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Diesel Fumes Change Brain Activity

By Michael Smith, North American Correspondent, MedPage Today

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Reviewed by [Dori F. Zaleznik, MD](#); Associate Clinical Professor of Medicine, Harvard Medical School, Boston.

HEERLEN, The Netherlands, March 10 -- Diesel fumes belching from a truck may do more to the brain than offend olfactory neurons, according to researchers here.

Action Points

- Explain to interested patients that this study suggests that pollution by diesel fumes is not just a question of noxious odors, but may also have effects on the brain.
- Note that the study was small and further research is needed.

In a small crossover study, researchers recorded marked changes in brain wave activity when volunteers were exposed to diesel fumes compared with exposure to filtered air, according to Paul Borm, Ph.D., of Zuyd University, and colleagues.

The effect may be from nanoparticles that slowly penetrate the brain or affect neurophysiologic signaling, Dr. Borm and colleagues said online in the open-access journal *Particle and Fibre Toxicology*.

"The observed effects of diesel exhaust on the (electroencephalogram) add up to the evidence that air pollution may exert its effects by a variety of pathways and may induce effects in the brain," the researchers said.

Dr. Borm said that the nanoparticles he and colleagues are concerned about are essentially the soot emitted by diesel engines.

"We can only speculate what these effects may mean for the chronic exposure to air pollution encountered in busy cities where the levels of such soot particles can be very high," he said.

For the study, he and colleagues enrolled 10 healthy men, ages 18 to 39, with no neurological or psychopathological impairment.

Blinded randomized, they were exposed to dilute diesel exhaust fumes (at 300 mcg per cubic meter of air) or filtered air for one-hour periods, while their brain activity was measured using quantitative electroencephalography at eight sites on the scalp. Then they were crossed over.

Pre-exposure measurements were taken outside the exposure chamber as a baseline and the exposures were separated by two to four days, the researchers said.

The researchers found:

- No difference in median power frequency between measurements outside the exposure chamber and pre-exposure measurements inside the chamber, implying there was no effect of the chamber itself, even though the smell of diesel fumes often lingered.
- An increasing difference in median power frequency, beginning after 30 minutes of exposure to diesel fumes, compared to the filtered air. The difference was significant at $P0.05$ and continued to increase over the exposure period.
- The effect was most pronounced at the frontal electrode sites and was mainly of increased fast wave (beta-2) activity.
- The difference between diesel and filtered air exposure continued to rise after the end of the exposure and remained significant at $P0.05$.

The findings "suggest an increased activity of the left frontal cortex during and after" diesel exposure, Dr. Borm and colleagues said.

But they cautioned that it's still not clear exactly what is happening and how the effect is produced. They noted that diesel exhaust is a mixture of combustion derived nanoparticles and exhaust gases.

It's possible that nanoparticles may translocate to the brain, causing the increased activity, "but no direct evidence is presented for this explanation," they said.

Also, the exposure room was contaminated with a pungent smell "and it cannot be excluded that the smell of diesel exhaust plays a role in the increased cortical arousal in the exposed subjects," Dr. Borm and colleagues said.

That explanation is unlikely, they said, because the volunteers only reported the unpleasant smell at the beginning of each session, while the changes in brain activity took place later, and also because the odor was also present during the sham condition.

The study was supported by SKO, the British Heart Foundation, the Swedish Lung-Heart Foundation, and the Swedish National Air Pollution program. Maastricht Instruments and Biometrisch Centrum supplied equipment. The researchers did not report any conflicts.

Primary source: Particle and Fibre Toxicology

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Cruts B "[Exposure to diesel exhaust induces changes in EEG in human volunteers](#)" *Particle and Fibre Toxicology* 2008.

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