted for demographic characteristics.

Figure A5: Gestational Length Differences by Maternal Race: Weeks



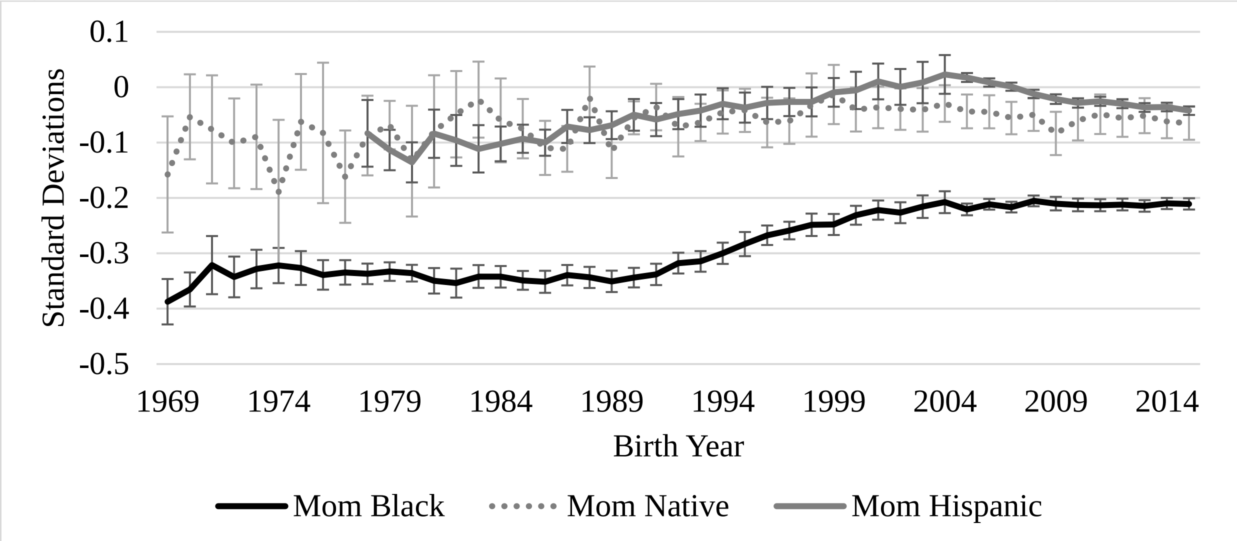
Source: NVSS Birth Data 1969-2015. Mean differences in gestational length by maternal race in each birth year.

Figure A6: Gestational Length Differences by Maternal Race: Standard Deviation Units



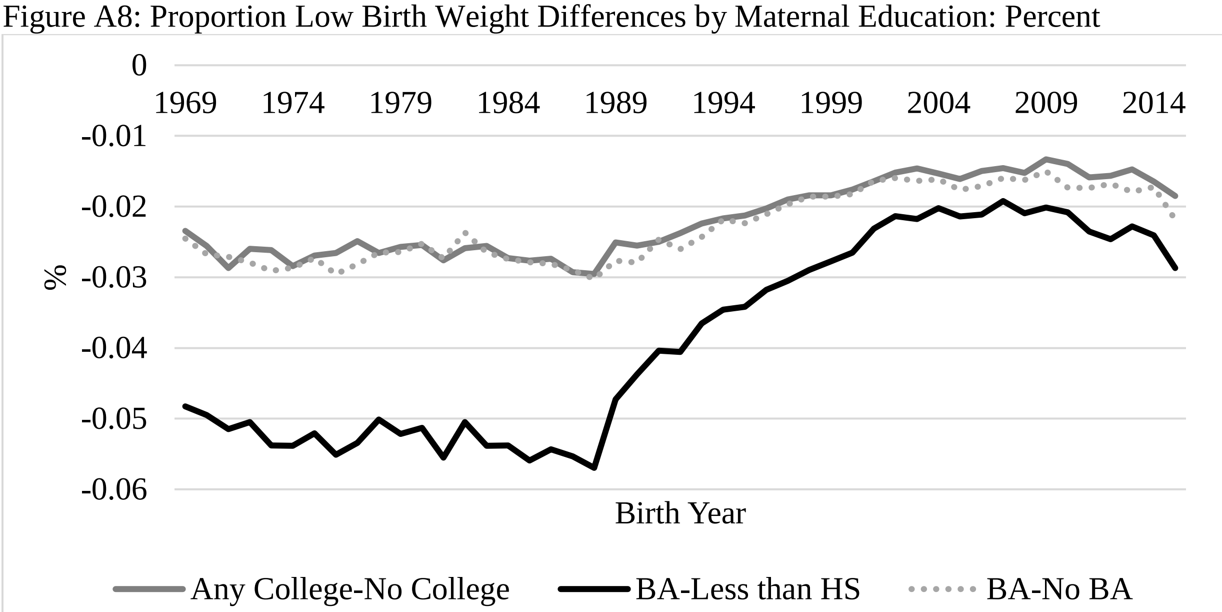
Source: NVSS Birth Data 1969-2015. Mean differences in gestational length by maternal race divided by pooled standard deviations of the two groups in each birth year.

Figure A7: Gestational Length Differences by Maternal Race: Adjusted for Demographics



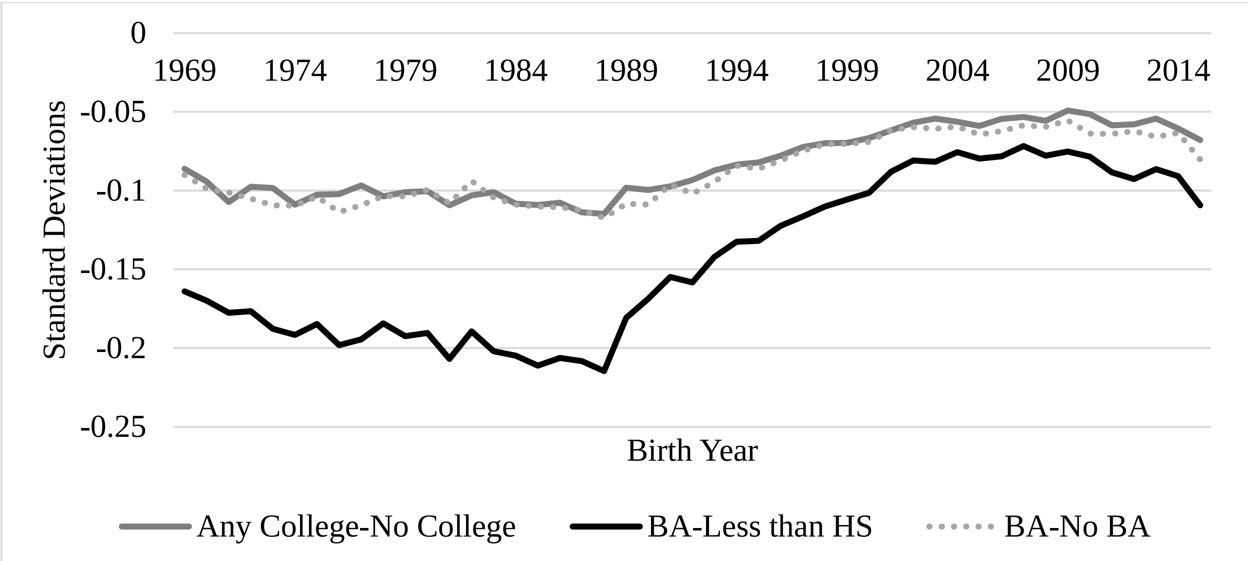
Source: NVSS Birth Data 1969-2015. Coefficient of maternal race indicators when predicting standardized gestational length in each birth year, controlling for maternal education, maternal age, child sex, and multiple birth. Coefficients predicting standardized gestational length represent differences from births to white mothers, adjusted for demographic characteristics.

Figure A8: Proportion Low Birth Weight Differences by Maternal Education: Percent



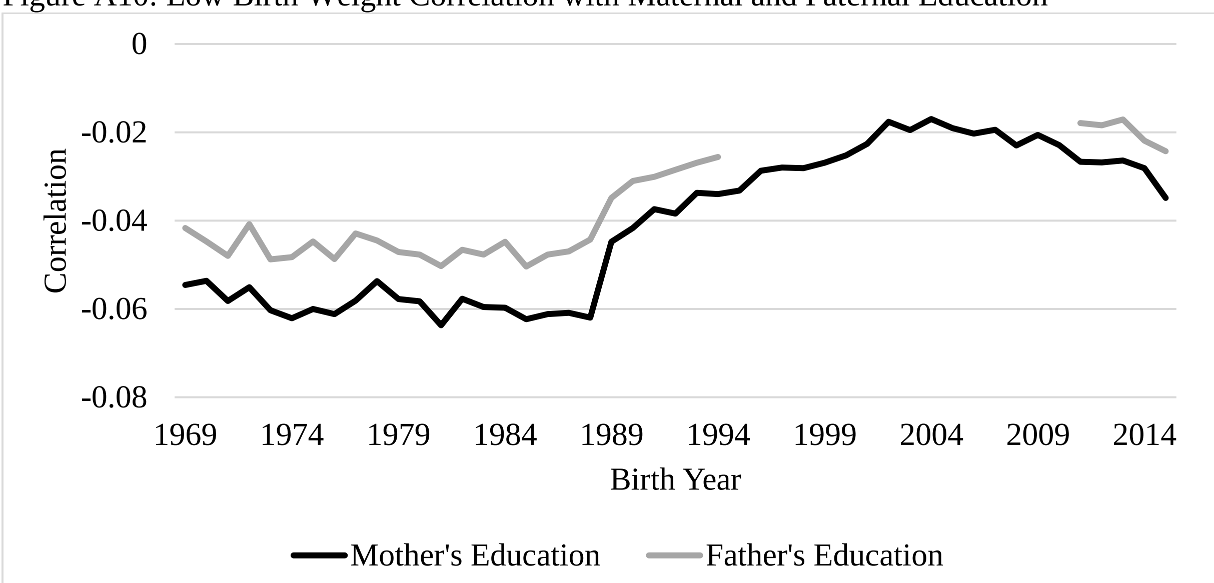
Source: NVSS Birth Data 1969-2015. Mean differences in proportion low birth weight by maternal education in each birth year.

Figure A9: Proportion Low Birth Weight Differences by Maternal Education: Standard Deviation Units



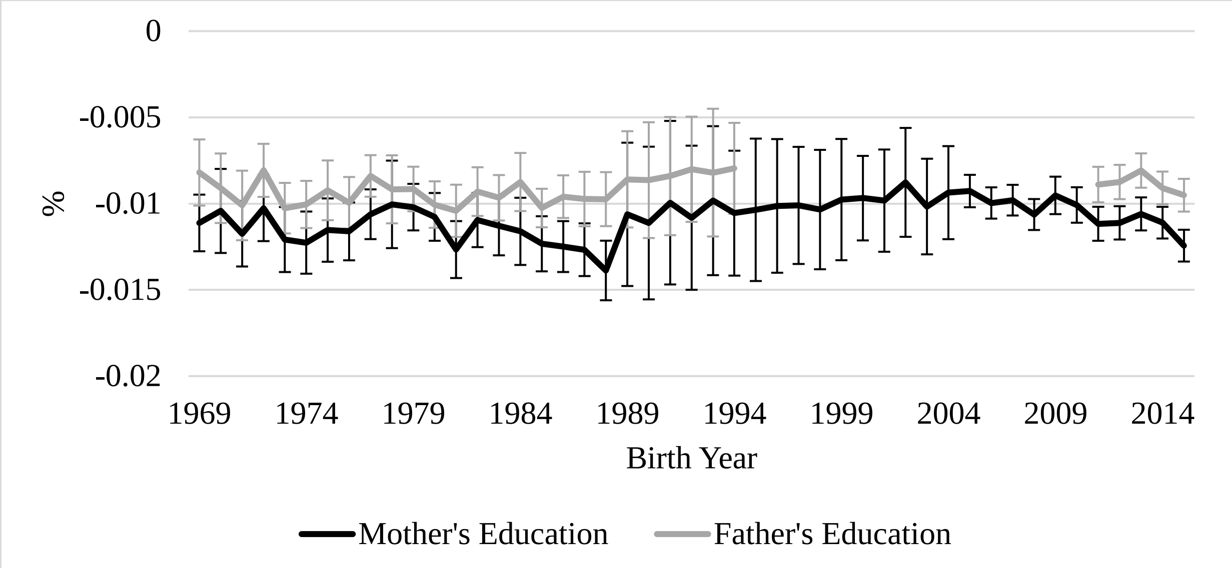
Source: NVSS Birth Data 1969-2015. Mean differences in proportion low birth weight by maternal education divided by pooled standard deviations of the two groups in each birth year.

Figure A10: Low Birth Weight Correlation with Maternal and Paternal Education



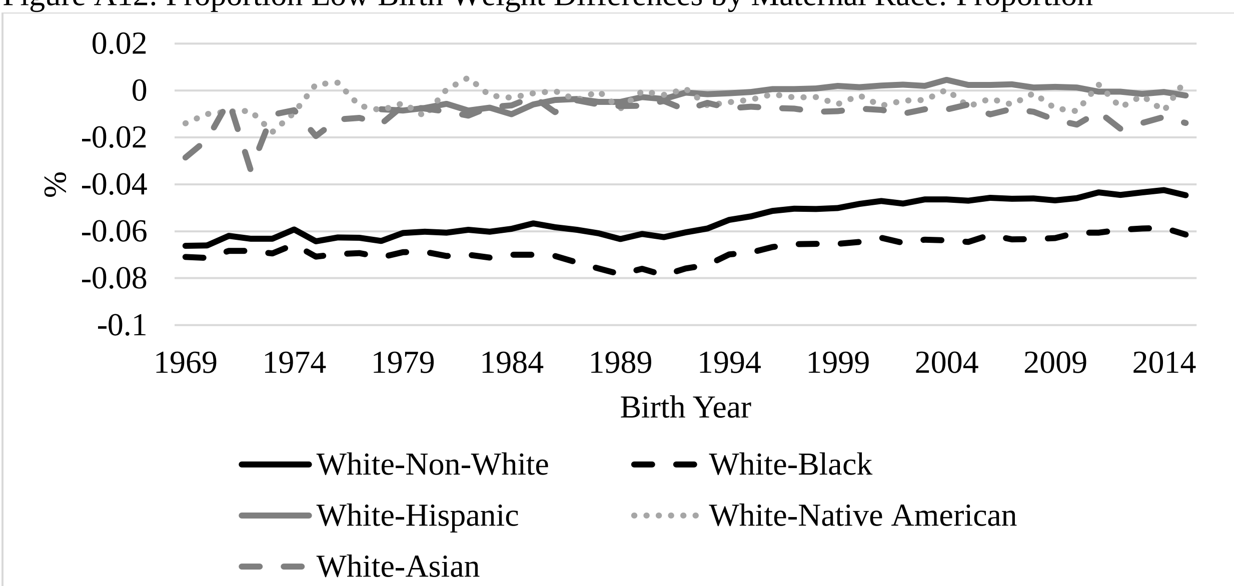
Source: NVSS Birth Data 1969-2015. Correlation between low birth weight and standardized measures of maternal and paternal years of education in each birth year.

Figure A11: Low Birth Weight Correlation with Maternal Education and Paternal Education: Adjusted for Demographics



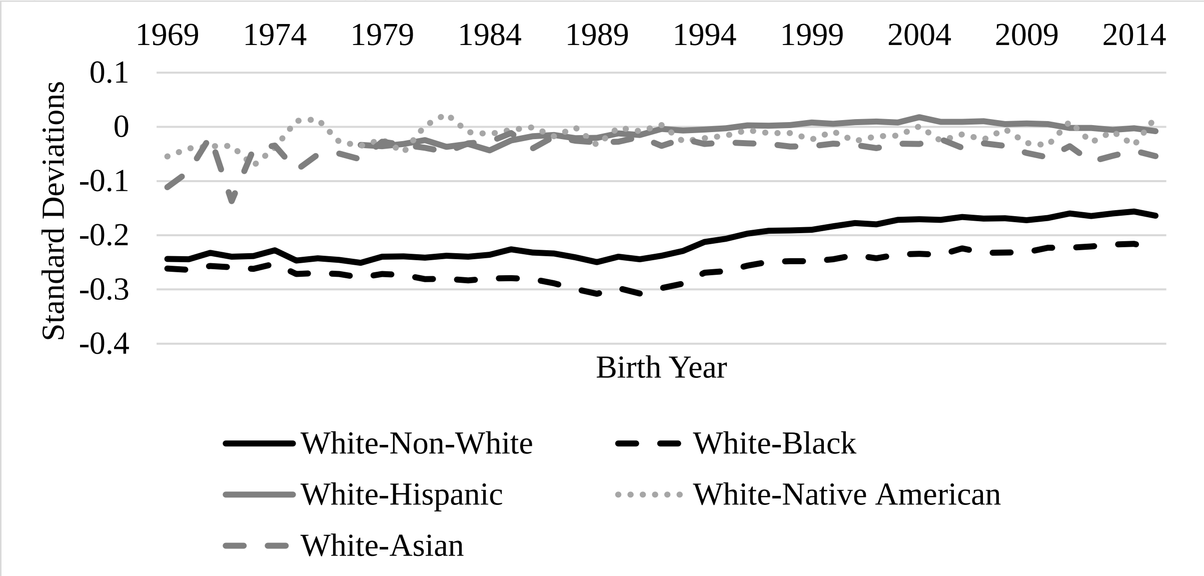
Source: NVSS Birth Data 1969-2015. Coefficient of standardized maternal and paternal years of education when predicting low birth weight in each birth year, controlling for maternal race, maternal age, child sex, and multiple birth.

Figure A12: Proportion Low Birth Weight Differences by Maternal Race: Proportion



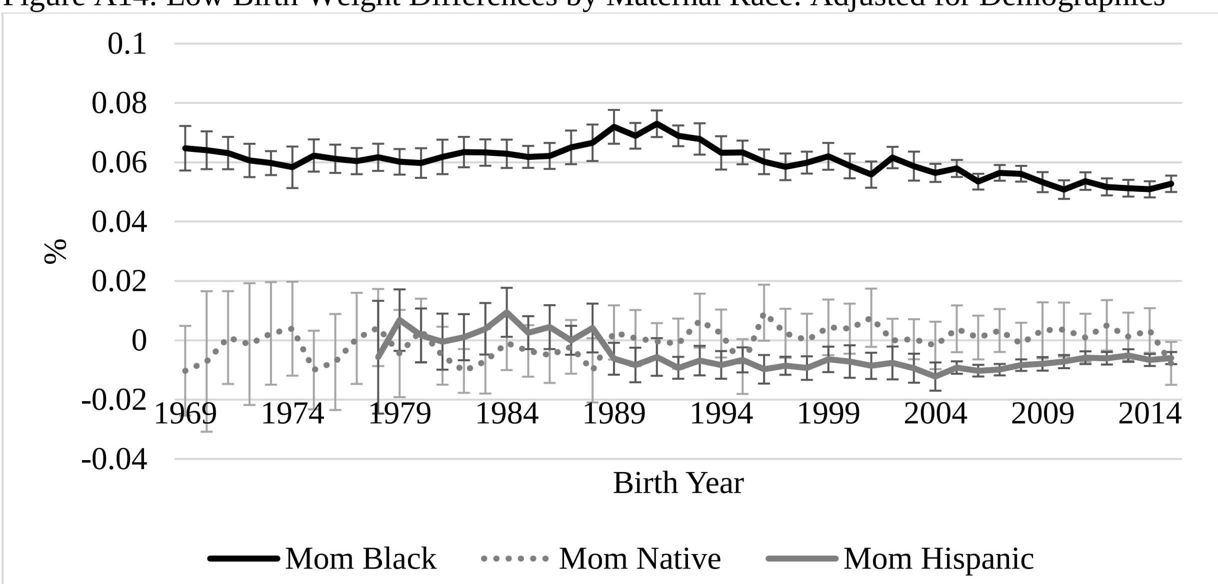
Source: NVSS Birth Data 1969-2015. Mean differences in proportion low birth weight by maternal race in each birth year.

Figure A13: Low Birth Weight Differences by Maternal Race: Standard Deviation Units



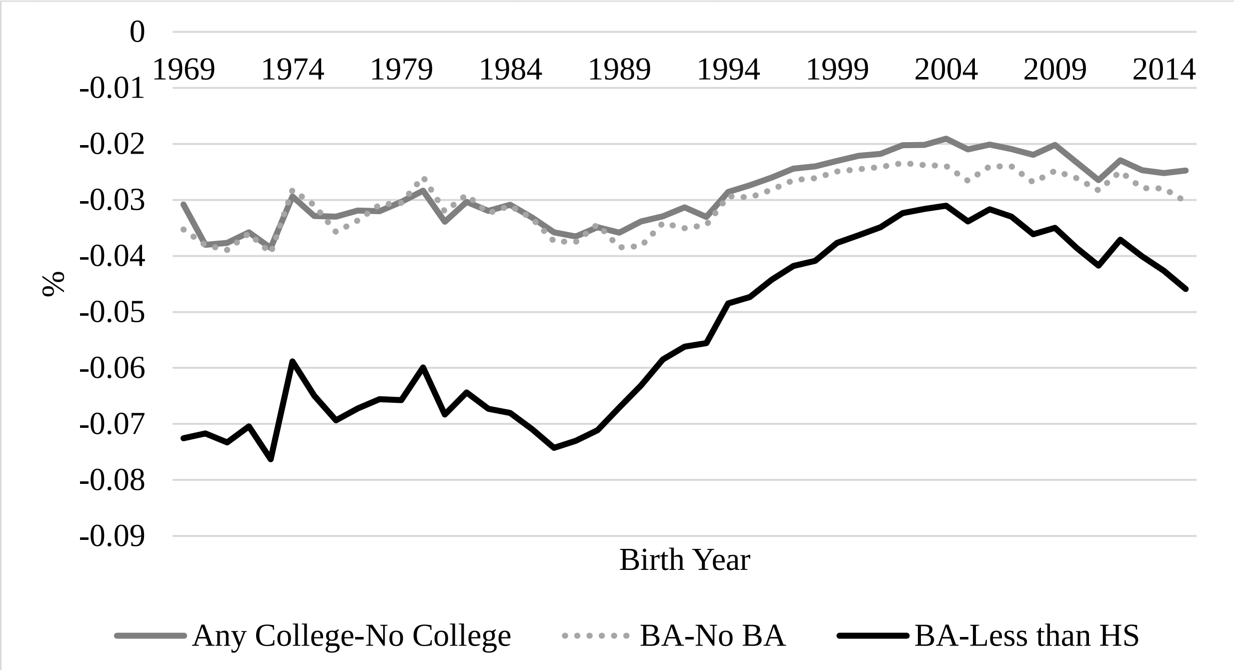
Source: NVSS Birth Data 1969-2015. Mean differences in proportion low birth weight by maternal race divided by pooled standard deviations of the two groups in each birth year.

Figure A14: Low Birth Weight Differences by Maternal Race: Adjusted for Demographics



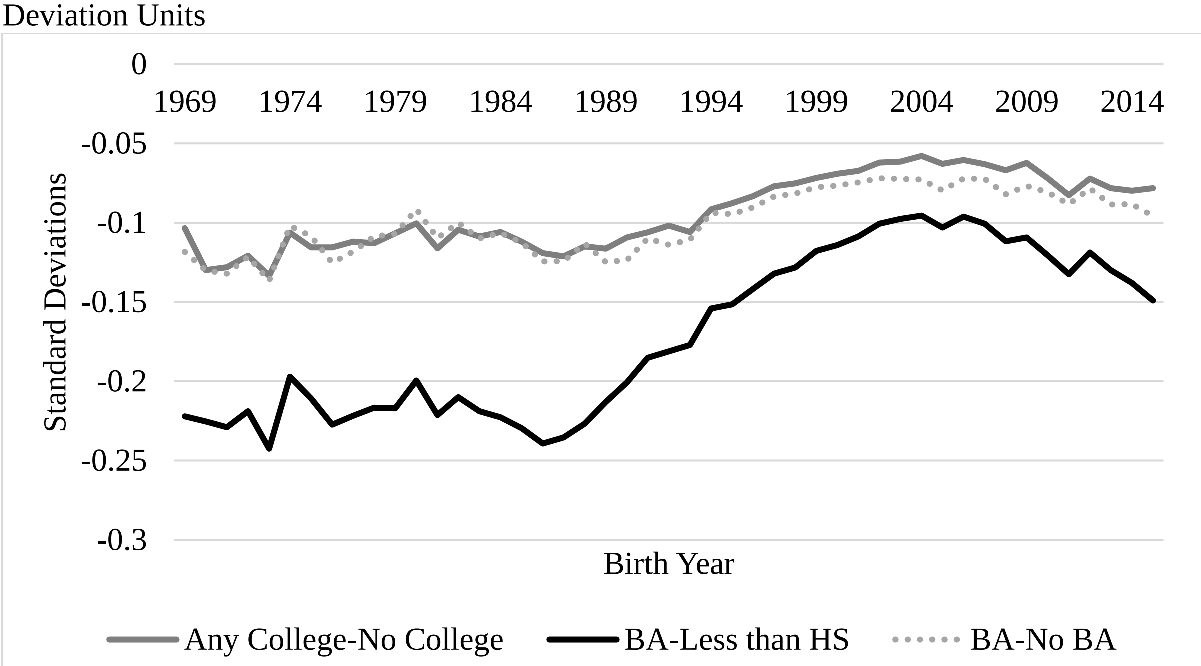
Source: NVSS Birth Data 1969-2015. Coefficient of maternal race indicators when predicting low birth weight in each birth year, controlling for maternal education, maternal age, child sex, and multiple birth.

Figure A15: Proportion Preterm Delivery Differences by Maternal Education: Percent



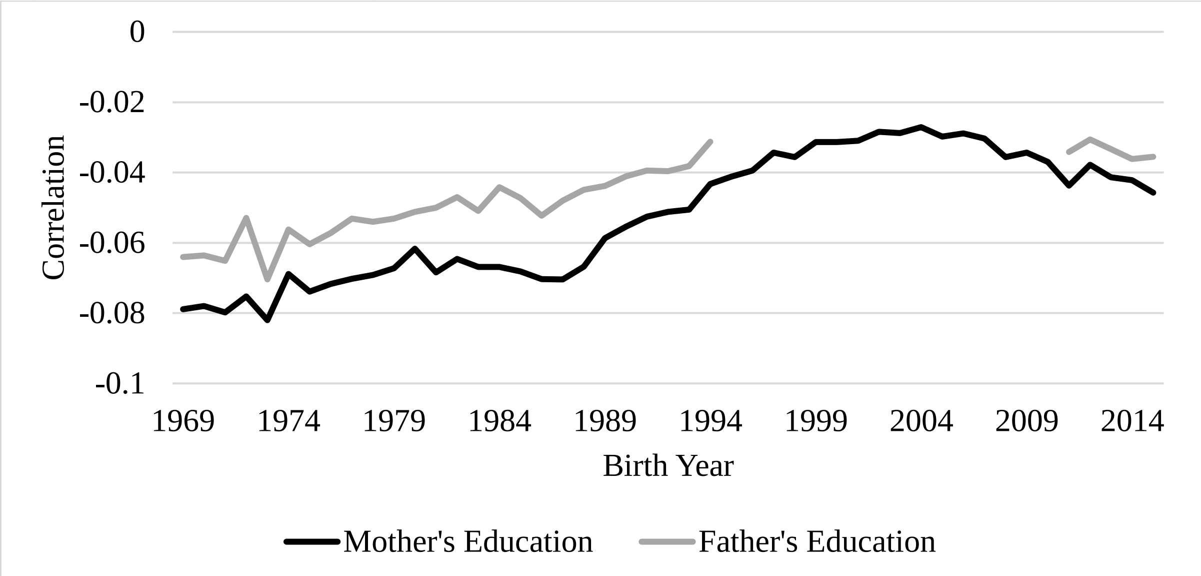
Source: NVSS Birth Data 1969-2015. Mean differences in proportion preterm delivery by maternal education in each birth year.

Figure A16: Proportion Preterm Delivery Differences by Maternal Education: Standard Deviation Units



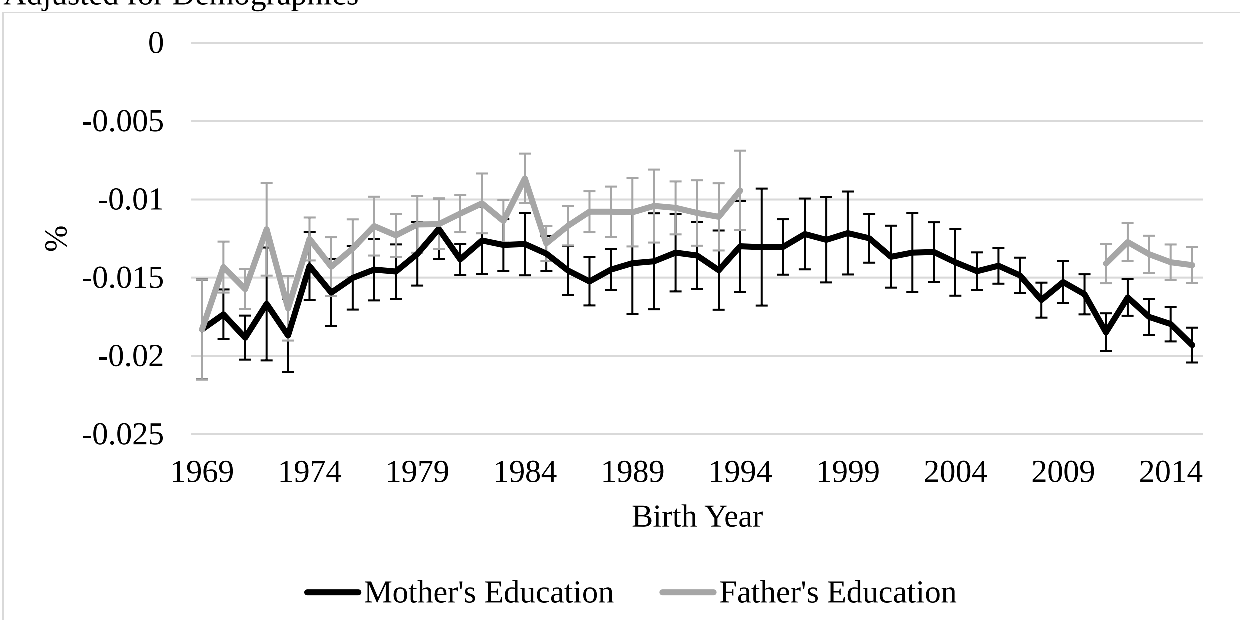
Source: NVSS Birth Data 1969-2015. Mean differences in proportion preterm delivery by maternal education divided by pooled standard deviations of the two groups in each birth year.

Figure A17: Preterm Delivery Correlation with Maternal and Paternal Education



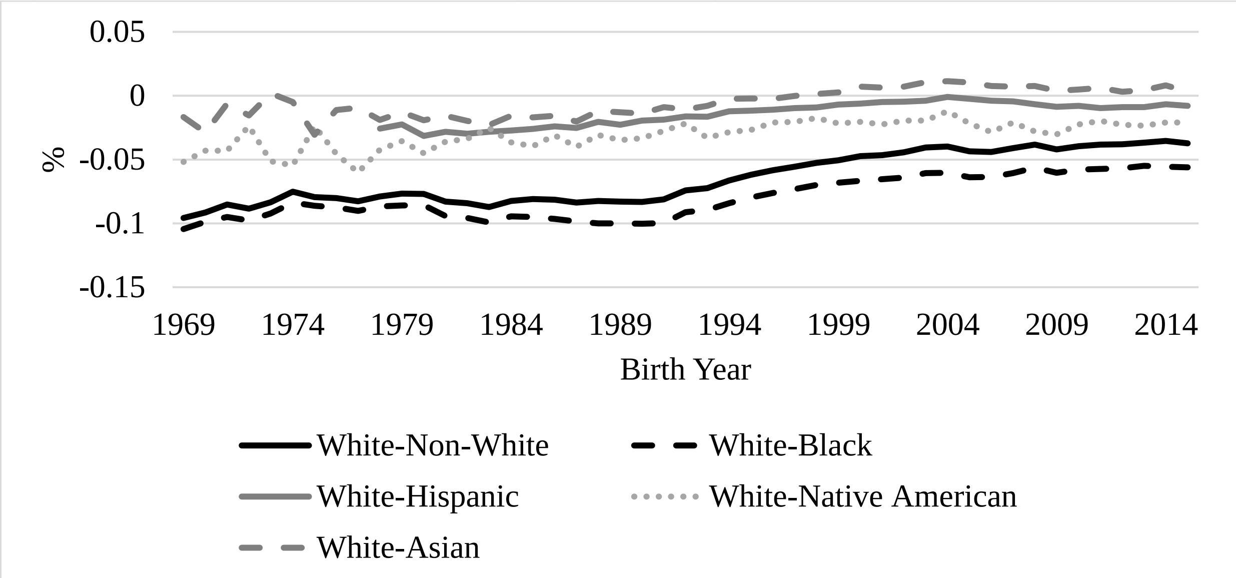
Source: NVSS Birth Data 1969-2015. Correlation between preterm delivery and standardized measures of maternal and paternal years of education in each birth year.

Figure A18: Preterm Delivery Differences by Maternal Education and Paternal Education: Adjusted for Demographics



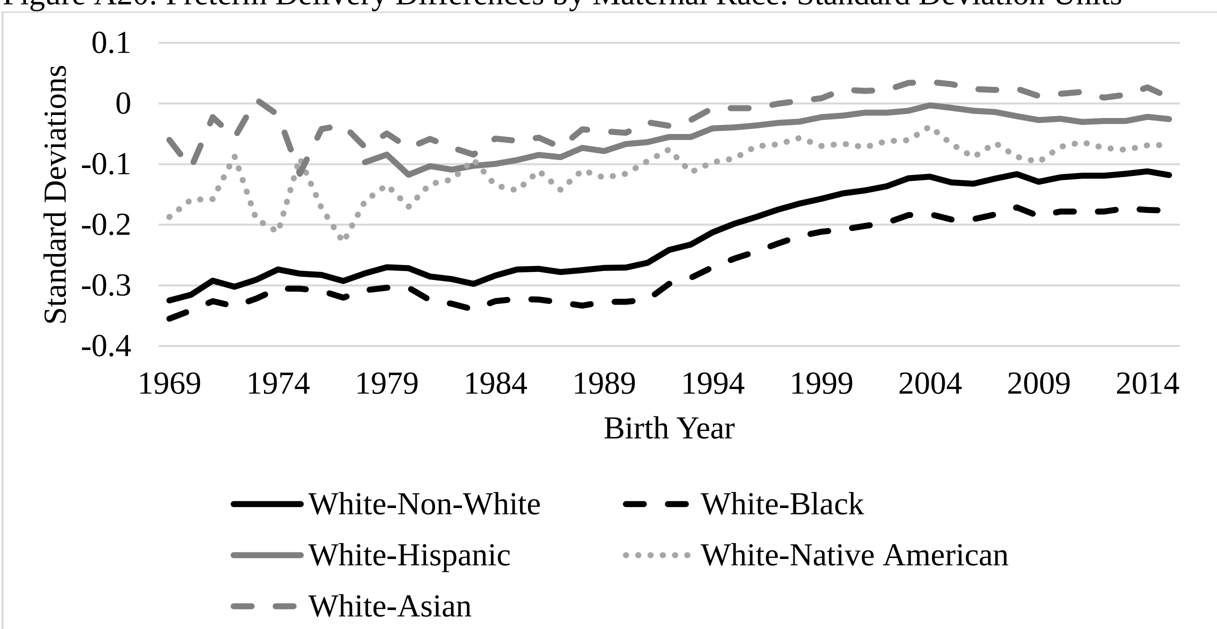
Source: NVSS Birth Data 1969-2015. Coefficient of standardized maternal and paternal years of education when predicting preterm delivery in each birth year, controlling for maternal race, maternal age, child sex, and multiple birth.

Figure A19: Proportion Preterm Delivery Differences by Maternal Race: Proportion



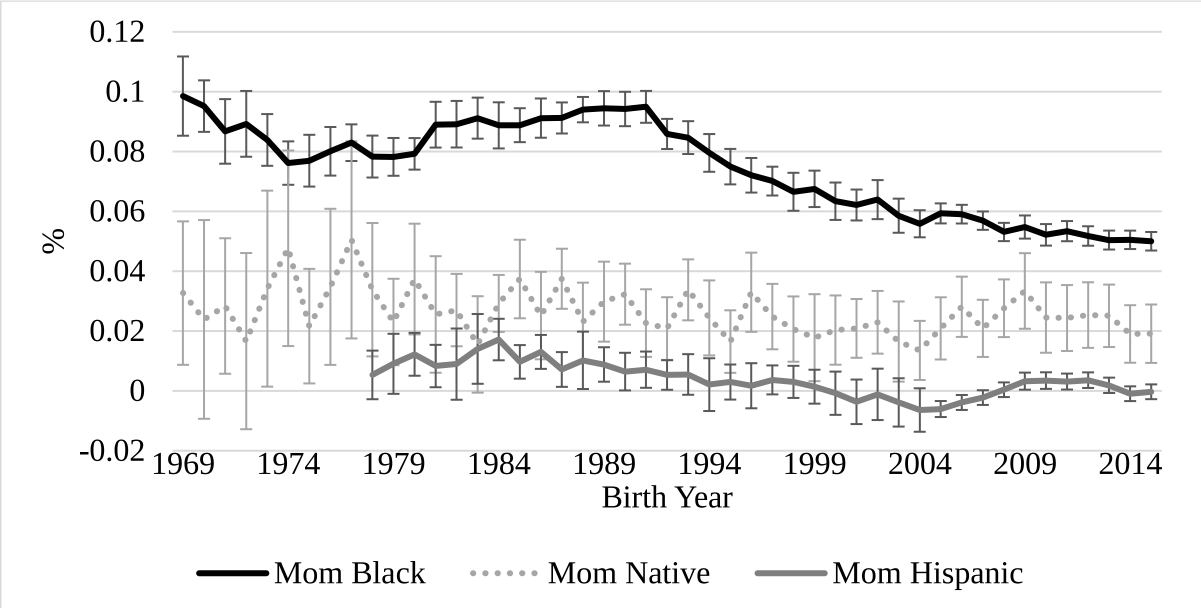
Source: NVSS Birth Data 1969-2015. Mean differences in proportion preterm delivery by maternal race in each birth year.

Figure A20: Preterm Delivery Differences by Maternal Race: Standard Deviation Units



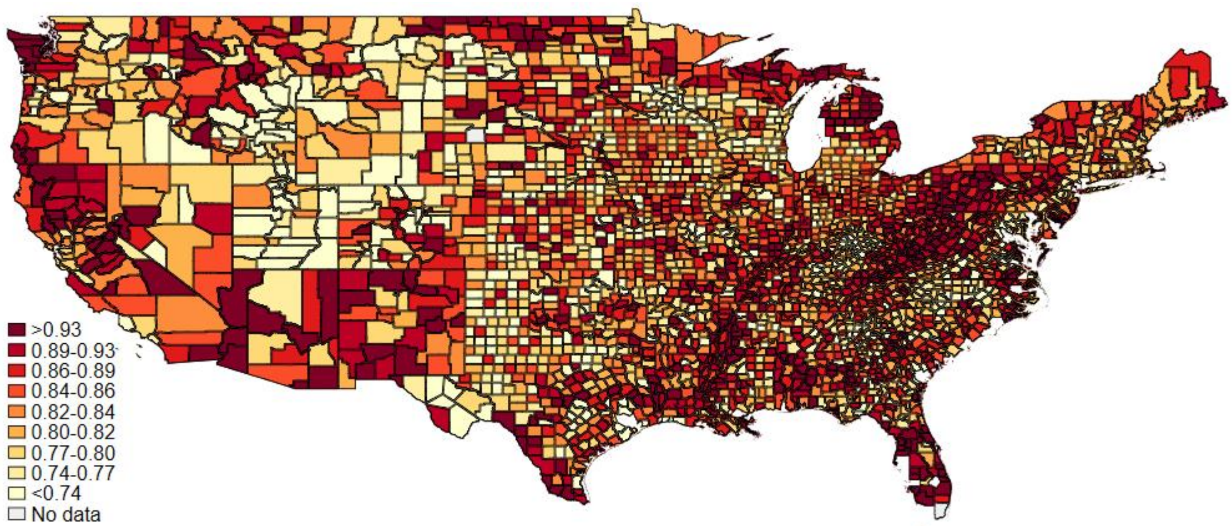
Source: NVSS Birth Data 1969-2015. Mean differences in proportion preterm delivery by maternal race divided by pooled standard deviations of the two groups in each birth year.

Figure A21: Low Birth Weight Differences by Maternal Race: Adjusted for Demographics



Source: NVSS Birth Data 1969-2015. Coefficient of maternal race indicators when predicting preterm delivery in each birth year, controlling for maternal education, maternal age, child sex, and multiple birth.

Figure A22: Income Tax Returns per Employee by County in 1990



Source: IRS tax returns by county 1990; Bureau of Labor Statistics labor force by county 1990.