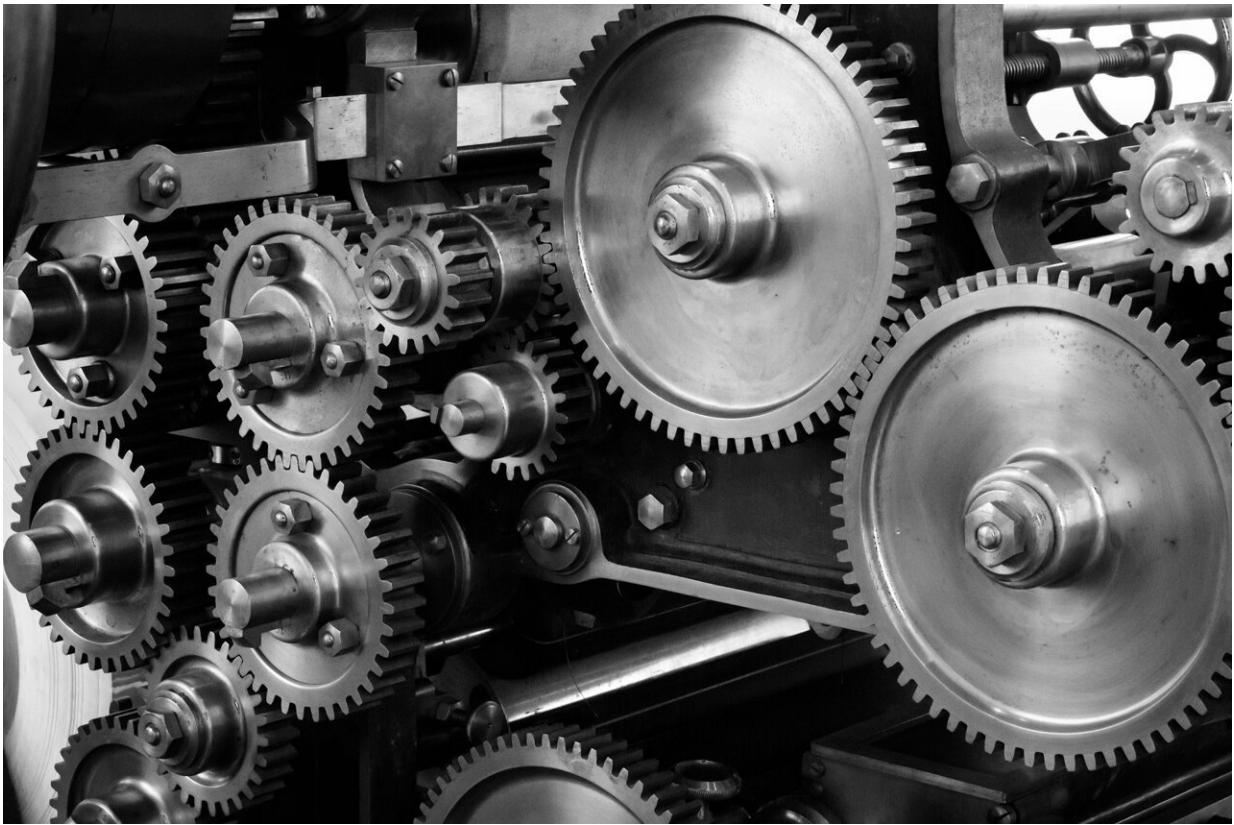


Industrial disasters may cause higher rates of disability and cancer for future generations

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Credit: Pixabay/CC0 Public Domain

Industrial accidents may have a much longer-term and serious impact on people's health than just the immediate aftermath, suggests a study from the University of California San Diego published online in the journal

BMJ Open.

"Our paper finds evidence that one of the worst industrial disasters in India, the Bhopal gas disaster in December 1984, may have led to men who were in-utero at the time of the accident having a higher risk of developing disabilities and cancer later in life," said study corresponding author Gordon McCord, associate teaching professor at the UC San Diego School of Global Policy and Strategy. "The results also suggest that the Bhopal gas disaster affected people across a substantially more widespread area than has previously been demonstrated."

In the Bhopal incident, there was a methyl isocyanate gas leak at a pesticide plant and the leak of toxic gas which spread for a 7km radius, exposing more than half a million people in the city of Bhopal to the gas and led to up to 30,000 deaths in the region.

"There were serious long-term and chronic [health](#) consequences for hundreds of thousands of survivors, including respiratory, neurological, musculoskeletal, ophthalmic and endocrine impacts," said study co-author Prashant Bharadwaj, professor in UC San Diego's Department of Economics.

In addition, the leak's toxins affected groundwater and the [reproductive health](#) and other [health outcomes](#) of exposed women, suggesting that generations not exposed to the toxic gas directly may nevertheless have suffered adverse health and social impacts of the event.

The paper also cites previous literature that found, for example, that there was a fourfold increase in the rate of miscarriage following the gas leak, as well as increased risk of stillbirth and neonatal mortality.

However, the UC San Diego study is the first to extensively research the multi-generational impacts of such an event and recognize the potential

far-reaching repercussions by investigating these impacts on children born to female survivors of the Bhopal gas disaster.

The authors looked at official health and education data, such as India's National Family Health Survey, to estimate the long-term health effects (specifically adult cancer rates and disability) and the educational attainments of people who were exposed to the leaked gas in utero or as children in 1984.

They also used health data to examine the health effects of exposure to the event among 47,817 people aged 15-49 years living in Madhya Pradesh in 2015-16 as well as socioeconomic data on 13,369 men born between 1960 and 1990. The data also included 1,260 people who were born between 1981 and 1985 to women who lived within 250km of Bhopal.

"Our analysis of the results showed there were long-term, inter-generational impacts of the gas leak, showing that men who were in utero at the time whose mothers lived close to Bhopal were more likely to have a disability that affected their employment 15 years later," said study co-author, Anita Raj, a professor in the UC San Diego Departments of Medicine and Education Studies and founding director of the campus' Center on Gender Equity and Health. "They also had an eightfold higher cancer risk and lower educational attainment more than 30 years later, when compared to adults who were born before or after the disaster and who lived further away from Bhopal."

The researchers also found changes in the sex ratio among children born in 1985, suggesting an effect of the event up to 100 km from the accident.

Women who lived within 100 km of Bhopal experienced a relative decrease in the birth of males compared to females in the 1985

group—64% of children born from 1981 to 1984 were male, a proportion that dropped to 60% in 1985—whereas women living beyond 100 km had no difference in the sex ratio across the 1981–1984 and the 1985 groups.

The study had some limitations in that the people included would have had a range of actual exposure to the dangerous gas and the researcher's calculations could be affected by migration and mortality.

Nevertheless, the researchers concluded: "These results indicate social costs stemming from the Bhopal gas disaster that extend far beyond the mortality and morbidity experienced in the immediate aftermath. Quantifying these multi-generational impacts is important for policy consideration."

They added, "Moreover, the evidence presented in this paper starkly highlights the long-term, inter-generational health and human capital effects of the Bhopal gas disaster and underscores the need for ongoing survivor support, as well as robust regulatory protection."

More information: Long-term Health and Human Capital Effects of In Utero Exposure to an Industrial Disaster: A Spatial Difference-in-Difference Analysis of the Bhopal Gas Tragedy, *BMJ Open* (2023).

Gordon C. McCord et al, In Utero Exposure to Industrial Disasters: A Case Study of the Bhopal Gas Tragedy, *SSRN Electronic Journal* (2021).
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