

Summer Smog, Allergic Living, 2006
Sarah Scott

In June of 2005, the smog hanging over downtown Toronto was so thick you couldn't see the CN Tower from the mid-town restaurant where Sara La Rocque was waiting tables at an outdoor patio. That was when Sara, a 21-year-old creative writing student, quit her job to go home and strip wallpaper. One day later, she couldn't breathe properly. Although she had experienced a brief bout of asthma as a child, this was different. It was like breathing through a straw. For most of the rest of the summer, as Ontario lumbered through a record summer of smog advisories, Sara stayed indoors. She was miserable. She couldn't even walk the family's golden retriever or the Burmese mountain dog around the block until six weeks later.

Sara's pretty sure what triggered her condition: "My asthma is smog-induced," she said. "I believe it's what caused it." A few years ago, most scientists would have doubted her analysis. The common wisdom was that air pollution can only exacerbate symptoms in people who are already living with asthma. But now, a handful of mavericks in the scientific world are building a case to prove Sara's point – that pollution might not just exacerbate asthma, but cause it.

No one – not Sara, not the asthma researchers – knows for sure. The cause or causes of asthma are still unclear, although theories abound, starting with the hygiene hypothesis. It suggests that our urban society is too germ- and virus-free, causing the underworked immune systems of those who inherit the allergic tendency to react to proteins – such as inhaled pollen or dust mites – that should be harmless. The immune system's over-reaction results in airway inflammation and asthma attacks. There are also new indications that antibiotics in early life and obesity may be contributing factors, but some scientists keep coming back to the study of air pollution, and particularly of that dense layer of smog that blights our cities all too often in the summer. Somewhere in that haze of pollution, many researchers believe, lies an answer to the mystery of why asthma gets switched on with such frequency in the urban world.

Over the past decade, scientists have found compelling evidence that pollution irritates the lungs and triggers attacks in those who already have asthma. Some research shows it can worsen asthmatic flare-ups to allergens such as pollen, dust mites or pet dander. "Air pollution remains one of the most underappreciated contributors to asthma exacerbation," wrote George Thurston, an associate professor of environmental medicine at New York University School of Medicine, in a 2005 article in *Journal of Allergy and Clinical Immunology*. A classic example: When a strike closed a steel mill in Utah for the winter during the mid-1980s, researchers found that admissions of children to hospital for asthma and pneumonia were cut in half - and they climbed right back up the following winter after the steel mill had reopened. It's a vivid example of how pollution can trigger asthmatic attacks, and there are plenty more examples from around the globe.

A group of researchers from California are now taking the relationship one step further. They suggest that outdoor air pollution not only triggers or exacerbates asthma in those who have already been diagnosed - but may even cause the disease. Scientists from the University of Southern California have been following thousands of California schoolchildren over several years to study how their health is affected by the key components of smog, such as emissions from cars and trucks and ground-level ozone. Their findings suggest that living beside a roadway greatly increases a child's chance of developing asthma. What's more, they've found that kids who breathe high concentrations of ozone while playing sports are more likely to develop asthma than kids playing in cleaner air.

These studies suggest that "air pollution is related to the onset and not just the exacerbation (of asthma)," said one of the co-authors, Jim Gauderman, associate professor of preventive medicine at University of Southern California's Keck School of Medicine. Does that mean that pollution causes asthma? "That kind of definitive statement is quite a ways off," Gauderman acknowledged. For one thing, it's not clear yet how pollution may cause asthma, and scientists don't even know which airborne chemical is doing the damage. Proving the case that pollution causes asthma will require plenty more studies --- studies of human populations to confirm the California findings, plus more studies of animals in the lab to show how pollution may cause asthma, he said. "Then we can talk cause," says Gauderman.

To even suggest that pollution causes asthma is a highly controversial proposition. Most of the earlier studies found no evidence that air pollution increased the risk of getting asthma. What's more, the 58% increase in the prevalence of childhood asthma since 1980 happened at a time when the air became cleaner, not dirtier. As Noreen Clark, a public health professor at the University of Michigan, put it in a frequently cited 1999 review:

"Studies illustrating the causal effect between outdoor air pollution and asthma prevalence are scant."

Clark's skepticism is the prevailing view. But scientists at the University of Southern California are challenging that thinking. The previous researchers didn't see the link between asthma and pollution, Gauderman says, because they relied on community-wide air monitors to assess levels of pollution. Yet pollutants in the air can vary considerably depending on where you are in the community, and whether you're breathing in a lot of dirty air while playing sports outdoors. By looking more closely at people who breathe in more polluted air – either because they live in a pocket of pollution or because they're playing sports and breathing harder – the link between air pollution and asthma becomes more visible.

In May, for instance, the USC researchers reported that kids who live within 75 metres of a roadway are 50 per cent more likely to develop asthma than kids who live farther away. This was a study of over 5,000 kids age 5 to 7. The biggest increase in risk was seen in kids with no family history of asthma who lived near the roadway since before age two. (Kids who moved near the roadway after age two did not increase their risk of asthma.) It may indicate that infants, or even fetuses, may be especially vulnerable to the effects of traffic pollution, according to the group led by USC epidemiologist Rob McConnell.

"We conclude that living in a residence with more nearby traffic increases the risk of childhood asthma," the researchers reported in *Environmental Health Perspectives*. In fact, breathing fresh vehicle exhaust was responsible for nearly 60 per cent of the asthma reported in kids living within 75 metres of a major roadway. "Because a substantial number of southern California children live near a major road, this exposure is potentially an important public health problem that could be remediable by transportation and residential development policy and by more effective control of vehicular emissions."

A couple of years earlier, in 2002, the USC researchers suggested that another ingredient of smog – ozone – might cause asthma to develop. McConnell and fellow USC scientists tracked more than 3,500 children aged 9 to 16 who had no history of asthma. The kids lived in 12 communities with varying levels of pollution. Overall, those living in high pollution neighborhoods were not, in fact, more likely to get asthma than kids in lower pollution neighbourhoods. But when the USC researchers looked more closely at

the children who played a lot of sports outdoors, they found something interesting. They zeroed in on the 273 kids who participated regularly in three or more sports. The sporty kids in high ozone neighborhoods were over three times as likely to develop asthma than kids who didn't play sports in their area. The children who played lots of sports in cleaner air, on the other hand, did not have a higher risk of asthma. It was not a case of exercise-induced asthma. "Our results show that playing multiple team sports in a high ozone environment is associated with development of physician-diagnosed asthma," the team led by McConnell reported in *The Lancet*. "The results are consistent with a large increased risk both for new onset asthma and for exacerbation of previously undiagnosed asthma."

But it will take a lot more evidence to convince the skeptics that outdoor air pollution can cause asthma. If breathing something in the air is causing the asthma epidemic, it's more likely to be air indoors than outdoors, says Dr. Allan Becker of the Children's Hospital in Winnipeg. He's one of over 100 researchers who are part of AllerGen, a Canadian network of scientists and institutions mobilizing to improve the quality of life for allergic and immune disease sufferers. Over two-thirds of all asthma starts in the first five years of life, Becker notes, and children at that age spend 90 per cent of their time indoors. So it makes sense that something inside - what kids breathe or what they eat - is contributing to the rise in asthma. Bolstering that theory is the change in house construction since the 1970s, when the asthma epidemic took off. Since that time, homes have been built to reduce the leakage of air from the outside, significantly reducing the amount of air flowing through cracks around the windows. To Becker, indoor air is a major suspect in the mystery of what is driving the asthma epidemic; it will be tested in a major research project sponsored by AllerGen to begin next year.

Those who suspect that pollution causes asthma face a big challenge: Which airborne pollutant does the damage? That's a tough call because there are so many ingredients in the smog that infiltrates the cities all too often in the summer. Emissions from vehicles - a key contributor to smog - are a key culprit. As Harvard School of Public Health's Joel Schwartz put it in a 2004 article in *Pediatrics*: "The overwhelming weight of the recent

evidence suggests that traffic pollution is associated with the risk of developing asthma."

But it's not clear which pollutant in vehicle exhaust may potentially trigger asthma. In his research, Gauderman measured levels of Nitrogen Dioxide, emitted by cars and trucks, outside homes of over 200 kids. His team found that for every increase of 5.7 parts per billion in average nitrogen dioxide, the risk of getting asthma by age 10 increased 83 per cent in kids. But it's not clear whether NO₂ caused the increased cases of asthma -- or one of the other gases in vehicle exhaust.

Nevertheless, by now the evidence linking diesel fumes to the development of asthma has been convincing enough to make governments act. New regulations in Canada and the U.S. reduce the amount of sulfur in diesel to less than 15 parts per million from 500 ppm. The regulations will be fully in effect on Sept. 1, 2006.

Researchers are also looking closely at the effects of ozone, the invisible gas that McConnell's group found was linked to the onset of asthma in sporty California kids. It's formed when several gasses mix in the presence of sunlight – including nitrogen oxide, which comes mainly from vehicles and coal-fired power plants, and Volatile Organic Compounds (VOCs), which comes from gassing up cars and products like paints and cleaning fluids.

Scientists have amassed a powerful body of evidence to show that ozone triggers asthmatic trouble in people who already have the disease. During the 1996 Summer Games in Atlanta, for instance, the city restricted traffic during the 17-day Games, which cut peak ozone levels by 27.9 per cent. The result: A 41.6 percent decline in children's asthma attacks.

But no one was able to suggest that ozone might cause asthma -- until the USC group's groundbreaking study on the sporty kids. "This study needs to be replicated elsewhere," Thurston observed last year in the *Journal of Allergy and Clinical Immunology*. "But it does suggest that higher long-term exposure to air pollution might well cause the

induction of asthma."

So does air pollution cause asthma? No one knows for sure. "Pollution itself will not cause an allergic response," says Gauderman. But lab studies suggest that it can cause chronic inflammation in the airways and make a person more susceptible to an allergic response that could induce an asthmatic attack.

As for Sara, she's walking her dogs again and gearing up for summer in the city, perhaps in an office job if she can find one. But on smog days, "I'll have to stay inside."