Nuclear Power Generation and Health Outcomes: Evidence from U.S. Commercial Nuclear Plants

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Abstract

Nuclear power is experiencing a resurgence, yet the health impacts remain poorly understood. This paper estimates the effects of commercial nuclear power plant operations in the United States on infant mortality and births. The effects of staggered power plant openings on outcomes are estimated using Callaway and Sant'Anna event studies. The paper has two preliminary findings. First, nuclear power generation did not have an adverse impact on infant mortality. Second, nuclear power generation did not have an adverse impact on births. The results are robust to alternative control groups.

JEL Codes: I18, L94, Q40, Q53

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1 Introduction

Nuclear power remains a central component of global strategies to achieve decarbonization and meet climate targets (Lee et al., 2023). Yet, despite its low-carbon benefits, concerns persist regarding potential health risks from radiation exposure associated with nuclear power generation. Licensed facilities in the United States routinely release extremely small amounts of radiation during normal operations, which are tightly regulated and monitored by the Nuclear Regulatory Commission (NRC) to ensure doses remain well below established safety limits. Decades of monitoring and epidemiological research—including the seminal National Cancer Institute (NCI) study *Cancer in Populations Living Near Nuclear Facilities* (Jablon, Hrubec and Boice, 1991)—have found no systematic evidence that proximity to nuclear facilities increases cancer mortality.

Nonetheless, public concern has endured, in part fueled by high-profile nuclear accidents such as Three Mile Island, Chernobyl, and Fukushima, which have heightened perceptions of risk even when routine operational exposures remain extremely low. These perceptions have influenced public debates, policy decisions, and contributed to the slow growth or even phaseout of nuclear power in some countries. In response to ongoing concerns, the NRC commissioned the National Academy of Sciences (NAS) in 2010 to reexamine the issue using modern data and methods. The NAS ultimately concluded that, given the small expected effect sizes, data limitations, and long latency periods of most cancers, such a study was unlikely to produce meaningful results within a reasonable timeframe or cost. As a result, the NRC continues to rely on the NCI's findings while monitoring emerging evidence on low-dose radiation exposure. Importantly, since the early case studies of radiation exposure in the 1970s, researchers have argued that short-run indicators—such as infant mortality and birth outcomes—may offer a more sensitive lens for detecting potential effects of low-level radiation exposure (DeGroot, 1972; Landau, 1972; Sternglass, 1972; Tompkins, Hamilton and Hoffman, 1972).

This paper estimates the effects of commercial nuclear power plant operations in the United States on infant mortality and births. We focus on infant health outcomes because they are more plausibly exogenous to the introduction of nuclear power plants than all-age mortality; given the short exposure window around birth, they are less likely to reflect long-term selective migration or health accumulation effects that we cannot observe in our data. We leverage nuclear generation data from the U.S. Energy

Information Administration archives (EIA, June 2025). Our primary outcomes of interest are infant mortality and infant births. Infant birth and mortality data are from the ICPSR Natality and Mortality dataset (Bailey et al., 2016).

To estimate the effects, we use Callaway and Sant'Anna (2021) event studies. Any county recording positive net nuclear electricity generation is classified as treated. To construct the control group, we compiled a list of canceled nuclear plant projects from multiple publicly available sources, including *Nuclear Plant Cancellations: Causes, Costs, and Consequences* (DOE, 1983).[1]

The paper has two preliminary findings. First, nuclear power generation did not have an adverse impact on infant mortality. Second, nuclear power generation did not have an adverse impact on births. In both cases, our confidence intervals always include zero. The results are robust to two alternative control groups. The first is Ring 2 counties, which are one county removed from treated counties. The second is the entire US with the exception of Ring 1 counties, which are adjacent to treated counties, and Ring 2 counties.

Our preliminary findings are subject to a number of important caveats. First, we cannot rule out potential chronic effects of nuclear power generation, as our data do not track individual health outcomes over time. Several studies have examined chronic impacts of sustained low-dose radiation exposure, particularly in the context of nuclear accidents such as Chernobyl or Fukushima (Almond, Edlund and Palme, 2009; Black et al., 2019). Second, we do not consider the health implications of catastrophic nuclear accidents, which differ qualitatively from routine plant operations. Third, our analysis is restricted to commercial plant sites and does not examine offsite nuclear waste storage facilities, which may impose distinct environmental and health risks. Finally, we do not address the health consequences of atmospheric atomic weapons testing, which has been linked to increased cancer risks and mortality over time (Simon et al., 2010).

Our study contributes to a long-standing literature on the health impacts of nuclear power generation. One of the earliest systematic investigations into this topic was conducted by Morris H. DeGroot for the *Sixth Berkeley Symposium on Mathematical Statistics and Probability*. He concluded: *"... in view of the smallness of the effects and*

[1]Utility companies retain the discretion to cancel nuclear generation projects at any stage. The primary reasons for these cancellations were economic motives and stricter regulations due to the Three Mile Island accident (DOE, 1983).

the simplicity of the model. Namely, the studies are inconclusive. They neither establish nor disprove the existence of an effect. They do, however, lead to the inescapable recommendation that more comprehensive and detailed studies of these questions are urgently needed" (DeGroot, 1972). To our knowledge, there are no studies that show a causal relationship between nuclear power generation and infant health. Jablon, Hrubec and Boice (1991) did not find higher rates of cancer near nuclear power plants. While relatively comprehensive, the study is limited by its correlational design and narrow focus on cancer. Case studies in both the U.S. and the U.K. found no significant increase in cancer or infant mortality near nuclear power plants, with the possible exception of childhood leukemia (Enstrom, 1983; Forman et al., 1987). In contrast, other studies have estimated negative health effects of proximity to nuclear plants on various health outcomes ((Ghirga, 2010; Hatch et al., 1991; Mangano, 2008; Mangano et al., 2002)).[2] To our knowledge, we provide the first causal estimates documenting the lack of relationship between nuclear power generation and infant health.

The rest of the paper proceeds as follows. Section 2 discusses the background information on commercial nuclear power plant operations and the literature on nuclear power generation and infant health. Section 3 describes our data. Section 4 presents our empirical strategy. Section 5 reports results, and Section 6 concludes.

[2]Additionally, an epidemiological study by the National Academy of Sciences highlighted the challenges in conducting epidemiologic studies of cancer risks in populations near NRC-licensed nuclear facilities (Council et al., 2012).

References

Almond, Douglas, Lena Edlund, and Mårten Palme. 2009. "Chernobyl's subclinical legacy: prenatal exposure to radioactive fallout and school outcomes in Sweden." *The Quarterly journal of economics*, 124(4): 1729–1772.

Bailey, Martha, Karen Clay, Price Fishback, Michael R. Haines, Shawn Kantor, Edson Severnini, and Anna Wentz. 2016. *US county-level natality and mortality data, 1915-2007.*

Black, Sandra E, Aline Bütikofer, Paul J Devereux, and Kjell G Salvanes. 2019. "This is only a test? Long-run and intergenerational impacts of prenatal exposure to radioactive fallout." *Review of Economics and Statistics*, 101(3): 531–546.

Callaway, Brantly, and Pedro H.C. Sant'Anna. 2021. "Difference-in-Differences with multiple time periods." *Journal of Econometrics*, 225(2): 200–230.

Council, National Research, Division on Earth, Life Studies, Radiation Studies Board, and Committee on the Analysis of Cancer Risks in Populations near Nuclear Facilitiesâ¬" Phase I. 2012. *Analysis of cancer risks in populations near nuclear facilities: phase 1.* National Academies Press.

DeGroot, Morris H. 1972. "Statistical studies of the effect of low level radiation from nuclear reactors on human health." Vol. 6, 223–234, University of California Press.

DOE. 1983. "Nuclear plant cancellations: Causes, costs, and consequences."

EIA. June 2025. *U.S. Energy Information Administration, Annual Electric Power Industry Report.* Vol. Form EIA-860.

Enstrom, James E. 1983. "Cancer mortality patterns around the San Onofre nuclear power plant, 1960-1978." *American journal of public health*, 73(1): 83–92.

Forman, David, Paula Cook-Mozaffari, Sarah Darby, Gwyneth Davey, Irene Stratton, Richard Doll, and Malcolm Pike. 1987. "Cancer near nuclear installations." *Nature*, 329(6139): 499–505.

Ghirga, Giovanni. 2010. "Cancer in children residing near nuclear power plants: an open question." *Italian journal of pediatrics*, 36: 1–4.

Hatch, Maureen C, Sylvan Wallenstein, Jan Beyea, Jeri W Nieves, and Mervyn Susser. 1991. "Cancer rates after the Three Mile Island nuclear accident and proximity of residence to the plant." *American Journal of Public Health*, 81(6): 719–724.

Jablon, Seymour, Zdenek Hrubec, and John D Boice. 1991. "Cancer in populations living near nuclear facilities: a survey of mortality nationwide and incidence in two states." *Jama*, 265(11): 1403–1408.

Landau, Emanuel. 1972. "Radiation and Infant Mortality—Some Hazards of Methodology." Vol. 6, 345–353, University of California Press.

Lee, Hoesung, Katherine Calvin, Dipak Dasgupta, Gerhard Krinner, Aditi Mukherji, Peter Thorne, Christopher Trisos, José Romero, Paulina Aldunce, Ko Barret, et al. 2023. "IPCC, 2023: Climate change 2023: Synthesis report, summary for policymakers. Contribution of working groups i, II and III to the sixth assessment report of the intergovernmental panel on climate change [core writing team, h. Lee and j. Romero (eds.)]. IPCC, geneva, Switzerland."

Mangano, Joseph J. 2008. "Excess infant mortality after nuclear plant startup in rural Mississippi." *International Journal of Health Services*, 38(2): 277–291.

Mangano, Joseph J, Jay M Gould, Ernest J Sternglass, Janette D Sherman, Jerry Brown, and William McDonnell. 2002. "Infant death and childhood cancer reductions after nuclear plant closings in the United States." *Archives of Environmental Health: An International Journal*, 57(1): 23–31.

Simon, Steven L, André Bouville, Charles E Land, and Harold L Beck. 2010. "Radiation doses and cancer risks in the Marshall Islands associated with exposure to radioactive fallout from Bikini and Enewetak nuclear weapons tests: summary." *Health physics*, 99(2): 105–123.

Sternglass, Ernest J. 1972. "Environmental Radiation and Human Health." Vol. 6, 145–221, University of California Press.

Tompkins, Edythalena A., Peggy M. Hamilton, and Daniel A. Hoffman. 1972. "Infant Mortality Around Three Nuclear Power Reactors." Vol. 6, 279–290, University of California Press.