

The long-term consequences of children’s health and circumstance

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Pregnancy and early childhood are especially critical periods for child development. Both nature (genes) and nurture (environment), and particularly interactions between the two, are important influences. One way that the nature-nurture interaction can work is through environment affecting how a particular gene is expressed, either mitigating or reinforcing genetic differences between individuals. There are many studies that link health at birth to future outcomes. In this article, I review some of this research, identify several factors that help explain the trends observed over time, and link the implications of these findings for policy.

Health at birth as a predictor of future outcomes

Much of the research examining the connection between health at birth and future outcomes uses birth weight as an indicator of health at birth. The primary reason for using

birth weight rather than other indicators is that it is relatively well measured, and data are available over a long time frame for diverse populations. There is also a demonstrable relationship between birth weight and adult outcomes such as earnings. Some evidence for this comes from the National Longitudinal Survey of Youth, a nationally representative longitudinal survey of Americans who were between the ages of 14 and 21 in 1978. Children of women included in this survey were themselves surveyed beginning in 1986. One study found that those with higher birth weights also had higher earnings as young adults (ages 24 through 27).¹

These relationships have also been explored in more rigorous ways, including using sibling or twin comparisons. Siblings raised together provide a natural control group because they share many aspects of family background, allowing researchers to control for characteristics that are difficult to measure, and thereby better isolate the effects of birth weight. Large-scale sibling and twin studies in the United States and elsewhere have found a connection between birth weight and education, earnings, and health. One of the first studies to use twin comparisons to examine long-term outcomes was done in Norway, using data for all births from 1967 through 1997, matched to administrative data for 1982 through 2002.² The researchers found that higher birth weight twins had better outcomes in adulthood compared to their lower birth weight siblings. For example, a twin who weighed approximately 7.5 pounds at birth is about 10 percent more likely to finish high school than a

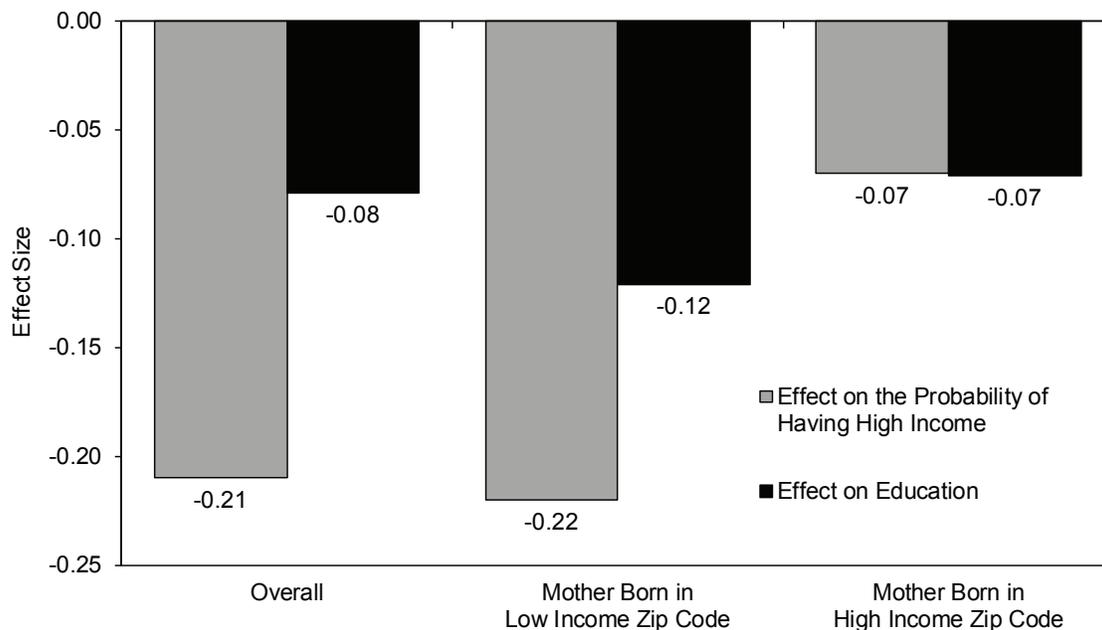


Figure 1. Effect of maternal low birth weight on mother’s adult outcomes at time of child’s birth.

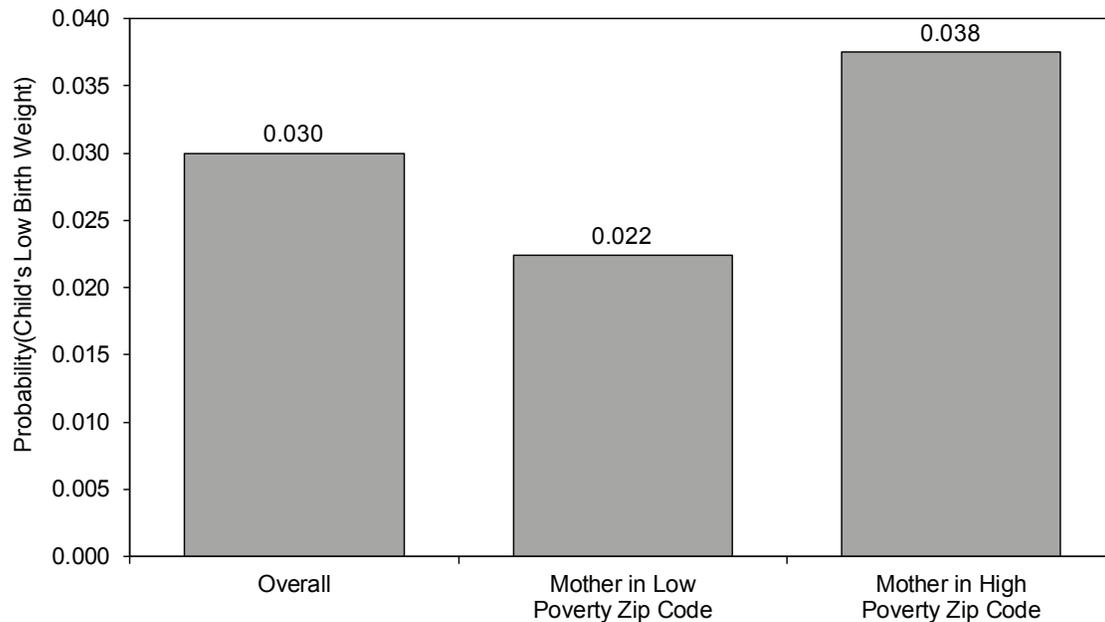


Figure 2. Effect of maternal low birth weight on probability of child having low birth weight, by characteristics of mother's current residence.

twin who weighed approximately 4 pounds. The effect sizes are similar for IQ and earnings, and slightly smaller (but still statistically significant) for adult height.

In another study, Enrico Moretti and I used data from three generations of California births, comparing mothers who are sisters, where one sister had a low birth weight and the other did not.³ Low birth weight sisters tended to have lower educational achievement compared to their higher birth weight sibling, and were more likely to live in a high-poverty zip code at the time of her own child's birth. As shown in Figure 1, these effects were stronger for women born in high-poverty zip codes; nearly all the negative effect of a mother's low birth weight is concentrated among those who were also born in a poor neighborhood. This suggests that environment plays a strong role in whether the negative effects of poor health at birth can be remediated.

If a characteristic is observed at birth and passed from one generation to the next, we tend to attribute it to genetics. However, these data on three generations of California births suggest that poor health at birth that is induced by environmental factors can be transmitted from one generation to the next, and also ameliorated by more favorable conditions.⁴ Figure 2 suggests that low birth weight can be transmitted from mother to child; the probability that a child is low birth weight is almost 50 percent higher if her mother was low birth weight, even after controlling for income or poverty levels in the mother's zip code of residence at the time of her own birth. However, the figure also shows that mothers who are in better circumstances are less likely to pass on this characteristic; the effect of maternal low birth weight is smaller if, at the time of the child's birth, the mother is living in a low-poverty zip code. This result demonstrates the important role of the maternal environment in determining a child's health at birth.

Inequalities in health at birth

The research discussed above strongly suggests that health at birth is an important aspect of child development, which influences future outcomes including earnings, employment, education, and the health of the next generation. Given this evidence, any large inequalities in health at birth are cause for concern. Figure 3 shows that there are indeed large inequalities in the incidence of low birth weight both by race and by indicators of socioeconomic status.⁵

The good news is that these inequalities seem to be diminishing over time. For example, Figure 4 shows trends in the percentage of children with low birth weight, by maternal socioeconomic status. While the incidence of low birth weight has remained steady over time for advantaged mothers (defined as those who are non-Hispanic white, married, and college educated), it has declined for disadvantaged mothers (defined as those who are African American, unmarried, and have less than a high school education), thus narrowing the gap between the two.⁶

Further evidence for health inequalities diminishing over time comes from comparison of mortality rates for children under age 4 in 1990 and 2010, by county poverty rate.⁷ Over that 20-year period, mortality fell most for the poorest counties, suggesting decreasing inequality in child mortality. There were also very large reductions in mortality among black children.

What factors can account for reductions in health inequality among infants and children?

The time trends described above pose a puzzle: evidence shows that child health is strongly linked to socioeconomic status, and inequalities in socioeconomic status have

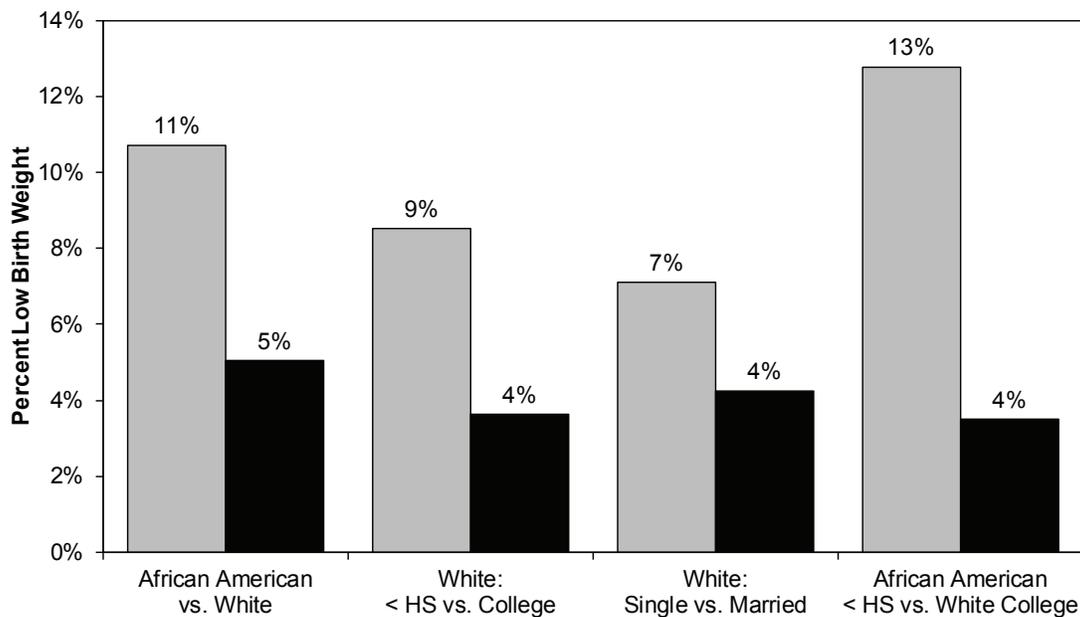


Figure 3. Percent of U.S. infants with low birth weight, by maternal characteristics, 2011.

Source: A. Aizer and J. Currie, “The Intergenerational Transmission of Inequality: Maternal Disadvantage and Health at Birth,” *Science* 344, No. 6186 (2014): 856–861.

Notes: The data come from birth certificates for 36 U.S. states with complete information for mothers ages 19 through 39. “Low birth weight” is defined as under 2,500 grams (5.5 pounds). Only single births are counted because multiple births are much more likely to be low birth weight, and many multiple births result from assisted reproductive technology. Sample sizes range from 65,184 for African American < HS, to 1,651,397 for white. Given the large sample sizes, the standard errors of the means are very small (< 0.15 percentage points).

increased over time, especially in the United States, and yet inequalities in child health have been decreasing.⁸ Below, I discuss four pieces of the puzzle that appear likely to explain at least some of the observed reductions in health inequality among infants and children: improvements in medical care, long-term improvements in maternal health, reductions in toxic environments, and changes in maternal health behaviors. Each of these seems to have improved child health, particularly for those of lower socioeconomic status, thus contributing to a reduction in children’s health inequality in spite of the concurrent increase in socioeconomic inequality.

Improvements in medical care

In the late 1980s, the United States greatly expanded public insurance for low-income pregnant women and children. Jonathon Gruber and I found that this expansion lowered the incidence of infant mortality for this disadvantaged group.⁹ More recent research has shown that the expansion has had positive long-term effects on children’s health, including on hospitalizations, mortality, and adult earnings. For example, a study looking at hospitalizations for chronic illness among black children born before and after the health care expansion found a dramatic decrease in hospitalizations for those born after the change, with the largest reductions in hospitalizations for mental illness.¹⁰ Because the population for which public insurance was expanded was by definition

disadvantaged, this reduction in hospitalizations also reflects a reduction in children’s health inequality.

Long-term improvements in maternal health

Another factor that appears linked to reducing children’s health inequality is long-term improvements in maternal health. Since healthier children become healthier adults, and healthier adults are more likely to have healthy babies, improvements in mother’s early life could lead to improved infant health.

During the 1960s and 1970s, racial inequalities in early life health were reduced dramatically, in part due to the Civil Rights Act of 1964. For example, one study found that the rate of hospital births for blacks in the South grew dramatically following the Civil Rights Act, which prohibited discrimination and segregation in public hospitals.¹¹ The study also found that this increase was correlated with substantial improvements in the relative health of black children during the decade following the federal intervention.

Do these children, who benefited from better health in infancy as a result of civil rights legislation, pass on this better health to their own children? Research suggests that they do. A study I did with Douglas Almond and Mariesa Herrmann looked at the effect of the post-neonatal

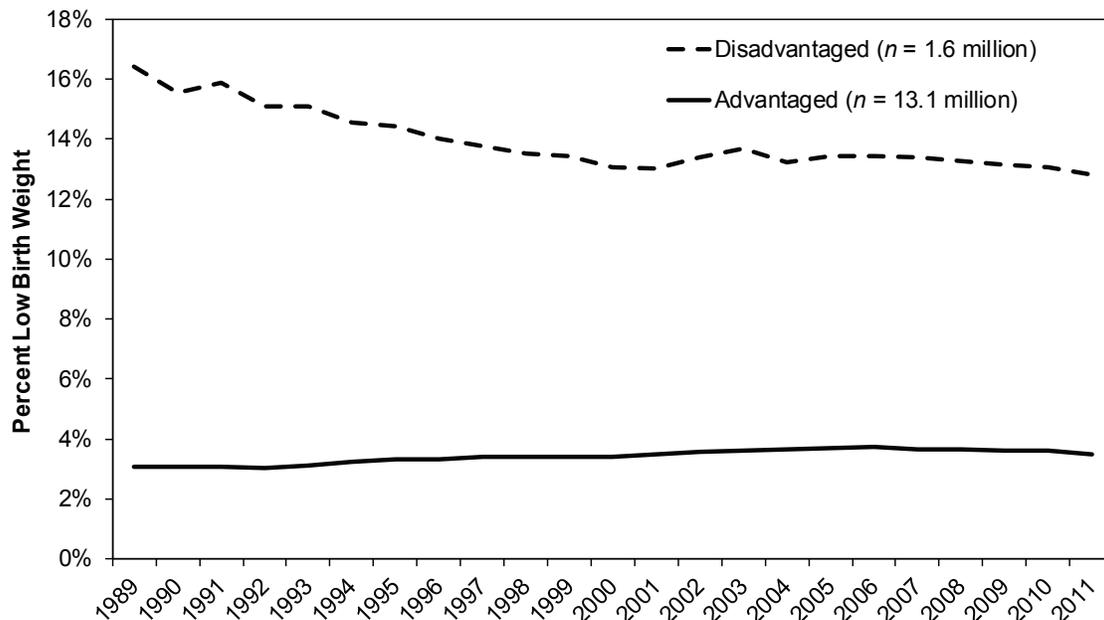


Figure 4. Trends in percent low birth weight from 1989 through 2011 by maternal socioeconomic status.

Source: A. Aizer and J. Currie, “The Intergenerational Transmission of Inequality: Maternal Disadvantage and Health at Birth,” *Science* 344, No. 6186 (2014): 856–861.

Notes: The data comes from birth certificates for 36 U.S. states with complete information, for mothers age 19 through 39. “Low birth weight” is defined as under 2,500 grams (5.5 pounds). Only single births are counted. “Disadvantaged” is defined as black, unmarried, and less than high school education. “Advantaged” is defined as non-Hispanic white, married, and college education.

environment on maternal health and infant health. We found that an indicator of the infectious disease environment at the time of the mother’s birth was associated with a higher probability of the mother having diabetes at the time she gives birth herself.¹² This probability is higher for black mothers than for white mothers. These results suggest that conditions in the mother’s childhood contribute to her health many years later when she becomes a mother, and that this can in turn affect her child’s outcomes. Thus, improvements in early childhood health for black women as a result of the Civil Rights Act could be expected to narrow children’s health inequality when those women have their own children.

Reductions in toxic environments

A third factor that has contributed to reductions in children’s health inequality is reductions in toxic environments. The Clean Air Act of 1970 set national air quality standards for six common air pollutants also called criteria pollutants: carbon monoxide, ozone, lead, nitrogen dioxide, particulate matter, and sulfur dioxide. The Toxic Release Inventory, a database compiled by the Environmental Protection Agency (EPA), began in 1990 as a result of the Emergency Planning and Community Right-to-Know Act of 1986. This act requires that factories report their emissions to the EPA if they are using any chemicals from a particular list. Although this law is not an obligation to reduce emissions, the public reporting requirement has been followed by a significant reduction of the six criteria pollutants identified in the Clean Air Act.¹³

Disadvantaged mothers are more likely to be exposed to pollution, as they are more likely to live near busy roads, Superfund hazardous waste sites, and factories with toxic emissions.¹⁴ Again, there are differences by race and ethnicity. Some 40 percent of white mothers live within 2,000 meters of a Toxic Release Inventory site, an industrial site using amounts of specified chemicals that exceed threshold levels; among black mothers, 60 percent live near a site.¹⁵

The existing literature does not provide full information about which pollutants are harmful, nor about how close a home needs to be to one of these factories for there to be any negative health effect. In order to address these questions, Lucas Davis, Michael Greenstone, Reed Walker, and I used birth records from five large states, linked to information about the openings and closings of 1,600 plants known to have emitted toxic chemicals.¹⁶ We found that many pollutants can be detected up to one mile from the site of origin. We then compared infants whose families lived within one mile of an operating Toxic Release Inventory plant to infants whose families lived one to two miles from a plant.¹⁷ We found a significantly higher incidence of low birth weight for infants whose families lived within one mile of an operating plant.

Combining these findings—that black mothers are more likely to live near a Toxic Release Inventory site, and that infants whose families live near a plant are more likely to have a low birth weight—we estimate that about 6 percent of

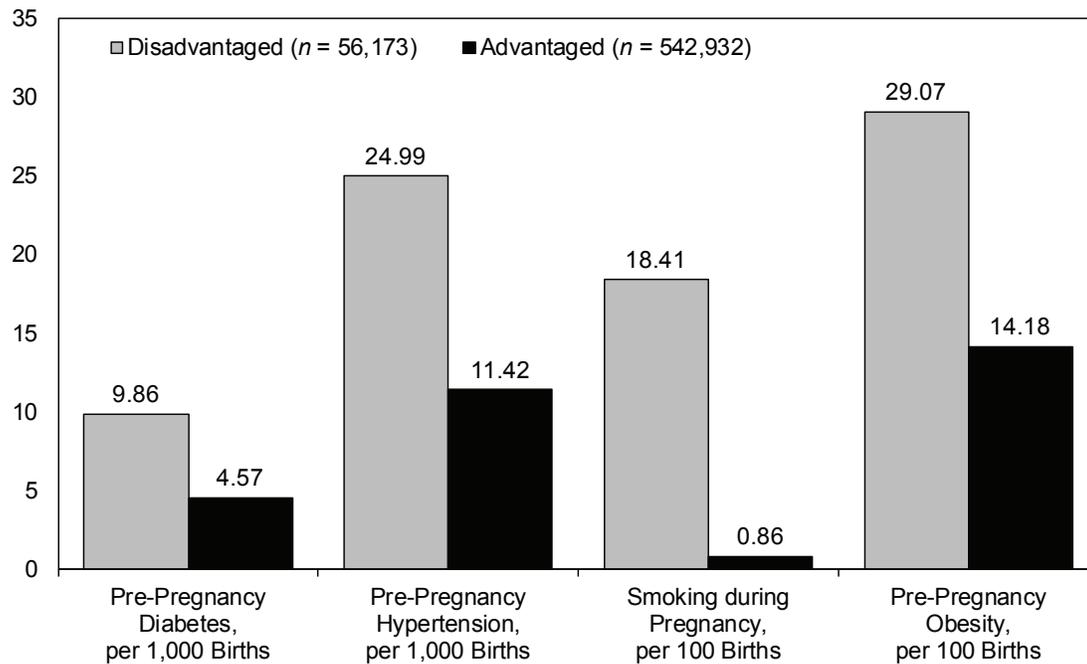


Figure 5. Differences in maternal health and behavior by maternal socioeconomic status.

Source: A. Aizer and J. Currie, “The Intergenerational Transmission of Inequality: Maternal Disadvantage and Health at Birth,” *Science* 344, No. 6186 (2014): 856–861.

Notes: The data comes from birth certificates for 36 U.S. states with complete information, for mothers age 19 through 39. “Low birth weight” is defined as under 2,500 grams (5.5 pounds). Only single births are counted. “Disadvantaged” is defined as black, unmarried, and less than high school education. “Advantaged” is defined as non-Hispanic white, married, and college education. Given the large sample sizes, the standard errors of the means are very small (<0.2 units). Note that basis of rates varies by indicator, as specified in axis labels.

the gap in low birth weight incidence between white college-educated mothers and black high school dropout mothers could be due to differential exposure to pollutants. Thus, reductions in pollution as a result of increased environmental regulation could be expected to reduce this gap.

Reductions in unhealthy behaviors

The final factor that has contributed to reductions in children’s health inequality is a reduction in unhealthy maternal behaviors. Behaviors that can be measured on the birth certificate include the use of prenatal care, weight gain during pregnancy, and smoking. It is also possible to observe whether mothers have obesity, hypertension, and diabetes. There are large differences in maternal health and behavior by socioeconomic status, as shown in Figure 5. The most economically disadvantaged mothers (those who are black, unmarried, and have less than a high school education) are more likely to have diabetes, hypertension, smoke during pregnancy, or be obese, compared to the most economically advantaged mothers (those who are non-Hispanic white, married, and college educated).¹⁸ Again, these gaps are changing over time; for example, although disadvantaged women are much more likely to smoke during pregnancy than more advantaged women, this difference has narrowed over time. Anti-smoking policies, including cigarette taxes and bans on smoking in the workplace, while reducing smoking in general, have also helped to reduce

this smoking gap. These reductions in smoking gaps over time also match up well with trends in diminishing low birth weight gaps. These matching trends are not surprising, given earlier research showing that smoking during pregnancy has negative effects on child birth weight.¹⁹

Other behavior trends have not had as positive trajectories. Extremes of weight gain during pregnancy (either very low weight gain or very high weight gain), for example, have both been trending upwards over the past two decades, and are both associated with negative pregnancy outcomes.²⁰

Other factors that may reduce children’s health inequality

In addition to the four factors discussed above—increased access to medical care, improved maternal health, and reduction in toxic environments and unhealthy maternal behaviors—other recent work has suggested additional reasons for reduction in health inequality at birth in the face of increasing economic inequality. Initiatives such as nutrition programs, income transfers, and child care programs have all been found to have a positive effect on infant health, particularly for those of lower socioeconomic status. For example, the rollout of the Food Stamp Program in the 1960s and early 1970s was found to have improved birth outcomes for both white and black mothers, with larger effects among black mothers.²¹ Another study found that the Earned Income Tax Credit reduced the incidence of low birth

weight and increased mean birth weight, with larger effects on births to black mothers.²² Finally, an examination of two early childhood interventions targeted to disadvantaged children, the Perry Preschool Project and the Abecedarian Project, found that both interventions had positive effects on the healthy behavior and health of their participants.²³

Conclusions

Health at birth is very strongly linked to socioeconomic status, but inequalities in economic status have increased over the last 25 years, especially in the United States, while inequalities in the health of young children have decreased. This trend suggests that we do not need to be resigned to health inequalities, but rather that public policy can work with the family to improve health outcomes for disadvantaged women and their children even when family incomes are stagnant.

Improvements in medical care, long-term improvements in maternal health, reductions in toxic environments, and changes in maternal health behaviors have all been partly responsible for reducing inequality in child health. I think that the specific policies within these broader areas that are most responsible for this reduction are improvements in access to medical care for both mothers and children; reductions in pollution; and reductions in smoking due to cigarette taxes, smoking bans, and other anti-smoking public policies. ■

¹J. Currie, "Inequality at Birth: Some Causes and Consequences," *American Economic Review* 101, No. 3 (May 2011): 1–22.

²S. E. Black, P. J. Devereux, and K. G. Salvanes, "From the Cradle to the Labor Market? The Effect of Birth Weight on Adult Outcomes," *The Quarterly Journal of Economics* 122, No. 1: pp. 409–439.

³J. Currie and E. Moretti, "Biology as Destiny? Short- and Long-Run Determinants of Intergenerational Transmission of Birth Weight," *Journal of Labor Economics* 25, No. 2: pp. 231–263.

⁴Currie and Moretti, "Biology as Destiny?"

⁵A. Aizer and J. Currie, "The Intergenerational Transmission of Inequality: Maternal Disadvantage and Health at Birth," *Science* 344, No. 6186 (May 2014): 856–861.

⁶Aizer and Currie, "The Intergenerational Transmission of Inequality."

⁷J. Currie and H. Schwandt, "Inequality in Mortality Decreased Among the Young While Increasing for Older Adults, 1990–2010," *Science* 352, No. 6286 (May 2016): 708–712.

⁸For evidence that inequalities in socioeconomic status have increased over time, see, for example: D. H. Autor, "Skills, Education, and the Rise of Earnings Inequality Among the 'Other 99 Percent'," *Science* 344, No. 6186 (May 2014): 843–851.

⁹J. Currie and J. Gruber, "Saving Babies: The Efficacy and Cost of Recent Changes in the Medicaid Eligibility of Pregnant Women," *Journal of Political Economy* 104, No. 6 (1996): 1263–1296.

¹⁰L. R. Wherry, S. Miller, R. Kaestner, and B. D. Meyer, "Childhood Medicaid Coverage and Later Life Health Care Utilization," NBER Working Paper No. 20929, National Bureau of Economic Research, February 2015. <http://www.nber.org/papers/w20929>

¹¹K. Y. Chay and M. Greenstone, "The Convergence in Black–White Infant Mortality Rates During the 1960's," *American Economic Review* 90, No. 2 (2000): 326–332.

¹²D. Almond, J. Currie, and M. Herrmann, "From Infant to Mother: Early Disease Environment and Future Maternal Health," NBER Working Paper No. 17676, National Bureau of Economic Research, December 2011. <http://www.nber.org/papers/w17676>

¹³Information about air quality standards and trends for the six common air pollutants known as criteria pollutants can be found at <http://www.epa.gov/airtrends/>.

¹⁴J. Currie, "Inequality at Birth: Some Causes and Consequences," NBER Working Paper No. 16798, National Bureau of Economic Research, February 2011. <http://www.nber.org/papers/w16798>

¹⁵Based on 1989–2003 data from five states: Texas, New Jersey, Michigan, Pennsylvania, and California.

¹⁶J. Currie, L. Davis, M. Greenstone, and R. Walker, "Do Housing Prices Reflect Environmental Health Risks? Evidence from More than 1600 Toxic Plant Openings and Closings," NBER Working Paper No. 18700, National Bureau of Economic Research, January 2013. <http://www.nber.org/papers/w18700>

¹⁷We would expect both groups in this case to be similarly affected by the labor market and economic effects of a plant opening or closing.

¹⁸Aizer and Currie, "The Intergenerational Transmission of Inequality."

¹⁹E. Tominey, "Maternal Smoking During Pregnancy and Child Birth Weight," CEPDP, 828. Centre for Economic Performance, London School of Economics and Political Science, London, UK, 2007.

²⁰W. Lin, "Why has the Health Inequality Among Infants in the U.S. Declined? Accounting for the Shrinking Gap," *Health Economics* 18, No. 7 (2008): 823–841.

²¹D. Almond, H. W. Hoynes, and D. W. Schanzenbach, "Inside the War on Poverty: The Impact of Food Stamps on Birth Outcomes," *The Review of Economics and Statistics* 93, No. 2 (May 2011): 387–403.

²²H. Hoynes, D. Miller, and D. Simon, "Income, the Earned Income Tax Credit, and Infant Health," *American Economic Journal: Economic Policy* 7, No. 1 (2015): 172–211. <http://dx.doi.org/10.1257/pol.20120179>

²³G. Conti, J. Heckman, and R. Pinto, "The Effects of Two Influential Early Childhood Interventions on Health and Healthy Behaviors," IZA DP No. 9247, Institute for the Study of Labor, August 2015. <http://ftp.iza.org/dp9247.pdf>