

Dioxin Exposure and Public Health: Insights from the East Palestine Train Derailment

Haynes, E. N., Eskenazi, B., Hilbert, T. J., Brancato, C., Holland, N., Kim, C., Calafat, A. M., Jones, R., Davis, M., Birnbaum, L. S., & Sjodin, A. (2024). Serum Dioxin Levels in a Subset of Participants of the East Palestine, Ohio Train Derailment Health Tracking Study. *Environmental Science & Technology Letters*, 11(7), 673–678. <https://doi.org/10.1021/acs.estlett.4c00263>

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Smoke from the 2023 Ohio train derailment taken during the night on February 3.
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In the late evening of February 3, 2023, [a catastrophic train derailment in East Palestine, Ohio](#), released hazardous chemicals into the surrounding environment, prompting emergency declarations and an ongoing national conversation on environmental and hazardous chemical safety. The train, operated by Norfolk Southern, [was likely derailed by an overheated wheel bearing](#). In all, [53 train cars derailed](#), many of which caught fire – 11 of the derailed cars carried hazardous materials like vinyl chloride, ethylene glycol, ethylhexyl

acrylate, butyl acrylate, and isobutylene. Approximately [4,700 residents were ordered to evacuate](#) due to the imminent risk of chemical exposure.

The derailment's aftermath raised serious concerns about air, water, and soil contamination. One of the most contentious issues was the [decision to conduct a "vent and burn"](#) operation on February 6, 2023, which involved the controlled release and combustion of vinyl chloride. This measure was taken to prevent an uncontrolled explosion but [led to the release of toxic byproducts](#), including polychlorinated dibenzo-p-dioxins (PCDD/F), dibenzofurans, and coplanar polychlorinated biphenyls (cPCBs), collectively known as dioxins. These persistent organic pollutants are known to have severe public health implications, including raising the risk of cancer, reproductive issues, and immune system dysfunction.

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Drone footage shows the freight train derailment in East Palestine, Ohio, U.S., February 6, 2023, in this screengrab obtained from a video released by the National Transportation Safety Board.



An air monitoring device in East Palestine.
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In the weeks following the disaster, the Environmental Protection Agency (EPA) monitored air and water quality, reporting that levels of certain pollutants were within acceptable limits. However, residents and resident advocacy groups, as well as independent researchers, expressed concerns that the existing regulatory thresholds did not fully capture or protect residents from the long-term health risks associated with dioxin exposure. The train derailment also resurfaced debates surrounding the regulation of vinyl chloride, a known carcinogen. This has led recently to an [EPA ruling](#) that more strictly regulates the use and disposal of vinyl chloride. Yet debate still circulates over the rule, and critics argue that stronger preventative measures and regulatory oversight could have mitigated the scale of the disaster, its potential health impacts, and future disaster prevention.

The Health Risks of Dioxins

Vinyl chloride is a [key building block for polyvinyl chloride \(PVC\) plastics](#) and a widely used industrial chemical. It is also a [known carcinogen](#), and, when burned, it [produces highly toxic compounds, including dioxins](#). The vent and burn operation in East Palestine led to the uncontrolled release of dioxins and other substances into the atmosphere, where they likely settled onto soil and in water, creating long-term exposure risks.



[Dioxins form during the incomplete combustion of chlorine-containing materials](#) such as vinyl chloride. Once released, they are among [the most toxic environmental pollutants](#) and persist in the environment, bioaccumulate in the food chain, and pose chronic health risks to exposed populations. One particular dioxin, Tetrachlorodibenzo-p-Dioxin (TCDD), [was a component of Agent Orange](#), a highly toxic herbicide used to clear forest during the Vietnam War, which has likely [impacted the health](#) of hundreds of thousands of service members and millions of Vietnamese people. The East Palestine train derailment created conditions to allow for the substantial release of dioxins, leading to likely lasting public health consequences in the community and beyond.

Dioxins are a class of toxic compounds [that accumulate in fatty tissues](#) and [persist in the environment for years](#). Their ability to interfere with hormonal and immune functions makes them a significant public health threat. Long-term exposure to dioxins has been linked to:

Cancer: Dioxins are classified as known human carcinogens, contributing to increased risks of liver, lung, and breast cancers.

Reproductive and Developmental Toxicity: Prenatal exposure has been associated with birth defects, hormone disruption, and lower birth weights.

Endocrine Disruption: Dioxins interfere with hormone signaling, affecting metabolism and reproductive health.

Immune System Effects: Exposure has been linked to weakened immune responses and increased susceptibility to infections.

Was There Excess Dioxin Exposure in East Palestine?

In response to public concern, researchers at the University of Kentucky College of Public Health [conducted a pilot study in July 2023](#) to assess dioxin levels in residents of East Palestine. The study measured serum dioxin concentrations in the blood of 18 participants who lived within approximately one mile of the derailment site. These participants were White, nonsmokers, and had a mean age of 55.

Using gas chromatography and high-resolution mass spectrometry, the study evaluated the levels of 20 dioxin, furan, and cPCB congeners. The results were then compared to baseline data from the 2011–2012 National Health and Nutrition Examination Survey (NHANES).

The results of the study showed that serum dioxin levels in East Palestine residents were comparable to or lower than those found in the general U.S. population in 2011–2012:

No Significant Increase: Participants' toxic equivalency (TEQ) values were within the expected range for their age, sex, and race.

Age Trends: Younger participants exhibited lower dioxin levels, consistent with trends of declining environmental exposure over time.

Limitations

The study was conducted five months post-incident, meaning peak exposure levels could have been missed. Additionally, the small sample size limits broader conclusions about long-term health risks. Other protective factors also might not be considered, such as exposure during the incident or protections at the participant's residence.

While these findings suggest that immediate dioxin exposure from the derailment may not have resulted in significantly elevated serum levels, the study underscores the need for continued monitoring. Given dioxins' long 7 to 11-year half-life, ongoing health surveillance is crucial to assess cumulative exposure and potential delayed health effects. This study would not have captured such cumulative exposure.



Petrochemical refineries in Houston, Texas. Creative Commons Attribution-Share Alike 2.0

The Oil and Gas Connection

The East Palestine derailment is a stark reminder of the oil and gas industry's role in environmental contamination. Many hazardous chemicals involved in the derailment, including vinyl chloride, [are petrochemical products derived from fossil fuels](#). The production, transport, and accidental release of these substances [pose serious health risks to communities near industrial sites](#) and along railroads that transport these compounds. In the U.S., [up to 36 million pounds of vinyl chloride travels on more than 200 rail cars across nearly 2,000 miles of railways at any given moment](#). Over 3 million people live within one mile of just a single vinyl chloride transporting [train route between Texas and New Jersey](#).

Looking Ahead: The Need for Policy Action

The EPA continues to monitor the air around East Palestine using a plane equipped with a camera that provides [real-time chemical and radiological data](#). The EPA also uses a mobile atmospheric gas analyzer in the area to monitor outdoor air emissions.

The EPA has also issued [several legal orders](#) to Norfolk Southern, including [orders to remove contaminated sediments](#) in culverted areas and to further identify and remove oils and hazardous substances from the sediment in nearby streams. In May 2024, the U.S. Department of Justice [reached a settlement with Norfolk Southern valued at \\$310 million](#) to further address and pay for damages related to the derailment.

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Columbiana County Health District maintains a repository of [ongoing academic research](#) related to the health outcomes of the train derailment. They are also continuing to test private well water and host a variety of resources [on their main webpage](#) in collaboration with other state and federal agencies.

The East Palestine derailment incident also highlights significant gaps in disaster response and regulatory oversight. To protect public health, policymakers should prioritize:

Stronger Environmental Regulations: Stricter monitoring and reporting requirements for industrial pollutants, including the tracking of cumulative emissions.

Improved Disaster Response Strategies: Rapid deployment of health assessments, biomonitoring, and response efforts in affected communities.

Long-Term Health Studies: Ongoing research into the health impacts of industrial chemical exposure, particularly for vulnerable populations.

As fossil fuel production continues to expand, the intersection of petrochemical pollution and public health will continue to grow. The East Palestine derailment serves as a case study in the broader need for stronger environmental protections, safer handling of hazardous materials, and a transition toward safer, sustainable energy sources.

To learn more about this study, explore these links:

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