

# New Concern Linked to Exposure

**THERE IS A HOST** of potential health issues linked to exposure to diesel exhaust: respiratory difficulties, inflammation, cardiovascular effects, heart problems, carcinogenic risks and asthma complications. Now, a recent study out of the Netherlands is adding another concern to that list: changes in brain function.

Citing the study as the first ever to “demonstrate functional changes in brain activity as a result of exposure to diesel exhaust in human subjects,” researchers found that after only 30 minutes of exposure, participants showed increased activity in the brain’s frontal cortex, indicating a stress response. The heightened activity continued to rise during a one-hour, post-exposure interval.

“Passage to the brain is of particular concern since nanoparticles are potent inducers of oxidative stress and the brain is very sensitive to damage caused by oxidative stress,” researchers write, noting that type of stress has been implicated in the development of Parkinson’s and Alzheimer’s diseases. “It is conceivable that the long-term effects of [particulate] exposure might include a decrease in cognitive function,” authors say.

The study, published in March in *Particle and Fibre Toxicology*, involved 10 male subjects, aged 18 to 39, exposed to either filtered air or exhaust from a diesel engine.

The level of exposure for the latter group — which included small pollutant levels of nitrogen dioxide, carbon monoxide and hydrocarbons — was set to reflect a peak exposure that may occur on the job.

Acknowledging that the findings are hampered by the lack of similar studies, researchers suggest the results are due to an effect of nanoparticles that slowly penetrate the brain. “We can only speculate on what these effects on the frontal cortex may mean for chronic exposure to particulate matter and/or nanoparticles,” authors write.

Dr. Allen Kraut, an occupational physician with the MFL Occupational Health Centre in Winnipeg, notes that an electroencephalogram (EEG) was used to measure electrical signals in participants’ brains. “EEGs are pretty non-specific changes,” Dr. Kraut explains. “It’s really impossible to say whether it’s the particulates or whether it’s the solvents and the carbon monoxide that lead to the change. When I’ve looked at the literature on this, I haven’t come up with much on long-term neurological problems from diesel exposures,” he adds.

The problem with diesel exhaust is that it contains thousands of different chemical substances which can spell health problems for workers: carbon monoxide, nitrogen oxide, sulphur dioxide, arsenic, benzene, poly-

cyclic aromatic hydrocarbons (PAHs), aldehydes and volatile organic compounds (VOCs), to name a few.

“The aldehydes, for example, are irritants, some of the PAHs may be carcinogenic, some of the VOCs may be toxic,” says Maria Costantini, principal scientist with the Health Effects Institute in Boston.

### Cancer connection

But the key word is “may.” The International Agency for Research on Cancer considers diesel exhaust “probably carcinogenic to humans,” while the National Institute for Occupational Safety and Health categorizes exhaust as “a potential occupational carcinogenic hazard.”

It is this uncertainty that raised concerns several years ago for workers near a bridge connecting Windsor, Ontario with Detroit. From 2001 to 2006, reports Marie-Claire Coupal, the 4th national vice-president of the Customs Excise Union, six female border officers, who are among those who handle the traffic of about 9,500

diesel-powered transport trucks daily at the Ambassador Bridge, were diagnosed with breast cancer. A seventh employee, two blocks away at the University of Windsor, had the same diagnosis. Other officers have reported respiratory problems, Coupal adds.

Short-term health effects could be immediate or take “a few minutes to an hour to a couple of hours” to manifest, depending on the concentration, the substances present and the length of exposure, Dr. Kraut says. The MFL Occupational Health Centre reports short-term exposure may cause headaches; nausea or feelings of lightheadedness; watery, irritated eyes or runny nose; “scratchy” throat or cough, wheezing or difficulty breathing; and heartburn.

In the Ambassador Bridge case, there is only a “strong suspicion” that the inhalation of fumes was a contributory factor to the breast cancer cases, Coupal says.

Dr. Quentin Chiotti, senior scientist and climate change programme director with Toronto-based Pollution Probe, notes that “medical research is really beginning to focus more on the whole proximity-to-traffic corridor issue in terms of a whole host of health impacts.” But that doesn’t mean the breast cancer issue will ever be resolved, Dr. Chiotti cautions.

“Not to say that seven cases of breast cancer aren’t significant and probably attributed to emissions, but you’re rarely going to see any kind of direct policy action taken based upon a small set of the population,” he argues. “I’m not sure to what degree the carcinogenic health impacts have been properly or sufficiently documented relative to diesel and particulates,” Dr. Chiotti adds.

Apart from border officers, workers at railroads and underground mines who use diesel-powered equipment

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and those in the transportation industry, such as truck drivers, are among the employees who may be at risk.

“There’s no doubt that transportation continues to be a major source of air pollution and air toxins,” Dr. Chiotti says. “The technology on school buses is pretty poor. You look at even just the visible black smoke that comes out of those vehicles.”

Dr. Chiotti points out that the black carbon smoke is typically not the concern. Rather, it is inhalation of fine and ultrafine particles that presents the danger.

Construction is another industry in which the use of diesel-powered equipment introduces the possibility of exposure. “Generally, heavy equipment operators are most exposed to diesel emissions,” says Dru Sahai, an occupational hygienist with the Construction Safety Association of Ontario in Toronto.

Sahai notes that demolition workers and labourers may be exposed because of heavy equipment use. A variety of other equipment, including dozers, excavators, backhoes, pavers and graders, vibratory soil compactors and loaders, may also place workers in the line of fire, he adds.

To help reduce exposure, Sahai notes that “the most effective method of controlling diesel emissions is at their source.” This includes using low-sulphur fuel and retrofitting diesel equipment with catalytic converters and filters to reduce emissions and diesel particulate matter.

“Older diesel technologies or fuels were a nightmare when it came to toxics and carcinogenic impact,” suggests Dr. Chiotti. But given the quality of diesel today, he says he “would have no hesitation driving a diesel vehicle.”

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Costantini says one way catalyst filters help reduce exposure is by “trapping the particles,” some of which may be less than 2.5 microns or between 2.5 and 10 microns in diameter. Catalyst filters fit into an exhaust system and utilize a matrix that absorbs particles and separates them from the diesel exhaust.

“With a combination of trapping the particles and ventilating the environment, you would feel pretty comfortable that the workers are not exposed,” she adds. But fitting engines with filters can sometimes change pressure in the engine and negatively alter its performance, suggests Dr. Murray Finkelstein, a medical consultant for Ontario’s Ministry of Labour.

What about masks? “To my knowledge, there are very few masks, if any, out there that will actually capture and prevent you from inhaling fine particulates and ultrafine particulates,” says Dr. Chiotti.

The effects of exposure continue to be inconclusive — and much debated. “There have been chamber studies where they expose people to diesel exhaust and those show very limited effects, even in terms of symptoms,” argues Costantini.

Dr. Kraut, on the other hand, contends there is “growing evidence” that exposure to diesel particulates increases the likelihood of inflammation of the cardiovascular system, leading to increased chance of heart attack or stroke. Dr. Finkelstein, for his part, says the biggest concern is measurement, whether that be for total particles or elemental carbon, which is the pure carbon core of the diesel exhaust.

“We know that diesel can be dangerous, but it’s not clear yet from a control perspective what the hygienist should be measuring to get the best optimal controls,” he says.

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