

Human Immune Systems May Be Pollution Victims

■ **Health:** Contamination seems to lower resistance to diseases. Theory is bolstered by growing body of evidence.

By MARLA CONE
TIMES ENVIRONMENTAL WRITER

Deep in the Canadian Arctic, the native Inuit live on permafrost so thick they must rely upon the bounty of the icy blue sea. Like their ancestors a millennium ago, they hunt the whale, seal and trout they call "country food."

Life seems unspoiled in the polar wilderness a thousand miles from the nearest industrial center. But in reality, these Arctic people carry in their bodies the world's biggest loads of immune-suppressing pollutants—mirroring the poisons found in whale blubber.

Inuit mothers probably are passing damage to their infants through their wombs and breast

milk. Born with depleted white blood cells, the children suffer excessive bouts of diseases, including a 20-fold increase in life-threatening meningitis. Their immune systems are so dysfunctional that they sometimes

DEFENSES DOWN

Pollution's toll on immunity against disease

■ Second of two parts

fail to produce enough antibodies even to react to the usual childhood vaccines.

The plight of the Inuit illustrates the hidden danger that environmental pollutants seem to pose to

Please see HUMANS, A14

HUMANS: Pollution May Boost Risk

Countless forms of the human body's vital defenses for fighting off disease.

New scientific findings suggest that contaminated water, food and air seem to be suppressing people's immune systems, lowering their resistance to viruses, bacteria and tumors they otherwise could have fended off.

"Around the world, people routinely encounter industrial compounds and pesticides that deplete the immune cells of marine mammals and laboratory animals at fairly small doses. The most suspicious and persistent ones—dioxin and dieldrin—have been found in the tissues of every living thing on Earth.

For most healthy people, a slight drop in immunity caused by the pollutants carried in their bodies merely could mean they catch the flu more often or stay sick a bit longer. But for vulnerable newborns or the chronically ill—especially those with the AIDS virus or other immune deficiencies—it could mean they compromise their health, immune experts say.

"We're really afraid—and I mean the whole doggone planet—immunosuppressed," said Steve Hollister, a veterinarian at the University of Veterinary Medicine. "Simply if we weren't not quite as healthy as we are, we'd be in a lot of trouble. Our risk of getting things [diseases] is slightly

and tumors in bays, wharfs, and Great Lakes fish apparently loves to eat. It's severely depressed immunity.

All animals, including humans, share the same basic immune system. We have to remember we live on the same planet as these animals," said Sylvain De Guise, an immunologist studying Quebec's beluga whales. "If we can demonstrate effects in a wildlife population, we raise concern about many other populations that may suffer more subtle effects, including humans."

Experts suspect that the most severe effects occur at the time of birth, since a fetus' developing immune system is vulnerable to toxic chemicals consumed by its mother. "If you ask me what the most sensitive organism is to these adverse effects, it's the embryo," said Linda Birnbaum, director of environmental toxicology at the U.S. Environmental Protection Agency's Health Effects Research Laboratory.

There is no doubt that people who encounter extraordinarily large doses of industrial chemicals suffer severe immune deficiencies. Scientists, however, are undecided about whether the multilayered immune system is resilient enough to rebound from the long-term, low dose exposure to contaminants typically found in the modern environment.

"What we're trying to decide is

said Peter Thomas, an immunologist at IIT Laboratories, a Chicago research institute largely funded by the chemical industry. "Look at HIV. You've really got to knock the hell out of the immune system to get AIDS. So why should we worry about the subtle effects from pollution?"

Most healthy adults can fend off viruses even with compromised immunity, but a fetus could suffer permanent damage to its thymus or bone marrow—the factories for immune cells—if its mother is exposed to contaminated food or water.

"Children are my greatest concern," he said. "In these kind of effects, it's the T cells, the T-helper cells, that are the most important administrator for pesticide and toxic control. Where we have observed health problems in humans, they have been found at the lowest contamination levels in the children, particularly for prenatal exposure."

Inuit Health

Inuit infants have provided a living test tube for immunologists. By air and by sea, the Canadian Arctic is almost cut off from the rest of the world. The Inuit live in igloos in electrical DDT used thousands of miles away, wind up there due to the northward flow of air and ocean currents. PCBs and DDT don't break down or wash away, binding instead to sediments and building up in the fat of animals and humans via the food chain.

Due to their diet of contaminated breast milk and fish, Inuit women's breast milk contains 10 times more PCBs than women in urban centers, according to Quebec government studies. Their babies have low B and T cell counts, which could explain their strikingly high rates of meningitis, bronchitis, pneumonia and other infections compared with other Canadians. One study showed that out of every four breast-feeding Inuit die due to infections.

"In our studies, there was a marked increase in the incidence of infectious disease among breast-fed babies exposed to a high concentration of contaminants," said Eric Dewailly, a Quebec Public Health Center researcher who coordinated the work.

Without seals, walrus and fish, there are few alternatives for nourishment in a region where eggs cost \$6 a dozen, a chicken brings \$25 and french vegetables are a rare treat. Quebec health official Susan Bruneau said the Inuit would resort to processed foods that leave them prone to an even worse threat—heart disease.

Breast-feeding is still encouraged because of its immunological benefits. "The benefits are still there," Bruneau said, "but the risks are potential."

In the United States, the EPA banned PCBs and DDT two decades ago, but the agency does little to protect people from other immune-suppressing chemicals. Pesticides on lab animals to protect against effects, but the tests are not sensitive enough to detect most changes in immune cells.

"With immune effects, we're right at the cutting edge," Goldman said. "There may be some opportunities in the future to add immune testing to look for signs of immunosuppression. We don't know whether the animals used to predict something meaningful in public health."

Although all animals have the same basic immune systems, some species are more susceptible to pollution damage than others, perhaps due to different metabolism. And no one knows where humans fit in the spectrum of vulnerability. "There appears to be a considerable difference in sensitivity. So do we protect the most vulnerable species or do we go for an average or do we go only for humans?" said Cornell University immunologist Robert Foy. "That's one of the great dilemmas we face."

Toxic substances, economic in the most humans when it comes to taking people—such as Vietnam veterans exposed in Agent Orange or residents of Times Beach—results have been mixed about the impact on their immune systems. "The public needs to understand the implications of Wisconsin's leaded gasoline ban, for example, that we will never know the true effects of this stuff in our air and water," Foy said. "To unravel the mysteries of immune suppression and autoimmune diseases, experts look for a telltale syndrome of pollution and sickness that is unlikely to be explained by more coincidence."

On the Arizona side of Nogales, Arizona lives in the shadow of Mexican factories and smelting plants. For years she would wake up coughing, but her immune body—or maybe her mind—was healthy.

PLEASE SEE HUMANS, A15



Anna Aguilar, who suffers from lupus, heads a group that spreads information about rising lupus and bone marrow cancer rates in the town. Her sign says: Contamination Doesn't Carry a Passport. Another sign, left, warns of contaminated water running through the town, located across the border from chemical-emitting factories.

The Immune System

Mammals, including humans, have developed a sensitive, elaborate and multilayered network to protect themselves from foreign invaders such as viruses, bacteria and tumors:

Autoimmunity	Autoimmune disorders linked to chemical pollutants	DISEASE
Cadmium	apoptoma	kidney disease
Carbon tetrachloride	Cooperia's lupus	lupus
Chloroform	lupus	lupus
Chromium	Hydrazine	lupus
Hydrazine	Hydrocarbon solvents	Cooperia's syndrome
Mercury	antioimmune	kidney disease
Permaplast	antioimmune	kidney disease
Perchloroethylene	antioimmune	kidney disease
PCBs	antioimmune	thyroid disease
Silica	scleroderma	scleroderma
Trichloroethylene	lupus, scleroderma	lupus, scleroderma
Vinyl chloride	scleroderma	scleroderma

The immune system can malfunction and become hyperactive, leading to a condition in which immune cells attack the body's own tissues. Many diseases can result, such as lupus. The most common symptom is joint pain. Natural killer cells, the first and most rapid defense against viruses and tumors. They recognize some tumor and virus cells without the need for specific antibodies. These white blood cells play an essential role in clearing an infection. Some cells communicate with other cells, such as B cells, to order an attack. These white blood cells secrete antibodies. Antibodies attack specific foreign agents in bacteria, viruses, tumor cells, Thymus The small organ where stem cells mature to form T cells. Impairment of the Thymus leads to low immune cell counts. Bone marrow The soft tissue in bones where stem cells are manufactured. Stem cells then pass through the thymus to mature into T cells, while natural killer cells and B cells move straight to the blood. These small structures, situated throughout the body, filter out foreign cells draining from body tissues.



The Poisoned Pole

Although they live in one of the last, vast, wild regions, the Inuit people of Arctic Canada are believed to be the most highly contaminated humans on Earth. The area where they live soaks up much of the world's pollution due to northbound air and ocean currents. Because of extremely low temperatures, PCBs and DDT, their bodies contain 10 times as much of these industrial pollutants. The women's breast milk is more contaminated than in whale and seal blubber, and an infant could build up dangerous PCB levels in the blood after just a few months of breast-feeding. Inuit children suffer frequent meningitis, pneumonia, bronchitis and ear infections, which appear to be related to the immune damage caused by PCBs and other pollutants.

- Arctic women's milk fat: 1,092 parts per billion of PCBs
- Polar bear fat: 7,002 ppb
- Whale blubber: 1,002 ppb
- Seal blubber: 827 ppb
- Arctic fish: 152 ppb
- Non-Arctic women's milk fat (from Quebec): 157 ppb

Source: Quebec Health Research Center

higher." Also, in an unusual twist that only recently has captured the attention of experts, some chemicals, rather than suppressing the immune system, accelerate it—triggering an army of killer cells. Immune cells, however, are working, attacking the body's own healthy tissue in a false notion that they detected a foreign invader.

In recent years, lupus and other autoimmune diseases have increased internationally and seem to have popped up in extraordinary clusters in communities tainted by chemicals—most notably, in the once-thrived border town of Nogales, Ariz.

"To tell you the truth, it scares me," said Steve Hollister, a veterinarian at the University of Veterinary Medicine. "It frightens me when I see young people diagnosed, it frightens me when I see mothers incapacitated. I think of us as being on the cutting edge of something that is happening all over the world."

Suspensions about immune-damaging pollution are improved, and the scientific techniques to test them have emerged in only recent years. "We're just beginning to be alerted by a growing body of evidence from several hundred researchers, especially in Europe and Canada, who are examining animals in the wild, cells in laboratory tests and some human populations."

Gathered last year at an unprecedented environmental health summit, U.S. government, academic and industry scientists concluded that "the wide range of immune system impairments" that seem tied to pollution must be thoroughly investigated because the human race could be leaving behind a biologically ill-equipped generation.

... at what point [of immune increase] in the body, about and tumors," said Ralph Simons, an EPA researcher who co-authored an immunotoxicology textbook.

As shown by AIDS patients, if immune cells are depleted by half, the human body accumulates deadly infections. Damage from that source, though, is nowhere near World War II levels. People who carry 1 part per million of PCBs in their fat, in comparison, seals and fish carry 35% depletion of immune cells when carrying 17 parts per million in their bodies. Terms in the Great Lakes had 30% fewer immune cells when their eggs had 5 ppm.

On the personal assumption, based on the fact that 5% of their immune cells have lost 5% of their effectiveness in their bodies, and Michael Lester, head of immunology at the National Institute of Environmental Health Sciences and one of the nation's foremost experts on the topic, "A 5% decline may sound minimal, but it could mean a 50% decline in the ability to fight off disease."

But Lester said that, unlike lead, pollution can be permanent and affect billions of people. "If the individual's immune response is decreased by 5% in the large population," he said, "and that is chronic, then over the years that would be a pretty large deficit. The deficit probably increases in fact."

Lacking definitive proof, some scientists remain dubious that the amount of suppression is substantial enough to cause human illness. "Your immune system is being assaulted at all times during the day and night, but most of us go through life relatively healthy,"

Photo by LAWRENCE K. ITO For Associated Press

HUMANS: Not Immune

Continued from A14
crouching. The joints in her legs and feet throbbled, and she was so fatigued that she struggled to simply climb out of bed and dress for work.

When finally diagnosed with the rare autoimmune disorder lupus, Acuna didn't tell her friends, assuming she would never find anyone with the same peculiar and devastating disease. Years later, while lunching with three other women, Acuna stumbled upon her roommate's best-kept secret.

"Out of the four women sitting there, three of us had lupus," she said. "Friends started coming up to examine Acuna and about 100 other Nogales residents for a while I did this, but I started writing their names down. And I ended up with a roster of 42 people in Nogales diagnosed with lupus."

Arizona health officials suspect that an excessive rate of lupus and deadly, multiple myeloma—two diseases involving faulty antibody-producing B cells—among long-time Nogales residents is linked to toxic chemicals in the air or water. Medical researchers have proved that autoimmune disorders are triggered by accidental poisonings, medications and workplace use of chemicals. In the worst example, 20,000 Spaniards who consumed poisonous olive oil in 1981 suffered symptoms of scleroderma, a rare autoimmune disease in which the

Thousands of veterans of the Gulf War have complained of autoimmune-like joint pain. Sillca is known to cause autoimmunity in

skin hardens. Most recovered, but more than 350 died.
Now, emerging research is exploring whether chronic exposure to lower-dose environmental chemicals, including some widely used industrial solvents, can trigger autoimmunity, especially in people with a genetic predisposition. "We know medications can induce a syndrome similar to lupus, and those are chemicals. So why wouldn't chemicals in the environment cause a lupus-like illness?" said Dr. Bridget Walsh, a University of Arizona rheumatologist who examined Acuna and about 100 other Nogales residents for a groundbreaking 1994 study.

In Tucson, a study commissioned by residents suing Hughes Aircraft and Arizona Department of Health Services.
Lupus was confirmed in 19 people and considered probable in seven more—four times the reported average and the highest rate ever found for the disease, which mostly strikes women and is believed to be much longer, since some illnesses were undiagnosed or latent, and residents who grew up in Nogales and moved were excluded.

"When you have two rare diseases in excess that are both B lymphocyte disorders, that suggests something is going on," said "Thousands of veterans of the Gulf War have complained of autoimmune-like joint pain. Sillca is known to cause autoimmunity in

Debate About Causes
The most persuasive evidence from the university study found that the closer people live to the pollution sources, the higher their auto-antibodies, a measurement of the severity of their immune cells

quartz miners, leading experts to speculate that inhaling silica in desert sand might have triggered the effect in some soldiers. "I'm not convinced by the studies to date, but I'm impressed by these observations, and they could be important clues," said Dr. Evelyn Hess, a University of Cincinnati Medical Center expert in chemical-caused autoimmunity. "They should be followed up, since we're dealing with disorders which we don't know the cause."

Clusters of disease are often an illusion. Many are suspected, few are proved.
In Nogales, a town of 20,000, 12 people between 1989 and 1993 were diagnosed with multiple myeloma, a tumor of the bone marrow, more than twice the rate expected in a town its size, according to the study by the University of Arizona and Arizona Department of Health Services.

Lupus was confirmed in 19 people and considered probable in seven more—four times the reported average and the highest rate ever found for the disease, which mostly strikes women and is believed to be much longer, since some illnesses were undiagnosed or latent, and residents who grew up in Nogales and moved were excluded.

Larry Clark, a University of Arizona epidemiologist who led the investigation. "Were as close as living near the dump and the Hving near the dump and the chief of rheumatology at Cedars-Sinai Medical Center and a UCLA medical professor. Wallace was hired by Hughes Aircraft as an expert witness in the Tucson suit but is uninvolved in the Nogales research.

However, epidemiologist Clark said past generations of Latinos in Nogales apparently were unaffected by lupus, and there is no genetic link that could explain the other disease, myeloma.

"It's our generation that's getting sick, not our mothers or our grandmothers," said Acuna, 58, co-founder of Living Is For Everlasting, a community group that convinced the state to conduct the health study. "The only thing that has changed in Nogales' air. But no one knows which, if any, might be contributing to the diseases. The culprit could be something people were drinking and breathing years ago or that their mothers encountered before they were even born.

"I compare it to finding a needle in a haystack and somebody ate the haystack and somebody ate the haystack and somebody ate the haystack, an Arizona hazardous materials inspector who patrols the border area.

Autoimmune Response
The most persuasive evidence from the university study found that the closer people live to the pollution sources, the higher their auto-antibodies, a measurement of the severity of their immune cells

farther from the border.
It is possible, say some rheumatologists, that the lupus in Nogales has more to do with genetic factors than the environment. Lupus occurs more often in Native Americans than Caucasians, and many Latinos have Native American roots.

"The bottom line is it's my belief that there is no environmental cluster of lupus in Arizona or border area.

attack on healthy tissues. Women in Nogales had 10 times more auto-antibodies than those farther out in Nogales and in the town of Patagonia.
Margaret Chaboya, 45, was born and raised two blocks from the wash, in a pleasant vanilla-colored stucco home with a triple-arched porch. "Never," she said, "did I think there was anything harmful here." A homemaker with lupus, she was diagnosed with lupus days after she was diagnosed with lupus. "When you first get sick, who in the heck would blame the environment?" she said. "As Latinos, most of us think it's God's will or we're being punished for something."

Despite chemotherapy, steroids and 13 other daily medications, Chaboya periodically suffers agonizing migraines and leg pains so severe that the weight of a bed sheet is sometimes unbearable.

When you first get sick, who in the heck would blame the environment?" she said. "As Latinos, most of us think it's God's will or we're being punished for something."

It is possible, say some rheumatologists, that the lupus in Nogales has more to do with genetic factors than the environment. Lupus occurs more often in Native Americans than Caucasians, and many Latinos have Native American roots.

"The bottom line is it's my belief that there is no environmental cluster of lupus in Arizona or border area.

Autoimmune Response
The most persuasive evidence from the university study found that the closer people live to the pollution sources, the higher their auto-antibodies, a measurement of the severity of their immune cells