



Breathe carefully: air emissions of benzene may cause birth defects.

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Lupo, PJ, E Symanski, DK Waller, MA Canfield and LE Mitchellet. 2010. Maternal exposure to ambient levels of benzene and neural tube defect among offspring, Texas, 1999-2004. [Environmental Health Perspectives](http://dx.doi.org/10.1289/ehp.1002212) <http://dx.doi.org/10.1289/ehp.1002212>.

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Synopsis by [Ami Zota, Sc.D](#) and [Wendy Hessler](#)



Pregnant women living in Texas neighborhoods with higher air levels of benzene – a pollutant often released from oil refineries and traffic exhaust – are more likely to have babies with neural tube defects. Women living in the areas with the highest benzene levels had a two times greater risk for their children to be born with spina bifida. This study is the first to examine the link between environmental levels of benzene and neural tube defects in newborns and adds to the growing body of evidence linking prenatal air pollution exposures to harmful effects on the developing fetus.



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Context

Neural tube defects are a common type of birth defect that originate within the first four weeks after conception. In the affected fetus, the nervous system – the brain and spinal chord – does not form properly. Spina bifida and anencephaly are two well-known types of neural tube defects.

Infants with these birth defects experience a host of short and long-term health consequences, including paralysis, stillbirth and death. While taking folic acid before and during pregnancy can prevent the condition, the cause of these severe defects, in most cases, remains a mystery to doctors and scientists.

Benzene is a known human carcinogen and prenatal exposure is linked to infant health problems. Long-term exposure to high levels of benzene in the air can cause leukemia. Leukemia is a type of cancer that affects the primary blood-forming organs – the bone marrow and the lymph system ([ATSDR 2007](#)).

What did they do?

Using the Texas Birth Defects Registry data from 1999 to 2004, the scientists identified 553 babies with two forms of neural tube defects – spina bifida and anencephaly. They also identified 3,695 controls from a random sample of unaffected live births, which they matched to the cases on year of birth.

They characterized air pollution exposures using a U.S. Environmental Protection Agency model for air toxics. The scientists estimated annual concentrations for benzene at the census tract level, and then calculated each participant's exposure according to their home address at the time of delivery. The researchers were primarily interested in benzene, but also examined effects of several other air toxics, including toluene, ethylbenzene and xylene.

What did they find?

Maternal exposure to benzene is linked to neural tube defects in their offspring. The risk of giving birth to an infant with spina bifida – one type of neural tube defect – was more than doubled for women living in areas with the highest benzene levels compared to women living in areas with the lowest levels. Annual benzene levels for the "highest" exposure group ranged from

Exposure during the sensitive prenatal period may increase risks of health effects. Benzene can pass from mother to fetus through the placenta. Human studies suggest that maternal exposures to benzene during pregnancy may increase risk for miscarriages, low birth weight infants and childhood cancers.

Benzene is found in gasoline, and major sources include petrochemical industries – such as oil refineries – and vehicle exhaust. As a result, most people in urban areas are exposed to low levels of benzene.

Texas ranks number one in the nation for benzene levels in the outdoor air. Approximately half of all benzene emissions in the United States occur in Texas. The counties with the highest benzene emissions from stationary sources are found along the Gulf coast where there is a dense network of petrochemical industries.

Unlike lead or particulate matter, there is no federal EPA standard for benzene levels in the outdoor air. In the United States, federal workplace limits are set for 1 part per million (or 3,190 $\mu\text{g}/\text{m}^3$) during an eight-hour period.

levels from a 1999 U.S. Environmental Protection Agency air pollution model even though the study period extended through 2004. If there were regional shifts in benzene emissions during the study period, participants' exposures could be misclassified – for example, assigned to the high exposure category when their exposure was truly low. Future studies should use air pollution data from multiple years and sources.

While the scientists do not fully understand how benzene may cause neural tube defects, they speculate that benzene's ability to damage DNA material may play a critical role especially if exposures occur during a sensitive time of fetal development.

The population examined in this study was limited to Texas, an area with high benzene emissions. It is not known whether the study results apply to other regions of the U.S. or the world. Nevertheless, the findings may have a direct impact on regulation of benzene emissions particularly those from petrochemical industries, which emit high levels of benzene in Texas.

approximately 3 to 7 $\mu\text{g}/\text{m}^3$. These levels are a thousand times lower than the federal workplace limits for benzene.

The associations were strongest for those in the highest exposure group, but there were also positive associations between benzene and spina bifida risk with the low-medium, medium and medium-high exposure groups when compared to the lowest benzene group.

These results persisted after accounting for other important risk factors such as year of birth, maternal race, education, census tract poverty level and parity – the number of previous children. Compared to controls, cases were more likely to be Hispanic, born in Mexico, young and less educated.

No statistically significant associations were found between neural tube defects and the other air pollutants.

What does it mean?

Prenatal exposure to higher levels of benzene in the air is associated with an increased risk for neural tube defects. Mostly, exposures were as much as a thousand times lower than federal workplace standards in the United States.

This study adds to the growing body of evidence linking air pollution exposure to adverse birth outcomes. This is the first study to examine a link between outdoor levels of benzene and neural tube defects. Previous studies have found links between maternal exposures to air toxics in the workplace and an increased risk of birth defects in their offspring.

One limitation of this study was the approach the researchers used to characterize maternal air pollution exposure. The authors estimated benzene

Resources

[Neural tube defects](#). March of Dimes.

[Summary for benzene](#). Toxicity and Exposure Assessments for Children's Health (TEACH), U.S. Environmental Protection Agency (PDF).

[ToxFAQ for benzene](#). Agency for Toxic Substances and Disease Registry (ATSDR).

[Toxics Release Inventory Program](#). US Environmental Protection Agency.

Benzene



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[Chemical levels in bores 'safe': LNG](#). Test results show bore water in southwest Queensland is clear of unsafe levels of cancer-causing chemicals, mining giant Australia Pacific LNG says. Benzene, toluene, ethylene and xylene was reported on October 19 to have been found in eight exploration wells run by the company in the Surat Basin, west of Brisbane. [Australian Associated Press](#).

[Calendar exposes cases of breast cancer in men at Camp Lejeune](#). Thirteen men who suffer from breast cancer appear in a new calendar. All served or lived on the Marine base at Camp Lejeune. All believe their cancer can be traced to the decades in which drinking water contaminated with benzene, TCE, and other poisons poured from the base's taps. [Charlotte Observer, North Carolina](#).

[Study links Texas birth defects to benzene levels](#). Women who live in Texas neighborhoods with higher levels of benzene, a pollutant from refineries and tailpipes, are more likely to have babies with a serious neurological defect called spina bifida — a condition in which a piece of the spinal cord protrudes from the spinal column, according to a new study. [Houston Chronicle, Texas](#).

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