



## RESEARCH SUMMARY

# Hydraulic Fracturing and Infant Health: New Evidence from Pennsylvania

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### KEY TAKEAWAYS

1. The application of hydraulic fracturing to develop oil and natural gas has led to a sharp increase in U.S. energy production and generated enormous benefits, including abruptly lower energy prices, stronger energy security and even lower air pollution and carbon dioxide emissions by displacing coal in electricity generation. The reductions in air pollution are likely to have led to improvements in health throughout the country.
2. As drilling activity has increased, however, a robust debate has begun within communities where drilling is occurring—or could occur—regarding the potential pros and cons at a local level. Advocates point to increased economic activity, including tax revenue and jobs. Opponents, on the other hand, point to potential disadvantages such as possible health risks.
3. Determining the possible health impacts on newborns is one area of focus, both because they are particularly vulnerable to health shocks and because it is possible to pinpoint the timing of exposure based on the in utero period. A number of studies in other contexts have found that air pollution can harm infant health through maternal exposure before the baby is born.
4. This is the first peer-reviewed study to provide large-scale evidence on hydraulic fracturing's health impacts on infants using records from more than 1.1 million births in Pennsylvania from 2004 to 2013. The researchers compare infants born to mothers living near a drilling site to those living further from the site both before and after the drilling began. As a check, the analysis also compares siblings who were exposed to fracking with those who were not.
5. The study finds a decrease in the health of infants born to mothers living up to 3 kilometers (1.8 miles) from a hydraulic fracturing site. The largest impacts were to babies born within 1 kilometer (0.6 miles) of a site, with those babies being 25 percent more likely to be born at a low birth weight. The effects for infants born 1-3 kilometers are about a third to a half of those within 1 kilometer. Infants born to mothers living beyond 3 kilometers saw little to no impact.
6. For policymakers weighing the costs and benefits of fracking before deciding whether to allow it in their communities, this study provides a clear cost: an increase in the probability of poorer health for babies born near these sites. Back-of-the-envelope calculations suggest that about 29,000 out of the nearly 4 million U.S. births (0.7 percent) annually occur within 1 kilometer of a fracking site and 95,500 are born within 3 kilometers.

## Introduction

The discovery of hydraulic fracturing is considered by many to be the most important change in the energy sector since the introduction of nuclear generated electricity more than 50 years ago. As a result of its discovery, U.S. production of oil and natural gas has increased to unforeseen levels. This has led to abruptly lower energy prices, stronger energy security and even lower air pollution and carbon dioxide emissions by displacing coal in electricity generation. The reductions in air pollution are likely to have led to improvements in health throughout the country.

As drilling activity has increased in recent years, however, a robust debate has begun within communities where development is occurring—and those where it could occur—regarding the potential pros and cons at a local level. Advocates point to increased economic activity, including tax revenue and jobs. Opponents, on the other hand, point to potential disadvantages such as increased levels of crime, a higher burden on public infrastructure, and possible health risks. But to date, credible evidence on the health consequences has not been available.

Based on the available evidence, the average community appears to benefit from allowing hydraulic fracturing. A recent study finds benefits to local communities from increases in income, employment and local housing prices, with the average household benefitting by as much as \$1,900 per year. Specifically, the authors (two of which are also authors of this study) found that the introduction of hydraulic fracturing results in a 7 percent increase in average income, driven by rises in wages and royalty payments, a 10 percent increase in employment, and a 6 percent increase in housing prices. However, the authors cautioned that new information on the local health consequences of hydraulic fracturing is likely to influence housing prices if it differs from current expectations of health effects.

There are several potential pathways by which hydraulic fracturing might affect health. A study by the Environmental Protection Agency has linked fracking to possible drinking water contamination due to chemicals that could seep into waterways. Additionally, the diesel generators used to power the drilling and the increased truck traffic in the area could lead to harmful air pollution.

Numerous studies have linked air pollution to decreases in infant health. For example, one study of the installation of EZ Pass toll plazas in New Jersey and Pennsylvania showed that EZ Pass was associated with reductions of 40 percent in carbon monoxide and 11 percent in nitrous oxide which in turn reduced the incidence of low birth weight by 12 percent among mothers living within 2 km (0.6 miles) of a toll plaza. Another recent study of openings and closings of industrial plants that emit hazardous air pollutants such as benzene (one of the chemicals that has been found near fracking sites) suggested that plant operation is associated with a roughly 3 percent increase in the incidence of low birth weight among mothers within 1.6 km (1 mile) of the plants.

## Research Design

This study seeks to measure the causal impacts of fracturing on infant health. The researchers chose to study the health of newborns for several reasons. First, there is increasing evidence that the fetus is vulnerable to maternal pollution exposure. Second, because the fetus is in utero for at most nine months, it is possible to pinpoint the timing of potential exposure. This is not the case with other possible health effects such as cancer, which develops over long periods of time. Moreover, birth data is available with precise information on mothers' residential locations, permitting the researchers to examine the effects of proximity to fracturing on newborns.

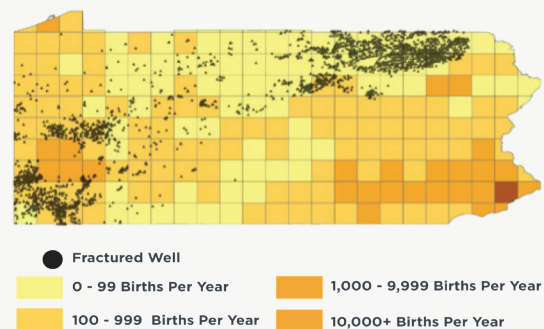
The most commonly used measure of infant health is whether the baby is classified as low birth weight, measured as less than 2,500 grams (5.5 pounds). Thus, the researchers focused on this measure. However, they also used an index of infant health outcomes in order to incorporate the many other measures of infant health that are available. The index is a combination of birth weight and indicators for low birth weight, prematurity (gestation less than 37 weeks), the presence of any congenital anomalies, and the presence of any other abnormal condition of the newborn. An increase in the index indicates better health.

The researchers utilized the universe of birth certificates in Pennsylvania from 2004 to 2013, comprising more than 1.1 million records. These records included information about the infant's health at birth, the geocoded location of maternal residence and detailed demographic information about the mother, including her race, education and marital status. They combined this data with a list of all fractured wells in Pennsylvania through 2014, which included 7,757 wells. This data contains well attributes including geocoded locations of the well and the month and year it was spudded (the initial step in hydraulic fracturing).

The researchers used geocoded locations to compute the distance between maternal residence and well sites, finding there are 270,410 births within about 15 kilometers (about 9.3 miles) of at least one current or future fracking site in Pennsylvania from 2004 through 2013. Of those, 58,937 births are less than 3 kilometers (1.8 miles) from a site, 24,148 births are less than 2 kilometers (1.2 miles), and 6,669 births are within 1 kilometer (0.6 miles).

The researchers compared the health of infants born to mothers living near a fracking site—defined as within 3 kilometers (1.8 miles)—before and after the fracking began. They then compared those results to the health of infants living farther from a fracking site (beyond 3 kilometers) both before and after fracking began. As a check, the study further refines this comparison so that it is based on siblings who were exposed to fracking with those who were not.

**Figure 1 • Locations Of Births And Fractured Wells, Pennsylvania**



## Findings

**1. Babies born to mothers living within 1 kilometer (0.6 miles) of a hydraulic fracturing site are 25 percent more likely to be born at a low birth weight.** Among infants born to mothers living within 1 kilometer of a well site, hydraulic fracturing increases the odds of low birth weight by 25 percent. Low birth weight is defined as less than 2,500 grams, or 5.5 pounds. Infants born with low birth weight experience a greater risk of infant mortality, ADHD, asthma, lower test scores, lower schooling attainment, lower earnings, and higher rates of social welfare program participation. The infant health index similarly suggests a relatively small but statistically significant decline in health. A back-of-the-envelope calculation suggests that about 29,000 out of the nearly 4 million U.S. births annually occur within a 1 kilometer of an active fracking site.

**2. Hydraulic fracturing reduces the health of infants born to mothers living up to 3 kilometers (1.8 miles) from a well site.** Mothers living between 1 kilometer (0.6 miles) and 3 kilometers (1.8 miles) from a well site also had babies who were in poorer health. However, the increased risk of giving birth to an infant with low birth weight was about a half to a third of what mothers living within 1 kilometer or less from a site experienced. The effects on the infant health index at these further distances from wells is also in the range of about one third to one half of the effect within 1 kilometer.

**3. The health impacts from hydraulic fracturing are highly local.** Mothers living beyond 3 kilometers (1.8 miles) from a fracking site saw little to no impact on low birth weight or in the index of infant health. Therefore, the results suggest that the adverse health implications from hydraulic fracturing are highly localized.

These health impacts are further constrained by the fact that areas surrounding fracking sites tend to be rural, so there are few people living within 3 kilometers of a site.

## Policy Implications

As local and state governments in the United States decide whether to allow hydraulic fracturing in their communities, it is crucial to carefully account for the costs and benefits of this type of industrial activity. One of the potential costs is a reduction in health among local communities who experience the adverse effects of pollution. This study provides the first peer-reviewed, large-scale evidence on the effect of hydraulic fracturing on infant health. It finds substantial reductions in infant health

within 1 kilometer of active fracturing sites, smaller effects within 1 to 3 kilometers, and no evidence further away from wells.

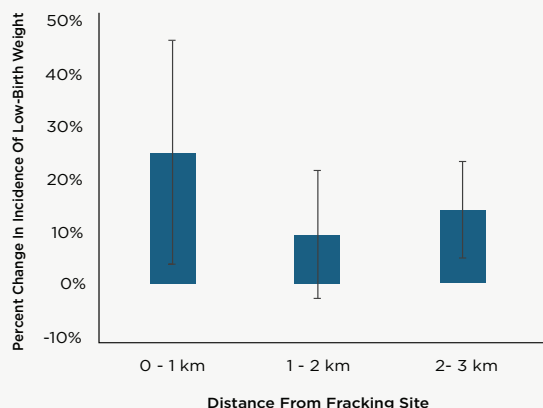
It should be noted that, of the wells studied in Pennsylvania, most were located in scarcely populated areas. However, as the hydraulic fracturing industry has developed in Pennsylvania, well sites have increasingly been built closer to more populated areas around Pittsburgh. This trend may continue nationally.

Future work should study the mechanism that causes local decreases in health. In particular, pollutants in the air or in the water, or chemicals onsite may affect local households. Traffic to and from the well may also play a role. Identifying a clear source could allow policymakers to better target regulations.

“Broadly, hydraulic fracturing has reduced energy prices and caused natural gas to greatly decrease the use of coal for power generation in the United States, leading to reductions in air pollution that have very likely improved health throughout the country. But these national benefits depend on local communities allowing hydraulic fracturing and governments around the world have taken very different approaches with some banning it and others embracing. This study provides the first large-scale peer-reviewed evidence of a link between hydraulic fracturing activities and our health, specifically the health of babies.”

**MICHAEL GREENSTONE**  
DIRECTOR, EPIC

**Figure 2** • Percent Change In Incidence Of Low-Birth Weight, By Distance From Active Hydraulic Fracturing Site



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