Promoting Health in Early Childhood

Maya Rossin-Slater

Summary

Children who are healthy early in life—from conception to age five—not only grow up to be healthier adults, they are also better educated, earn more, and contribute more to the economy. The United States lags behind other advanced countries in early childhood health, threatening both the health of future generations and the nation's long-term economic viability.

Moreover, unhealthy childhoods are not evenly distributed. An accounting of early childhood health in the United States reveals stark inequalities along racial/ethnic and socioeconomic lines. Because of the strong connection between early health and adult outcomes, early childhood offers a critical window to improve disadvantaged children's life chances through evidence-based interventions and thereby to reduce inequality. Restricting her review to studies that can plausibly show causation, Maya Rossin-Slater examines the evidence behind a variety of programs and policies that target any of three groups: women at risk of getting pregnant, pregnant women, or children through age five.

She finds that some programs and policies have failed to show consistent results. But the good news is that others are quite effective at improving early childhood health. The most successful include the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), universal immunization, and high-quality, center-based early childhood care and education. Economic analyses reveal that these programs' benefits outweigh their costs, suggesting that public spending to support them is more than justified.

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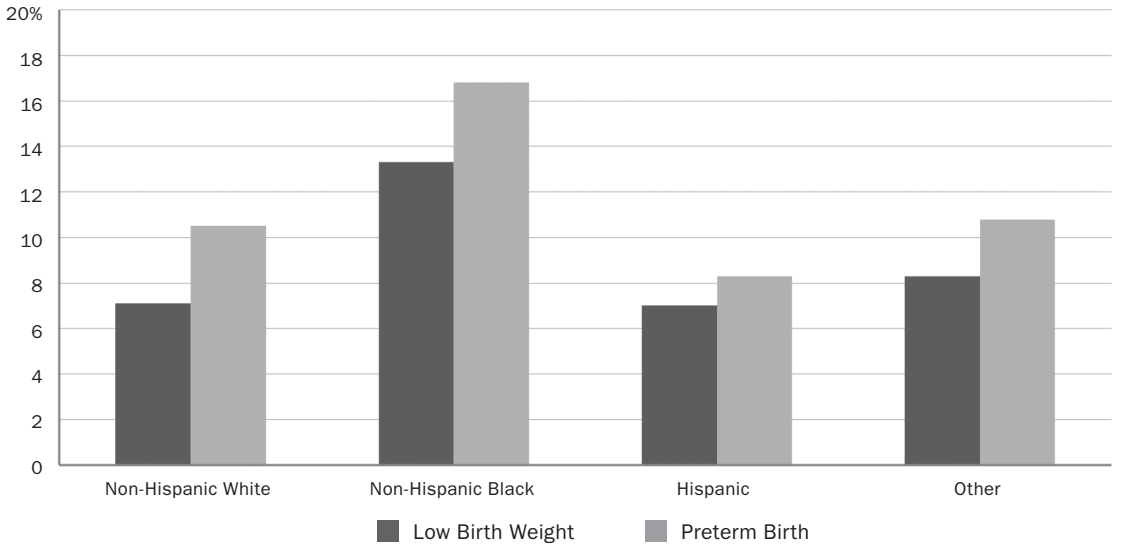
Though it's among the wealthiest countries in the world, the United States fares relatively poorly by standard indicators of early childhood health. For example, according to the U.S. Centers for Disease Control and Prevention (CDC), the U.S. infant mortality rate was ranked 32nd among the 34 countries of the Organization for Economic Cooperation and Development in 2010.[1] Similarly, the World Health Organization reports that the U.S. preterm birth rate (defined as birth at less than 37 weeks of gestation) ranks 130th out of 184 countries.[2]

One important reason is the United States' higher cross-group inequality relative to similarly wealthy countries. For instance, figure 1 shows that relative to other races and ethnicities, non-Hispanic white mothers exhibit the lowest rates of low birth weight (defined as less than 2,500 grams) and preterm birth: 7.1 and 10.5 percent, respectively. In contrast, among non-Hispanic African-American mothers, 13.3 percent of children are born with low birth weight and 16.8 percent are born preterm (90 and 70 percent higher than non-Hispanic whites, respectively). Figure 2 shows the relationship between infant health and other markers of socioeconomic status—unmarried mothers with low education levels experience higher rates of adverse birth outcomes relative to their married, more educated counterparts.

These facts, together with growing evidence that early childhood health affects well-being throughout life, suggest that the U.S. disadvantage in early-life health may have profound consequences not only for our well-being, but also for our economic growth and competitiveness.[3] Policies that target early-life conditions, especially among vulnerable populations, could help reverse this trend and reduce inequality.[4]

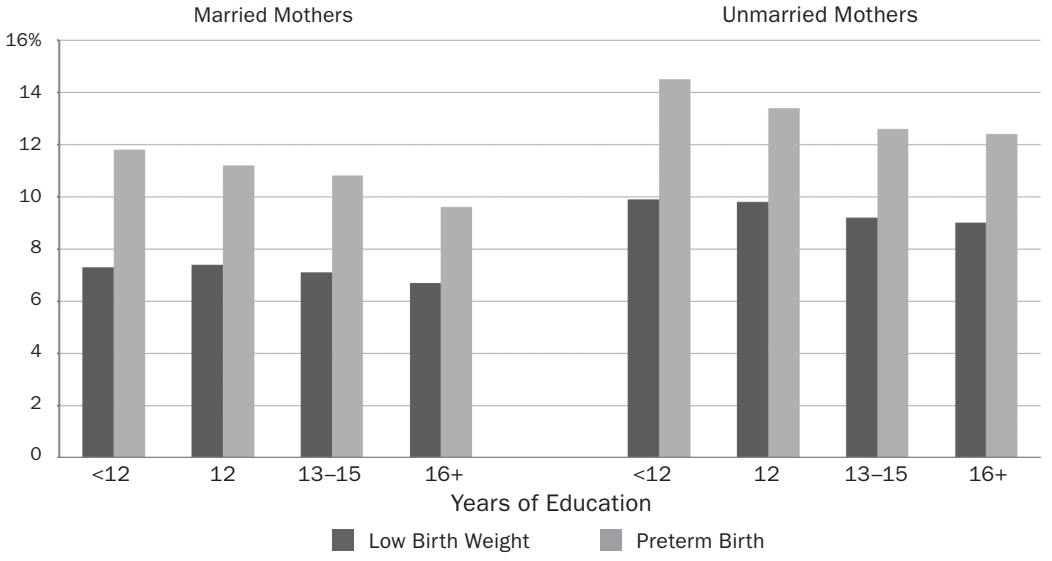
The United States has many policies to improve early-life conditions and health. These include preconception care and family planning, prenatal care, the Special Supplemental Program for Women, Infants,

Figure 1. Disparities in Birth Outcomes by Mothers' Race/Ethnicity, 2011



Source: Author's calculations using National Center for Health Statistics natality records on all 2011 births.

Figure 2. Disparities in Birth Outcomes by Mothers' Years of Education and Marital Status, 2011



Source: Author's calculations using National Center for Health Statistics natality records on all 2011 births.

and Children (WIC), family leave, universal vaccination programs, early childhood programs such as Head Start, and public education campaigns. These programs vary in structure and scope—for example, WIC targets the nutrition of pregnant women and young children by distributing vouchers to buy healthy foods, while early childhood education programs provide center-based care with curricula designed to develop cognitive and noncognitive skills among preschool children.

How effective are these programs, and how might they impact people throughout the life cycle? To answer these questions, I first discuss research on the link between early-life health and lifelong outcomes. Next, I review the effectiveness of interventions that target the early-life environment.

Because research on early-life wellbeing is extensive, I had to carefully choose what to cover. First, I focus on human development from conception to age five. Throughout this article, the terms "early life" and "early childhood" refer to this period and are used interchangeably.

Second, I discuss only programs that directly target any of three groups: women at risk of becoming pregnant, pregnant women, and children through age five. I don't review the many policies that don't explicitly target early-life conditions but can nevertheless affect them. For example, I don't discuss the Supplemental Nutrition Assistance Program (SNAP, commonly known as food stamps) or Temporary Assistance for Needy Families (TANF). Similarly, I don't review how environmental regulation impacts early-life circumstances, though many researchers have shown a link between environmental conditions such as air pollution and early-life health.

Third, I don't cover some policies that target early-life health but are reviewed in detail

elsewhere in this issue. For example, Lindsey Leininger and Helen Levy discuss health insurance, and Lonnie Berger and Sarah Font discuss programs that promote parenting skills, such as nurse home visiting initiatives, as well as income assistance and cash transfer programs.

Fourth, I constrain my review of the link between early-life health and adult outcomes to studies that use empirical designs that can plausibly show causation. Similarly, I describe only programs and policies that have been evaluated with such designs. This issue is particularly important for evaluating programs and policies because program participants (or individuals covered by a particular policy) are usually not randomly selected. For example, pregnant women receiving WIC benefits have lower incomes and lower education levels, on average, than other pregnant women. A naïve comparison of the birth outcomes of WIC participants and nonparticipants can't isolate WIC's causal effects from those of the women's other background characteristics that might also affect infant wellbeing. Therefore, I limit the discussion to interventions that have either had randomized evaluations or been studied using empirical methods that attempt to control for nonrandom selection. I briefly describe some of these empirical methods below.

Fifth, I restrict my review to articles and reports published since 1994, as well as working papers that have not yet been published.

This article delivers three key takeaways. The first is that the relationship between early-life conditions and wellbeing throughout the life course is strong. Many studies have documented a causal link between early-life health and adult outcomes, including health, educational attainment, employment, and socioeconomic status more broadly. This relationship is economically meaningful. For instance, one of the most comprehensive studies, using birth weight as a marker of early-life health, found that increasing a child's birth weight from 2,500 grams (the cutoff for low birth weight) to the U.S. national average of 3,300 grams would lead to a 3 percent increase in adult full-time earnings.[5]

The fact that early-life health has such far-reaching consequences points to the potential value of policies that can improve early-life conditions. However, the second takeaway of this article is that the success of current U.S. policies varies. Some of the most effective programs are WIC, universal immunization programs, and high-quality, center-based early childhood care and education. In contrast, other policies, such as prenatal care and family leave, have shown less consistent results.

The third takeaway is that, among policies that affect early-life health, the benefits tend to outweigh the costs. For instance, my calculations suggest that a lower bound on the benefit-cost ratio of WIC based on its impacts on birth weight alone is between 0.2 and 2.2, implying that the true ratio is likely to be greater than one. Early-life medical interventions are even more cost-effective—for example, U.S. childhood immunizations are estimated to have a benefit-cost ratio greater than 10. Finally, many intensive center-based early childhood care programs are estimated to have benefit-cost ratios of 2 or 3 to 1.

This article proceeds as follows. First I discuss conceptual models of how early-life factors can affect outcomes throughout life.

Next, I briefly describe some of the common approaches used to analyze the data. Then I review the empirical evidence on the long-term impacts of early-life health. The next section discusses studies on the effectiveness of some existing programs that target in utero and early childhood health and circumstances. Finally, I conclude with a discussion of cost-benefit comparisons across policies.

Conceptual Models

The idea that early-life conditions can have lasting consequences on lifelong human welfare was most famously put forth by David J. Barker, a British physician and epidemiologist, who coined the phrase "fetal origins hypothesis." Barker argued that adverse in utero conditions can "program" a fetus to have metabolic characteristics that are associated with future disease.[6] The hypothesis suggests that the health consequences of fetal conditions are both persistent and possibly latent—individuals may not experience any adverse effects (such as heart conditions) until middle age.

This idea has been a catalyst for researchers in many disciplines to adopt a "life course" approach to human development. The "life course" framework highlights how biological, behavioral, and psychosocial processes that operate throughout an individual's life can accumulate to influence health and disease risk at older ages.[7] Exposures and shocks during gestation and in early childhood are central components of this approach.

James Heckman and co-authors have formalized this perspective using a human capital model, with several stages of childhood.[8] The model's key idea is that skills produced at one stage raise the productivity of investments in later stages—that is, skills beget skills. The model predicts that returns to investments in early childhood are higher than returns to investments later in life. Furthermore, the return to later investments may depend on the earlier investments.

Early-life investments may be especially important for at-risk children in low-income families. These children often experience substantial chronic stress, in the womb and after birth. Exposure to stress can alter children's neurodevelopment, affecting their ability to concentrate, remember things, or focus their thinking. All of these skills are essential to wellbeing throughout life. Thus early-life investments that can undo some of the neurobiological damage caused by chronic stress may be critical for improving poor children's life chances.[9]

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In sum, researchers across a wide range of disciplines believe that early-life health helps determine lifelong wellbeing. Below, I discuss the empirical evidence on this relationship and describe evaluations of existing policies targeting early-life conditions. First, however, I discuss issues related to inferring causality in these analyses.

Empirical Approaches

The studies I describe below try to answer questions such as "How does early-life health affect adult earnings?" and "How does Head Start affect measures of children's cognitive

ability?" To answer questions like these, we would like to understand causal relationships between two or more factors or variables. A causal relationship is especially useful for making predictions about what will happen if circumstances or policies are changed—something that policy makers must know to make well-informed decisions.

One of the biggest challenges is distinguishing causation from correlation. For example, suppose we would like to estimate the causal effect of some measure of early-life health on an adult outcome such as annual full-time earnings at age 30. We collect longitudinal data (that is, data that follow people over time), which combine information on some markers of early-life health (such as birth weight) and individual full-time earnings at age 30. Suppose that in this data, we see that individuals who had better early-life health also have higher age-30 earnings, on average. Can we conclude that better early-life health *causes* higher adult earnings?

The answer is no, because other factors may be correlated with both better early-life health and higher age-30 earnings. For instance, people born in richer families may have more resources at their disposal (such as access to high-quality medical care, good schools, networks, and connections) that can lead to both better early-life health and higher earnings than do people born in poorer families. In other words, early-life health is not randomly assigned, and people with different levels of early-life health are also different in other ways. An analysis that doesn't account for these other distinctions is subject to something called "omitted variables bias." Such an analysis can't separate the causal effects of early-life health from the effects of other factors.

Researchers have many ways to overcome omitted variables bias. A randomized experiment is one of the most convincing. If an intervention assigns people to treatment and control groups at random, there should be no systematic differences between the groups, and any differences in outcomes should be attributable only to the causal effects of the intervention. For example, an experiment might randomly assign some pregnant women to receive a treatment that increases their children's birth weight (and alters nothing else in their lives) and other pregnant women to a control group. Any differences in age-30 earnings of the children of these two groups of women should then be driven only by the randomly manipulated differences in their birth weights.

However, randomized experiments are often infeasible, for either financial or ethical reasons, and researchers must use other methods to find causal relationships. One is to simply include all relevant observable characteristics in what's called a regression analysis. For the example above, a regression might include family background variables (such as family income and parental education level) as controls. This analysis would estimate the relationship between birth weight and adult earnings, holding constant all observable characteristics of the individuals in the data. Although this approach mitigates the omitted variables problem to some extent, it can't do so completely, because unobserved omitted variables are likely also important.

One way to partially tackle the problem of unobserved variables is to compare siblings born to the same parents. In the above example, we could test whether differences in siblings' birth weights are correlated with differences in their age-30 earnings. This approach can control for both observable

and unobservable time-invariant family characteristics. Put differently, this method holds constant any factors that are the same across siblings (such as parents' education). But it can't control for factors that might be different across siblings. For instance, a household's financial situation might change over time, and this change might lead to differences in early-life health markers of siblings born in different years. If household financial circumstances in early childhood also impact children's long-term outcomes through other channels, then sibling comparisons may still omit these time-varying variables.

A third approach uses "natural experiments" to approximate randomized experiments. These analyses exploit real events—for example, disease outbreaks, natural disasters, or staggered policy rollouts—that can assign treatment to individuals almost randomly. For example, as I describe below, the WIC program was implemented at different times in different counties. The rollout's timing was governed by administrative and budgetary factors, and not by any observable determinants of early-life health. As a result, researchers can use the variation to identify WIC's causal impacts by comparing people who had early-life access to WIC to those who did not.

Thus researchers can use a variety of empirical methods to identify causal relationships. In the next two sections, I refer to these methods and discuss the degree to which causal inference is plausible.

Empirical Evidence

Empirical evidence on the relationship between early-life health and wellbeing throughout life is abundant.

Some early studies used the 1944 Dutch famine as a natural experiment in malnutrition. Researchers followed groups of people who were exposed to the famine in utero and compared them with groups who were in utero in other years, finding that famine-exposed people had a higher risk of obesity, heart disease, and mental illness even 50–70 years later.[10]

To study less-acute health shocks, researchers use longitudinal data that combines information on individual markers of early-life health with adult outcomes. Much of this work uses birth weight as a marker of early-life health. Low birth weight is strongly associated with both infant mortality and later illness.[11]

Though birth weight captures information about prenatal health, health after birth and in early childhood is harder to quantify. Many researchers use adult height as an indicator of early childhood health after birth. Through age three, growth is more rapid than at any other stage of life, so health and nutrition during this period are critical to adult height.[12] Some researchers also use information on chronic health conditions in early childhood, which may capture some of the most severe health deficiencies.

One of the first studies using this approach analyzed data from the 1958 National Child Development Survey, which followed a group of Britons from birth until middle age and collected information on their birth weight, chronic health conditions at ages 7 and 16, and height at age 16, as well as a variety of adult outcomes such as health, labor market behavior, education, and socioeconomic standing. The study found that people with low birth weight were 25 to 44 percent less likely to pass English and math exams at

age 16, and 9 to 16 percent less likely to be employed in their 20s and 30s, even after controlling for a large number of individual and family background characteristics.[13]

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Another landmark study used the same data to find that all of the available early-life health indicators—birth weight, the presence of chronic conditions, and height—were correlated with adult health, employment, and socioeconomic status.[14] Other research shows that early-life health has impacts throughout the life cycle. For example, two researchers used data from the U.S. Health and Retirement Study, a longitudinal survey, funded by the National Institute on Aging and the Social Security Administration, that queries a representative sample of more than 26,000 Americans over the age of 50 every two years. They found that height affects cognitive function into old age—a one-inch increase in adult height was associated with small but statistically significant increases in cognitive skills.[15]

Although these analyses control for a large number of demographic and family background characteristics, people with worse early-life health may have unobservable characteristics that independently affect their life outcomes. For instance, mothers of low-birth-weight children, who are more likely to be poor, may have lower parenting skills and fewer resources than their wealthier counterparts.

One way to tackle this problem is to exploit differences in childhood health between siblings or twins and see how they correlate with long-run outcomes. One of the largest studies following this approach used administrative data from Norway on over 30,000 twins born between 1967 and 1997. It found that a 10 percent increase in birth weight reduced mortality in the first year of life by 13 percent, increased the probability of high school completion by 1 percent, and increased adult full-time earnings (at 25 and above) by 1 percent.[16] To put these effects in context, consider that in 2011, the U.S. average birth weight was 3,266 grams. The Norway study implies that a 30 percent increase in birth weight from 2,500 grams (the cutoff for a low-birth-weight designation) to the national average should raise adult earnings by 3 percent.

Similar sibling and twin studies have been conducted with data from other countries. These studies provide relatively strong evidence that early-life health indicators—birth weight, height, and various physical and mental health conditions—are associated with long-run outcomes including school test scores, educational attainment, and adult employment, income, public assistance take-up, crime, and self-reported health.[17] However, findings from twin studies may not apply to a broader population. And it isn't clear whether the long-term outcomes represent biological effects of early-life health, or whether they are mediated by social factors. For example, a parent might decide to invest more in a child with poor health at birth than in a twin or sibling.

Indeed, some evidence suggests that parents tend to compensate for poor health at birth, so sibling comparisons may understate the long-term effects of early-life health.[18]

Other research has used variation in the early-life environment caused by natural disasters and epidemics to identify the causal effects of early childhood health. For example, one study examined the long-run consequences of prenatal exposure to the 1918 influenza epidemic on a broad range of adult outcomes, using U.S. Census data. Comparing people who were in utero during the epidemic to those who were in utero either shortly before or after, the study found that exposed people with infected mothers were 13 to 15 percent less likely to complete high school and scored 2 to 7 percent lower on a socioeconomic status index. Prenatally exposed males had adult incomes that were 5 to 9 percent lower, and they were 3 to 6 percent more likely to have a work-limiting disability, while prenatally exposed females received 12 percent more income from welfare benefits in adulthood.[19] A related study on the 1918 influenza epidemic found that prenatally exposed people were more likely to have poor self-reported health and to experience trouble hearing, speaking, lifting, and walking in adulthood.[20] Other research has found lasting adverse effects of fetal exposure to other disease outbreaks, such as malaria outbreaks in the early twentieth century U.S. and the Asian influenza pandemic of 1957 in Britain.[21]

Researchers have looked beyond disease outbreaks to identify long-term consequences of early-life events, finding that prenatal and early childhood exposure to other adverse conditions harms later wellbeing. One study found that Swedish children prenatally exposed to radiation from Chernobyl fallout were about 4 percent less likely to qualify for high school based on performance in the final year of compulsory school.[22] Even low-dose exposure to radiation can have lasting consequences. Using Norwegian data, researchers estimated that small increases in prenatal exposure to radiation had small but measurable effects on outcomes such as educational attainment, age-18 IQ scores, and age-35 earnings.[23]

Early-life air pollution exposure also exerts long-run impacts. A 10 percent increase in exposure to total suspended particulates in an individual's year of birth reduces high school test scores by about 4 percent and lowers age-30 earnings by 1 percent.[24] And early-life exposure to lead impacts adult socioeconomic status and criminal activity.[25]

Finally, evidence suggests that early-life economic conditions can have lasting effects. For example, one study compared people born during the Netherlands' economic boom of 1872–76 with people born during the country's 1877–81 recession. People born in prosperous years had life expectancies about 1.6 years longer than those born during the downturn.[26] Another study exploited regional variation in phylloxera attacks that greatly reduced wine production in French vineyards between 1863 and 1890; people from wine-growing families born during a year that their region was affected by phylloxera were 3 to 5 percent shorter at age 20 than were counterparts who were not exposed to this income shock in early life.[27]

There is also evidence that early-life income shocks have played an important role in the U.S. more recently. Using variation in the timing of the Food Stamp program's introduction in the 1960s and 1970s across counties, one study found that having access

to the program between conception and age five reduced adult metabolic syndrome (which captures the presence of health conditions including obesity, diabetes, and high blood pressure), and, for women, increased economic self-sufficiency.[28]

Interventions Targeting Early-Life Health and Wellbeing

On the whole, the evidence on the links between early-life conditions and development and wellbeing throughout life is remarkably strong. How effective, then, are U.S. policies and programs that target early-life conditions?

Preconception Care and Family Planning

Mothers' health significantly affects their infants' health. Thus promoting women's health and wellbeing even before pregnancy is a natural way to improve their children's early-life health. In fact, in 2006, the CDC issued recommendations to "Improve Preconception Health and Care."[29] Preconception care's main goal is to provide health screenings as well as educational and medical interventions that might reduce risk factors in women's future pregnancies. However, evidence of its effectiveness in improving early-life health is limited. Only a few randomized trials have been conducted on selected populations (such as women with diabetes), and they yielded mixed results.[30] Nonrandomized studies have also been inconclusive and have often suffered from the omitted variables bias problem described above.[31]

Much more research has been conducted on family planning policies. These policies play an important role in preconception care, since planning and preparing for pregnancy may help women achieve their optimal physical and mental health at the time of conception. Moreover, because unintended pregnancy rates are highest among economically disadvantaged groups, these efforts may be particularly valuable for low-income populations.[32]

Many researchers have studied the consequences of access to family planning, through either the advent of birth control pills or the legalization of abortion in the 1960s, '70s, and '80s. A lot of these studies use natural-experiment variation stemming from differences in timing across states. The evidence suggests that these reproductive health policies led to declines in fertility and changes to birth timing among women.[33] Family planning programs targeting lower-income women (such as federal Title X programs and Medicaid family planning waivers) have also been shown to reduce birth rates and possibly even change children's economic circumstances.[34] Similarly, abortion policies may lead to improved circumstances for children at birth—for example, people born after legalized abortion are less likely to live in single-parent families, live in poverty, receive welfare, and die as infants.[35]

However, there is practically no evidence of direct relationships between these policies and maternal health during pregnancy or infant health at birth. Some studies show that unintended pregnancies are correlated with worse birth outcomes, suggesting that family planning and abortion initiatives may improve early-life health.[36] However, as women who have unintended pregnancies are different in many ways from those who do not, it's difficult to isolate the effect of "unintendedness" from the influence of other characteristics and circumstances.

In sum, a wealth of research shows that U.S. family planning policies have impacted women's fertility behaviors, both in the whole population and among disadvantaged groups. This research also points to improvements in children's economic circumstances, suggesting that giving women more control over their reproductive health may help the next generation. Yet although these findings suggest that family planning interventions may have favorable effects on early-life health, there is not enough evidence. We need more research on the early-life health effects of family planning programs and preconception health initiatives more broadly.

Prenatal Care

Once a woman becomes pregnant, much of her contact with the health-care system occurs through prenatal care, one of the most commonly used health services in the United States. According to the National Center for Health Statistics, 95 percent of women who gave birth in 2011 reported having at least one prenatal care visit. This near-universal contact with the health-care system during pregnancy is due in part to large expansions in the Medicaid program throughout the 1980s and '90s, and is likely to continue under the Affordable Care Act. Thus prenatal care could impact the health of nearly the entire population of mothers-to-be.

The American College of Obstetricians and Gynecologists recommends that, on average, women have 11 prenatal care visits during pregnancy. Much research has examined whether the number of routine visits affects infant health. Several randomized trials have compared women who had a standard number of prenatal care visits with women who had fewer. The largest such study, based in Britain, compared women who had 13 visits with women who had either six or seven visits.[37] The women with fewer visits were less satisfied with their care and more worried about their unborn child's wellbeing, but they experienced no more pregnancy complications or adverse birth outcomes than the other women did. Similar randomized trials have found little evidence that additional prenatal care visits had any impact on infant health.[38] However, many of these trials were conducted on small numbers of low-risk women, and thus can't tell us whether prenatal care might help higher-risk women who have chronic health conditions or engage in behaviors such as drinking or smoking during pregnancy.

Nonrandomized studies present more evidence on prenatal care. For example, one study used data on all sibling births in Arizona and Washington over 1992–2002, comparing the outcomes of children born to the same mother to identify effects when mothers had different numbers of prenatal care visits across pregnancies.[39] The results showed that an additional prenatal care visit increased birth weight by about 12 to 20 grams, with somewhat larger effects at the bottom of the birth weight distribution. However, unobserved time-varying factors (such as maternal employment and marital status) might determine how much prenatal care a mother gets and also affect birth outcomes, thereby biasing the estimates.

Another study used a natural experiment: a large bus strike in Pennsylvania that reduced the number of prenatal care visits that low-income women were able to attend. The study found that women with more prenatal care reported less smoking during pregnancy but saw no improvements in birth outcomes.[40] However, two cautions are in order. First, the bus strike only lasted 28 days and

thus couldn't have substantially reduced the number of prenatal visits that women were able to get—African American women living in the inner-city, who were most likely to be impacted, experienced a reduction of 0.45 visits, on average. Second, the bus strike may have affected other aspects of women's lives, such as their ability to get to work, and these unobserved factors may skew the estimates of prenatal care's effects.

Overall, the evidence on how prenatal care affects early-life health is relatively limited. However, prenatal care may influence maternal health-related parenting behaviors and the use of pediatric care, which may ultimately contribute to children's health and wellbeing later in life. For instance, one study shows that beginning prenatal care in the first trimester may decrease maternal postpartum smoking, increase well-baby visits, and increase breastfeeding.[41] Prenatal care may also impact maternal health—timely and adequate care has been shown to reduce obesity and hospitalization rates among new mothers.[42]

It may also be that the quantity of prenatal care is not the relevant dimension to study. Instead, quality may be more important. However, almost no research has examined the impacts of prenatal care's quality, in part due to a lack of data on quality measures. A recent Institute of Medicine report, which focuses on preterm birth as a marker of poor early-life health, calls for greater emphasis on research about the quality of prenatal care.[43] Finally, prenatal care may be an important way to offer mothers-to-be medical services that are not necessarily limited to pregnant women. For instance, exposure to the influenza virus has been linked to preterm delivery, and prenatal care visits may help ensure that pregnant women receive flu vaccinations.[44]

On the whole, evidence that the quantity of prenatal care affects birth weight and other markers of early-life health has been elusive. However, women may need high-quality care to see such impacts, and research on the quality as opposed to the quantity of care is much more limited. Moreover, prenatal care may improve mothers' health-related investments in their children and serve as a conduit for other medical or social interventions that support early childhood health.

WIC

Prenatal care policies broadly target the health of pregnant women. WIC, on the other hand, is one of the largest U.S. policies specifically targeting a single aspect of early-life health—namely, nutrition. Established in 1974, the program serves low-income pregnant and postpartum women, infants, and young children under age five. Participants must live in households with incomes below 185 percent of the poverty line and be "at nutritional risk" (most people who satisfy the income requirement are assessed to be at nutritional risk). Participants get monthly benefits to buy nutritious foods. WIC participants also learn about nutrition, health, and breastfeeding, and get referrals to social service agencies.

Research on how WIC affects early-life health dates back several decades.[45] Almost all of it has focused on WIC's effects on pregnant women; there is very little causal evidence of WIC's impacts among young children. Thus I focus on the early-life impacts of prenatal access to WIC.

Early studies found a positive association between WIC and birth weight.[46] The sizes of the estimated effects were quite substantial—participation in the program was associated with a 10 to 43 percent reduction

in the likelihood of low birth weight, for example.[47] However, the early WIC studies may be subject to omitted variables bias. In particular, if WIC participants tend to have characteristics associated with better birth outcomes that women who aren't on WIC don't have (for example, healthier behaviors, better knowledge of public programs, or stronger family support networks), then the benefits of WIC could be overstated.

To tackle this problem, researchers have looked for comparison groups that are similar to WIC participants. One study compared women receiving WIC benefits to women on Medicaid who were eligible for WIC but didn't take up benefits, and found that the children of WIC participants weighed 64 to 78 grams more at birth, were 30 percent less likely to have low birth weight or be premature, and were 10 percent less likely to be admitted to intensive care.[48] Importantly, this study shows that, compared to other women on Medicaid, WIC participants on average have observable characteristics that are associated with worse rather than better birth outcomes, suggesting that at least some of the earlier studies on WIC may have underestimated the program's benefits. Other studies, using similar methods and considering a variety of groups of women, found somewhat smaller effects on birth weight—7 to 40 gram increases in average birth weight, and about a 9 percent reduction in the likelihood of low birth weight.[49]

Other researchers have used sibling comparisons to control for time-invariant family background characteristics that could be correlated with both WIC take-up and early-life health. Comparing children born to women who participated in WIC during one pregnancy and not during another, researchers have found that the WIC-exposed children are more likely to be breastfed and less likely to experience anemia, failure to thrive, and nutritional deficiencies.[50]

Three recent studies found that WIC has notable benefits for infant health. One study linked Florida birth records to information on the infants' older siblings who were enrolled in elementary school. Since the household income eligibility threshold for reduced-price lunches is the same as for WIC, the researchers assumed that if a child received reduced-price lunch in any given year, then his infant sibling also received WIC benefits in that year. The analysis compared outcomes of infants whose older siblings were receiving reduced-price lunches to those who were not receiving such lunches but received them in either the previous or following year. The results suggested that WIC participation resulted in a 13 percentage point reduction in the probability of low birth weight.[51]

Another study examined WIC's rollout in the 1970s, using variation in access to the program by county and year to identify its effects. The authors show that the rollout was not correlated with other observable determinants of birth outcomes, such as local labor market conditions. They found that initial access to the WIC program led to 18- to 29-gram increases in average birth weight and an 8 percent reduction in the likelihood of low birth weight.[52]

To examine WIC's effects in more recent years, a third study used variation in WIC clinic openings and closings in Texas and compares siblings born to the same mother over 2005–09. The idea was to compare women who had a WIC clinic in their ZIP code of residence during one pregnancy and not another. Thus the variation in mothers'

WIC access came only from WIC clinic openings and closings, rather than from other, likely unobservable factors that might influence whether a woman receives WIC services during one pregnancy and not another. The results suggested that access to WIC increased take-up of food benefits, weight gain during pregnancy, birth weight, and the probability that women would start breastfeeding upon hospital discharge. The effects were larger than those in the study on WIC's rollout. Specifically, among mothers with a high school education or less (who are most likely to be eligible for WIC), WIC access was associated with a 32-gram increase in average birth weight and a 14 percent decrease in the likelihood of low birth weight.[53]

Recent work that carefully attempts to identify WIC's causal effects points to relatively large benefits.

Overall, research presents a range of estimates of the relationship between WIC and early-life health. Though some earlier studies may be subject to biases that could overstate WIC's benefits, more recent work that carefully attempts to identify WIC's causal effects nevertheless points to relatively large benefits.

No formal cost-benefit analysis of the WIC program has been conducted (in part because no studies have examined the program's long-term causal effects). But a quick calculation can shed light on the benefit-cost ratio. According to the U.S. Department of Agriculture, the program cost about $6.5 billion in 2013. With 8.7 million participants, this is about $745 per participant per year. The evidence suggests that WIC increases birth weight by 7 to 80 grams, which should yield savings in average hospital costs for delivery and initial care of $41 to $471.[54] Moreover, based on the link between birth weight and earnings, WIC should increase average annual adult earnings by 0.02 to 0.3 percent. Assuming the percentage gain in earnings remains constant over the life cycle, and making the standard assumption of a 3 percent real discount rate (which measures the rate at which society is willing to trade future benefits for current benefits), the mean present value of WIC in terms of lifetime earnings is calculated to be between $94.10 to $1,176 per participant in 2014 dollars.[55] Together, these estimates translate to benefit-cost ratios of 0.18 to 2.2, based on higher birth weights alone. As the program may also improve other aspects of child and maternal wellbeing, these estimates probably represent lower bounds, suggesting that the true benefit-cost ratio is likely to be greater than one.

Family Leave

The policies described thus far target early-life health directly. Family leave is a broader program that targets the needs of working parents. Because most mothers work—over 60 percent of mothers with children under age three are in the labor force—these policies can have important consequences not only for women's employment and careers, but also for early-life health.[56]

Family leave programs provide time off from work so that mothers can prepare for and recover from childbirth and parents can care for their newborns. Guaranteed leave (especially if it is job-protected) may reduce maternal stress, which has been shown to harm infant and child health.[57] There may be further health impacts after birth, because

family leave can influence the quantity and quality of time newborn children spend with their parents. For example, a mother on leave may have more time to take care of a sick child, breastfeed, or seek prompt medical care. Leave policies that provide health insurance coverage can also increase access to regular medical care. And leave policies may affect family income depending on whether they are paid or unpaid, and therefore influence the family's material resources for child rearing.

Before 1993, 25 states and the District of Columbia had enacted some type of family leave provisions, mostly unpaid and without job protection, that varied in length from six to 16 weeks.[58] In that year, the federal Family and Medical Leave Act (FMLA) was enacted. It mandated 12 weeks of unpaid, job-protected family leave with continued coverage by the employer's health insurance (if such coverage was already offered at the job). However, because of firm size and work history requirements, only about half of private sector workers were eligible. Currently, although five states (California, Hawaii, New Jersey, New York, and Rhode Island) provide paid family leave, the vast majority of working parents are covered only by a relatively short and unpaid leave policy, if at all.[59] In contrast, most other countries have national paid family leave policies.[60]

Yet research suggests that most countries' family leave policies have little impact on early-life health. A few studies show that European countries with longer leave policies have lower mortality rates from birth to age five.[61] However, it's hard to draw causal conclusions from international comparisons, as other factors may be correlated with both leave provision and infant health. For example, Scandinavian countries, which have some of the longest family leaves, also have a variety of other social safety net supports, such as low-cost public child care.

More recent work has focused on individual countries and examined what happens when existing leave policies are expanded or new ones are introduced. These natural experiments can more credibly identify causal effects by comparing children who were born under more generous family leave regimes to similar children born when leave was less generous. Several such studies have found that expansions in family leave have little effect on child wellbeing. For example, in Canada, expanding paid maternity leave from six months to a year had no statistically significant impacts on early childhood development indicators for children up to 29 months old.[62] A German study considered three family leave reforms: an increase from two to six months of paid leave in 1979, an increase from six to 10 months of paid leave in 1986, and an increase from 18 to 36 months of unpaid leave in 1986. None of them had detectable effects on any long-run child outcomes, including grade retention, selective high school attendance, adult wages, and employment.[63] Similarly, a Swedish expansion in paid leave from 12 to 15 months had no significant impacts on a variety of child health measures or on academic performance at age 16.[64]

These studies offer credible evidence that extensions in paid family leave longer than two months may not play a large role in child wellbeing in Canada and Europe, but they don't tell us what to expect from introducing paid or unpaid leave for the first time. Moreover, the institutional setting where a family leave policy is enacted likely matters. A reform that expands paid leave from 12

to 15 months in a setting with subsidized child care and universal health insurance (as in Sweden) is quite different from one that provides family leave for the first time on a national level in a setting such as the U.S. where neither child care nor health insurance is guaranteed. In fact, a recent study on the 1977 introduction of a four-month paid leave in Norway, where the preceding policy provided only three months of unpaid leave, contrasts with the findings from other countries. The Norwegian policy had lasting beneficial impacts on children's educational attainment, and especially helped children from disadvantaged backgrounds whose mothers were least likely to have been able to take unpaid leave.[65]

In the United States, recent evidence suggests that even the 12 weeks of unpaid leave guaranteed by the FMLA can affect early-life health. One study used a natural-experiment analysis, exploiting variation across states in pre-FMLA leave policies and across counties in average firm size. The results show that FMLA led to a 6-gram increase in average birth weight and a fairly large reduction in the infant mortality rate of about 10 percent. However, these benefits accrued only to children of highly educated and married women, who were most likely to be eligible for FMLA and able to afford unpaid time off.[66]

We have little evidence on the effects of the few state-level paid leave policies. Some work suggests that California's paid family leave program, which was introduced in 2004 and has very few eligibility restrictions, increased leave-taking among less-educated, unmarried, and minority mothers who previously took an average of less than two weeks of leave.[67] Moreover, the policy appears to have substantially increased breastfeeding rates.[68] These findings show that paid leave might offer early-life health benefits to disadvantaged children in the U.S.

In sum, research suggests that expanding already generous paid leave programs in Canada and Western Europe has had little effect on children's early-life health or on measures of welfare throughout childhood and early adulthood. However, shorter unpaid and paid leave measures may help children of mothers who can make use of them.

Universal Immunization Programs

The policies discussed so far primarily impact early-life health through altering the choices and constraints faced by women who are at risk of being pregnant, pregnant women, and new mothers. But a number of widespread medical interventions, such as universal immunization programs, target the early-life health of infants and children directly.

The routine childhood vaccination schedule shows dramatic health benefits and substantial cost-effectiveness.

The routine U.S. childhood immunization schedule (from birth through age six) consists of vaccines for hepatitis B, diphtheria/tetanus/pertussis (DTap), rotavirus (RV), *Haemophilus influenzae* type b (Hib), pneumococcus (PCV), polio virus (IPV), measles/mumps/rubella (MMR), varicella (chickenpox), and hepatitis A. A number of studies have evaluated how these vaccinations affect child health, as measured by hospitalizations and mortality. For example, a study of PCV, which was introduced in the immunization

schedule in 2000, found that among children from birth to age two, pneumonia-related hospitalizations fell over 52 percent, from 115 per 10,000 in 1997–99 to 55 per 10,000 in 2004. Ambulatory visits for pneumonia fell 41 percent, from 993 per 10,000 to 585 per 10,000. Moreover, the vaccine lowered direct medical expenditures for pneumonia from an annual average of $688.2 million to $376.7 million, representing $310 million savings in 2004 dollars (about $375 million in 2014 dollars).[69]

Another study examines the varicella vaccine against chickenpox, recommended for universal childhood immunization in 1995. Afterward, the varicella-related hospitalization rate fell from 0.5 hospitalizations per 10,000 in 1993–95 to 0.13 per 10,000 by 2001. The decline was driven by hospitalizations among children from birth to age four. At the same time, varicella-related hospital charges declined from $161.1 million in 1993 to $66.3 million in 2001, saving $94.8 million in 2001 dollars (about $120 million in 2014 dollars).[70]

Overall, the routine childhood vaccination schedule shows dramatic health benefits and substantial cost-effectiveness—for example, one study showed that routine childhood immunization of children born in 2009 should prevent over 40,000 early deaths and 20 million cases of disease, implying a societal benefit-cost ratio of about 10.1.[71] And there is no evidence that vaccines are unsafe, despite the widely popularized claim that vaccines cause autism.[72]

Public Education Campaigns and Regulations

Several public education campaigns and regulations seek to change parental behaviors and thus improve early-life health. Breastfeeding education campaigns are an example. The American Academy of Pediatrics (AAP) recommends breastfeeding exclusively for the first six months of a baby's life, followed by breastfeeding in combination with some solid foods until at least 12 months. Many outreach efforts promote breastfeeding. For instance, in 2011, the U.S. surgeon general issued a "Call to Action," describing steps that individuals and organizations can take to support breastfeeding mothers. These include teaching fathers and grandmothers about the benefits of breastfeeding; making breastfeeding support a standard of care among midwives, obstetricians, nurse practitioners, family physicians, and pediatricians; encouraging support programs at work; and community peer counseling programs.[73] A recent review of the evidence on how breastfeeding impacts infant and child health suggests that if these efforts are successful, they are likely to be beneficial. Breastfeeding is associated with a lower risk of a variety of childhood diseases and conditions such as ear infections, severe lower respiratory tract infections, eczema, asthma, obesity, type 1 and 2 diabetes, childhood leukemia, and Sudden Infant Death Syndrome (SIDS).[74] Breastfeeding rates have increased substantially over the past few decades—breastfeeding initiation rose from 27 percent in 1970 to 77 percent in 2013—but there is substantial room for progress in ensuring that mothers continue breastfeeding through a child's first year of life. Only 49 percent of mothers report breastfeeding at 6 months after birth, and 27 percent report breastfeeding at 12 months.[75] Research suggests that successful breastfeeding campaigns must be multifaceted. For example, one breastfeeding campaign, which increased breastfeeding rates among new mothers by 18 percentage points, lobbied to change hospital policies and used

new language (for example, "breast milk substitute" instead of "baby formula"). It also trained health professionals and conducted targeted media outreach.[76]

Several public health campaigns and regulations are designed to prevent child injury and death. These include campaigns and regulations regarding car seats, bicycle helmets, flame-retardant materials, and the like.[77] The evidence suggests that large-scale educational strategies, such as distributing brochures or isolated public service announcements, have been largely ineffective at changing behaviors or preventing child injuries and deaths. In contrast, targeted interventions in clinical settings (for example, in a pediatrician's office or at a public health clinic) have had more success. Clinical interventions that combine counseling with visual information and free or low-cost safety devices have affected behaviors such using car seats, ensuring that hot tap water is at a safe temperature, and owning smoke detectors. These behaviors have in turn been shown to reduce injuries. But the benefits are relatively small, don't last long, and thus usually don't outweigh the programs' costs.

Community-based interventions have been the most effective at fostering long-term safety behaviors. These programs are often guided by an "accepted health behavior" framework, which targets factors that link to a desired behavior change. For example, such an intervention can first use education and advertising to change attitudes and increase knowledge. Next, the program can offer safety products at lower cost. Finally, the message can be reinforced in multiple settings, such as in physicians' offices, on television, at churches, and in schools. One successful program of this type is the Seattle Bike Helmet campaign, which increased bicycle helmet use among children from 2 to 60 percent in 10 years.[78]

A public education campaign that is especially relevant for early-life health is the "Safe to Sleep" campaign (formerly known as "Back to Sleep"). This large-scale public education program teaches caregivers how to reduce the risk of SIDS—the sudden, unexplained death of an infant under one year old. Most of these deaths occur before the infant reaches six months. SIDS usually occurs when a baby is sleeping, and is therefore also commonly known as "crib death."

After years of research into the causes of SIDS, the AAP recommended in 1992 that infants be placed on their backs to sleep. In 1994, the U.S. surgeon general backed the recommendation, and the National Institutes of Health launched the "Back to Sleep" campaign in collaboration with the AAP, the Public Health Service, and other organizations. Initially, the campaign consisted of mailings to AAP members, the American College of Obstetricians and Gynecologists, WIC providers, and all hospitals with newborn nurseries. Also, thousands of radio and television stations made public service announcements.

The campaign has since enlisted private partners such as Gerber, Procter & Gamble, and Johnson & Johnson, which now include messages with their products. The campaign has also periodically updated its message to target other sleep-related problems, such as soft bedding and bed-sharing. Moreover, specific campaigns target child-care centers, nurses who care for newborns, and African Americans and Native Americans (who have higher rates of SIDS than the national average). In 2011,

the AAP updated its recommendations to include a wider array of safe sleeping measures, and in 2012, the National Institutes of Health launched an updated campaign called "Safe to Sleep" that incorporated these recommendations.

To collect data on infant sleeping practices, the government also launched the National Infant Sleep Position study, which conducted phone surveys with 1,000 mothers per year from 1992 to 2010. The Pregnancy Risk Assessment Monitoring Study, which surveys large samples of new mothers in participating states, also includes questions about infant sleeping positions.

Given the length and scope of this campaign, it is perhaps surprising that we know little about the effectiveness of its key elements. Between 1992 and 2001, SIDS rates fell from 120 to 56 deaths per 100,000 live births; over the same period, the incidence of back sleeping increased from 13 to 72 percent. Both rates have been relatively flat since 2001.[79] However, such numbers imply only a correlation, and not necessarily a causal relationship.

Evaluations of more targeted parts of "Safe to Sleep" have produced somewhat mixed results. For example, a nonrandomized evaluation of an education campaign in African American neighborhoods showed some decreases in the numbers of mothers who said that they put their infants to sleep on adult beds or sofas, though these declines were not statistically significant.[80] A randomized study of a training program for workers in child-care centers yielded more promising results. The trainers conducted an initial evaluation of sleep practices, then randomized some centers to the training program and others to the control group. Three months later, back sleeping among infants increased from 51 to 62 percent in the treatment centers, but only from 51 to 57 percent in the control centers.[81]

These studies suggest that large-scale public education campaigns like "Back to Sleep" may be effective, but conclusive causal evidence is limited. Such campaigns seem to help most when they are targeted as training or counseling programs at agencies such as child-care centers.

Early Childhood Care and Education Programs

The final interventions I describe are center-based programs that provide care and education to children at young ages. In addition to targeting early-life health, these policies seek to improve cognitive and noncognitive skills among young children.

Head Start

Head Start is a federal program designed to promote school readiness among preschool-age children, implemented in 1965 as part of the War on Poverty with a goal of enhancing low-income children's "cognitive, social, and emotional development."[82] Head Start includes preschool education; medical, dental, and mental health care; nutrition services; and efforts to promote healthy relationships between parents and children. All Head Start programs serve preschool-age children and their families. Many also offer Early Head Start, which expands the services to cover infants, toddlers, and pregnant women. Families are eligible if they have incomes below the federal poverty level, if they are homeless, or if they receive either TANF or Social Security Income benefits. Foster children are eligible regardless of the foster family's income level. Head Start is funded through federal grants; public and

private agencies compete for these grants to provide local Head Start services.

Much research has examined Head Start's effectiveness. Most studies of the program's effects on children's cognitive test scores show temporary improvements followed by "fade-out" at later ages. For example, the federally mandated Head Start Impact Study, in which children were randomly assigned either to Head Start centers or to a control group with no Head Start exposure, assessed the effects of Head Start using a sample of nearly 5,000 children. The treatment children had higher cognitive test scores at the end of their time in Head Start, but these positive effects generally didn't last—there were few statistically significant differences between the treatment and control groups at the end of first grade. [83]

However, two important caveats should be noted. First, control-group children were allowed to attend other center-based care programs. Thus the experiment measured the effect of Head Start relative to other preschool programs, and can't answer whether Head Start might improve outcomes if the alternative were no program at all. Second, the study didn't measure noncognitive skills, which may be especially important in the long term for building human capital and economic success.[84]

In fact, research that compares siblings, where one child attended Head Start and the other did not, shows that despite the evidence of test score "fade-out," long-term benefits persist. Children who attended Head Start are more likely to graduate from high school, attend college, and have higher earnings in their 20s, and less likely to be booked or charged with a crime, than are siblings who didn't attend Head Start.[85] One study shows a measurable and economically meaningful increase in a summary index of adult outcomes consisting of high school graduation, college attendance, "idleness" (having no job and not being in school), crime, teen parenthood, and health.[86]

Children who attended Head Start are more likely to graduate from high school, attend college, and have higher earnings in their 20s, and less likely to be booked or charged with a crime, than are siblings who didn't attend Head Start.

Other studies have examined how Head Start affects health, exploiting natural experiments due to changes in policy rules. They suggest that Head Start reduces the likelihood of child obesity and mortality, as well as smoking rates in adulthood.[87] Finally, two recent studies using data from the Head Start Impact study show effects on outcomes the original study didn't analyze. One found that when children participate in Head Start, their parents are more involved with them, as measured by time spent reading or practicing math, and days spent with fathers who don't live with their children.[88] Another study found that the children whose cognitive skills are lowest when they enter Head Start are the ones who show the greatest test score gains.[89]

Thus despite cognitive test score "fade-out," studies suggest that Head Start has

long-term benefits for socioeconomic well-being and health. This discrepancy may highlight the fact that noncognitive skills, which Head Start may be particularly well-suited to develop, help shape adult wellbeing. Moreover, several cost-benefit analyses of Head Start suggest that the program's benefit-cost ratio exceeds one. When taking into account only the program's short- and medium-term effects for families in terms of improved child health and nutrition, child-care provision, reductions in special education enrollment, and reductions in grade repetition, Head Start's benefits are estimated to offset 40 to 60 percent of the costs.[90] Analyses that account for long-term impacts on education and earnings suggest benefit-cost ratios of 1.7 to 1.8.[91]

Randomized Early Childhood Education Interventions

In addition to Head Start, much smaller and more expensive early childhood education interventions have been implemented as randomized experiments. The HighScope Perry Preschool study was one of the first. It identified 123 low-income African American children ages three and four in Ypsilanti, Michigan, in the early 1960s and randomly assigned 58 of them to a treatment group. Treatment lasted for two years and consisted of a 2.5-hour preschool program on weekdays during the school year as well as weekly home visits by teachers. The curriculum involved "active learning," where children were encouraged to plan, carry out, and reflect on their own activities through a "plan-do-review" process. The children were also urged to make choices and solve problems. The teachers emphasized reflective and open-ended questions instead of strictly organized lesson plans. Once the intervention ended, the treatment and control groups were followed through age 40.

The Perry program showed remarkable lasting effects. Treatment children performed better on achievement tests and were more likely to graduate from high school. They were also more likely to be employed, less likely to be receiving social assistance, and less likely to be involved in crime or interact with the criminal justice system throughout adulthood. These impacts are economically meaningful: treatment individuals had lifetime earnings that were from 11 to 36 percent higher than those of the control group, depending on the assumptions used to estimate lifetime earnings.[92] Researchers estimate that the Perry program had meaningful social rates of return (7–10 percent) that imply a benefit-cost ratio between 2.2 and 3.2.[93]

A similar but longer-lasting intervention, the Abecedarian Project, took place in the 1970s. The program selected 112 mostly African American children, who were considered at risk for delayed cognitive development based on factors such as household income, parents' education, and parents' IQ. The children were randomly assigned to treatment and control groups. The treatment children entered the program when they were between 6 and 12 weeks old and stayed through age five. The program was entirely center-based, with teacher/child ratios of 1 to 3 for infants and toddlers and 1 to 6 for older children. The curriculum was based on language development and tailored to the children's individual needs. The participants have been followed through their mid-30s thus far.

Like the Perry program, Abecedarian had long-term benefits. By age 21, relative to the control group, treatment group children were 48 percent less likely to have repeated a grade, 37 percent less likely to have been in special education, 33 percent less likely

to have dropped out of high school, and more than 170 percent more likely to have attended college. Measuring only these benefits, the program's cost-effectiveness is already notable: in 2002 dollars, the program cost $34,599 per participant and led to an average $72,591 benefit, implying a benefit-cost ratio above two.[94] Recent work has found lasting health benefits as well. Treatment group members were significantly less likely to have risk factors for cardiovascular and metabolic diseases; for example, they saw a 12 percent reduction in mean systolic blood pressure.[95]

Another randomized intervention, the Infant Health and Development Project (IHDP), was conducted at eight sites from 1985 to 1988. Unlike Perry Preschool and Abecedarian, IHDP did not restrict eligibility based on family income or demographics, but instead targeted children who had low birth weight or were born preterm. In addition to center-based care, the IHDP treatment group also received home visits. Home visits began shortly after birth, and center-based care began at age one and lasted through age three. The 377 treatment and 608 control group children were followed through age 18. The program had large positive effects on children's cognitive ability in both childhood (ages 3–8) and young adulthood (age 18), with larger impacts for children from lower-income backgrounds.[96] One study estimated that if such a program were offered to low-income children throughout the U.S., it would eliminate the income-based gap in cognitive ability at age three, and close one-third to three-quarters of the gap at ages five and eight.[97]

In sum, targeted intensive early childhood center-based education programs improve both cognitive and noncognitive development throughout life. These interventions are costly (for example, the Abecedarian program would cost $43,748 per child in 2014 dollars), but their benefits are substantial, with benefit-cost ratios consistently much larger than one.

Universal Pre-Kindergarten

All the early childhood center-based programs described so far target low-income or otherwise disadvantaged children. However, government-funded early childhood programs might instead be offered universally in the belief that they can benefit all children and generate more political support. How effective, then, are existing universal pre-kindergarten (pre-K) programs?

As of 2012, 40 U.S. states and the District of Columbia had some kind of pre-K program. Access to the programs varies substantially—for example, only 1 percent of Rhode Island four-year-olds are enrolled in a pre-K program, compared with nearly 80 percent of Florida four-year-olds. These programs are funded, directed, and controlled by the states, and must serve preschool-age children (younger children may be served as well, but programs serving only infants and toddlers are not considered pre-K). The initiatives focus on center-based early childhood education and must offer a group learning experience to children at least two days per week.[98]

Because these programs are meant to be nearly universal, they are not randomized like those described in the previous section. Thus most of the evidence comes from natural-experiment analyses that compare children with birthdays near the state's eligibility cut-off date. Most states require that children must turn a certain age (three or four years old) by a particular date (such as September 1) to enroll in pre-K. Thus,

in any given year, children who were born just before that date will have completed a year of pre-K, while slightly younger children born just after that date will not yet have begun the program. Comparing these children can shed light on the program's short-term effects. Such analyses show that pre-K programs in Michigan, New Jersey, New Mexico, Oklahoma, and South Carolina have had some positive effects on a variety of measures of children's cognitive ability, at least in the short run.[99]

Despite these apparent benefits, evidence from other countries suggests some caution. For example, one study analyzes the introduction of universal, highly subsidized child care for preschool children in Quebec and finds adverse effects on children's behavior and health.[100] The detrimental effects likely resulted from the fact that the program offered lower-quality care than the children would have obtained elsewhere.

In sum, though U.S. universal pre-K programs show some promising short-term benefits, research from other settings suggests that the quality of center-based care plays an important role. Additionally, we don't know whether these programs have long-term impacts, so full cost-benefit analyses are not yet feasible.

Conclusions

If early-life conditions have lasting effects on human capital formation and adult economic success, the United States' disadvantage in infant health relative to other wealthy countries could have far-reaching implications. Drawing on research from a variety of disciplines, including economics and epidemiology, this article reviewed the evidence on the link between early-life conditions and outcomes throughout the life course. Studies on this topic vary substantially in empirical methods, data, and context. Despite this variation, the research provides overwhelming evidence that early-life conditions affect the population's wellbeing, measured by health, educational attainment, adult earnings, and other indicators throughout life.

This article also reviewed the effectiveness of interventions targeting the early-life environment. WIC, medical interventions such as vaccinations, and center-based early childhood care and education programs have all been shown to improve early-life conditions. Moreover, these programs are quite cost-effective, with benefit-cost ratios generally exceeding one. Of course, an important caveat is that cost-benefit analyses rely on many assumptions (for example, they must generally assume a discount rate) and don't take into account some costs and benefits that are difficult to put a price on. Nevertheless, the calculations suggest that public spending on these programs is more than justified by their benefits.

The research thus points to a critical window of opportunity for improving children's life chances through evidence-based early-life interventions. However, all is not lost if we don't successfully intervene in early childhood. Indeed, many policies that impact children's health and development later in life are described in other articles in this issue.

ENDNOTES

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