Diesel exhaust may impair blood vessel function

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TORONTO — Breathing in diesel exhaust fumes at levels typically found in large cities disrupts important blood vessel functions, new research has shown, suggesting a potential mechanism linking increased heart attack rates during periods of high air pollution.

Numerous studies over the last 20 years have shown that the numbers of deaths and hospitalizations due to heart attack and stroke go up as traffic-induced air pollution rises.

The link between air pollution and cardiovascular disease is strongest for fine-particle pollutants, of which the combustion of fossil fuels from vehicles is a major source. Yet the underlying factors responsible for air pollution's effects on the heart and blood vessels had remained largely unknown.

The study led by Dr. Nicholas Mills, a researcher at the Centre for Cardiovascular Science at the University of Edinburgh, suggests what some of those factors might be.

Researchers found that exposure to diesel exhaust for one hour during exercise caused a significant decrease in the blood vessels' ability to expand, or dilate. Exposure to the air pollution also decreased levels of an enzyme that helps prevent clots from forming in the blood and possibly causing a heart attack.

"Low levels of diesel exhaust are having real effects on our blood vessels, and the way in which they function, that may potentially be sufficient to act as a trigger for a heart attack," Mills said Monday from Edinburgh, Scotland.

Short-term exposure to air pollution can worsen existing problems and lead to hospitalization for heart attack and other heart and lung conditions. Long-term repeated exposure increases the risk of death from coronary heart disease, abnormal heart rhythms and heart failure.

"Long-term exposure could be contributing to the formation of coronary artery disease," said Mills, whose study is published in the Journal of the American Heart Association.

The study involved 30 healthy, non-smoking men, aged 20 to 38, who were evaluated during two one-hour tests, two weeks apart.

During each test, the men were randomly assigned to be exposed to either filtered air or diesel exhaust while riding a stationary bicycle for 15-minute intervals while inside a specially built diesel exposure chamber. Diesel exhaust was generated from an idling engine.

During exposure, the particle concentration was kept at a level comparable to curb-side exposure on a busy street in a large city.

"It mimics more the sorts of activities you might do when you're encountering diesel exhaust," said Mills of the study's design. "So if you're a cyclist, you might go for a 15-minute bike ride and be exposed to diesel exhaust in the bus lane, for example. Or if you're walking on the streets, then you're going to be breathing more air than if you're just sitting at rest."

At two points - two and six hours after being in the chamber - researchers injected one arm of each participant with drugs that cause blood vessels to relax and expand, then measured blood flow in the infused and non-infused arms.

Participants' blood was tested before exposure and at two and six hours afterwards. The drugs, known as vasodilators, caused increases in forearm blood flow after exposure to both filtered air and diesel exhaust.

But blood flow fell markedly two hours after diesel exposure, and the reduced response to the vasodilators continued to persist six hours later, Mills said.

Researchers were particularly interested in diesel engines because they generate 100 times more pollutant particles than comparable-sized gasoline engines - and the number of diesel-powered automobiles is on the rise around the world, especially in Europe.

"Whether these findings apply to gasoline-powered engines is unclear," he said, since diesel fuel and gasoline are consumed and break down differently during engine operation."

Dr. Stephan van Eeden, a respirologist at the University of British Columbia, said such studies are important because they strengthen the evidence needed to convince governments to tighten air pollution regulations, particularly for trucks and buses that spew high levels of pollutants into the environment.

"Doing these controlled experiments like this group have done actually gives more credence that there is a biological mechanism," van Eeden, a spokesman for the Heart and Stroke Foundation, said from Vancouver. "We can explain why it happens."

The research could have major public health implications, in part by giving governments more clout to demand that heavy diesel-powered vehicles be retrofitted with devices that trap diesel exhaust particles instead of belching them into the air, Mills said.

"It's important because when you know what the mechanism is, you can start to think about ways to alter the exposure to try to prevent their effects."