

Emotional Stress Linked to Common Cold

Psychologists report that high levels of mental stress increase the risk of both infection by cold viruses and the appearance of cold symptoms. For researchers probing the complex relationship between psychology and immunity, the new evidence provides a rare link between stress and an immune illness.

"Our study shows psychological stress has a big impact on the biological system of immunity," says psychologist Sheldon Cohen of Carnegie Mellon University in Pittsburgh, who co-directed the work with two British colleagues.

The researchers administered questionnaires on psychological stress to 420 healthy British adults. Participants reported the number of major stressful events experienced in the past year, the degree to which they felt able to cope with daily demands, and the frequency of "negative" emotions such as depression, anger and irritation. The investigators used these data to divide volunteers into four groups, from lowest to highest stress. Questionnaires also assessed three personality characteristics associated with stress: self-esteem, feelings of control over external events, and degree of extroversion or introversion.

Next, 394 volunteers received nasal drops containing a low dose of one of five respiratory viruses; the remaining 26 got saline drops. For two days before and seven days after the viral exposure, they stayed in large apartments either alone or with one or two others. Before exposure and for six days afterward, researchers collected nasal-wash samples to search for cold viruses or virus-specific antibodies. Clinicians examined participants daily for sneezing, watery eyes, sinus pain and other cold symptoms.

Among the virus-exposed volunteers, 325 became infected and 148 developed colds, the investigators report in the Aug. 29 *NEW ENGLAND JOURNAL OF MEDICINE*. Cold virus infections also showed up in five saline recipients, apparently from exposure to infected housemates, they note. No one in the saline group developed cold symptoms.

Cohen's group found that the rates of respiratory infection and colds increased in accordance with stress levels reported on the questionnaires. Compared with the lowest-stress group, volunteers who reported the most psychological stress ran twice the risk of getting a cold and more than five times the risk of becoming infected with a cold virus, the investigators say. The pattern held despite statistical controls for varied influences on immune function, including age, sex, education, allergies, weight, viral status prior

to the study, cigarette and alcohol use, exercise, diet, quality of sleep, number of housemates, and housemate infection rates. The link between stress and colds also proved independent of the personality characteristics assessed on questionnaires.

The consistency of the stress-infection connection across different cold viruses suggests a close relationship between stress and the suppression of either a general disease resistance or many immune processes involved in several illnesses, the researchers maintain.

"We don't find a tremendous statistical effect for stress on the common cold, but it's reasonably strong given the many other biological and environmental influences on colds," Cohen says.

Studies of stress, immunity and infec-

tion often generate inconclusive findings and physician skepticism (SN: 4/6/91, p.216). In a commentary accompanying the new report, Morton N. Swartz of Massachusetts General Hospital in Boston lauds the team's careful methods but cautions that the results might stem not from stress-induced effects on immunity, but rather from prior behaviors—such as sleep problems and alcohol use—that can undermine immunity and that often do not show up in brief responses to questionnaires.

Extensive measures of these behaviors require large amounts of time and money, Cohen responds. Although his study did not exhaustively review all such behaviors, he says the findings clearly suggest that stress helps produce a susceptibility to colds.

— B. Bower

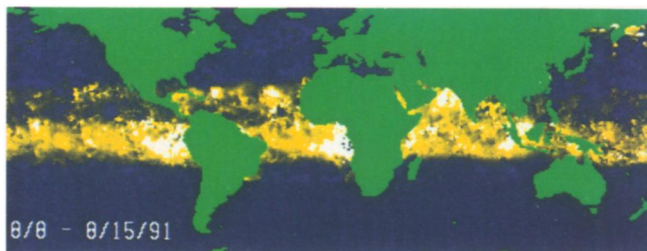
Pinatubo's impact spreads around the globe

More than 10,000 kilometers lie between the United States and the Philippines, but the eruption of Mt. Pinatubo in June may increase the risk of skin cancer in North America next summer, according to some preliminary estimates of the volcano's effect on stratospheric ozone. Scientists also expect the eruption to cool the globe for the next few years—a climatic twist that would complicate efforts to discern whether greenhouse-gas pollution is currently warming the Earth.

Pinatubo can wreak such distant and long-lasting effects because its eruption lofted millions of tons of sulfur dioxide gas into the stratosphere. As winds blew the volcanic cloud westward, the gas molecules reacted with water in the atmosphere to form tiny droplets, or aerosols, of sulfuric acid, which will stay in the stratosphere for two to three years before they fall.

Some computer models of atmospheric chemistry suggest that this huge increase in sulfur dioxide aerosols could thin the protective ozone layer, allowing more harmful ultraviolet radiation to reach Earth's surface. "We found a substantial ozone decrease, especially in the mid- and high-latitudes, and especially in winter," says Guy P. Brasseur, director of the atmospheric chemistry division at the National Center for Atmospheric Research (NCAR) in Boulder, Colo.

Scientists believe sulfuric acid aerosols



Satellite measurements of reflected sunlight during mid-August show a band of volcanic aerosols girdling the globe.

affect ozone levels through a complex cascade of events. The aerosols provide tiny surfaces on which certain nitrogen molecules can react. These reactions alter the chemistry of the stratosphere, causing "safe" chlorine molecules to transform into ones that can destroy ozone.

Satellite and aircraft measurements indicate Pinatubo was probably the largest volcanic eruption of the century, belching out at least twice as much sulfur dioxide as the 1982 eruption of Mexico's El Chichon. Using these data, Brasseur's model calculates that the aerosol increase will cause a 15 percent reduction in mid-latitude ozone values during winter. Brasseur cautions, however, that these predictions include significant uncertainties.

Susan Solomon, an atmospheric chemist at the National Oceanic and Atmospheric Administration in Boulder, used a different model to calculate the effect of the volcanic aerosols. Although she says it's too early to discuss specific results, she hints that her model predicts an ozone decrease even greater than that calculated by Brasseur.

Unlike Solomon, however, Brasseur also found substantial ozone depletions—on the order of 6 to 8 percent—in the mid-latitudes during *summer*, when ultraviolet levels reach their yearly maximum. Sasha Madronich of NCAR calculates that such thinning would allow summertime levels of ultraviolet radiation to reach 18 percent higher than normal in the northern mid-latitudes, which includes much of the United States, Europe and the Soviet Union. The boost in radiation would increase skin cancer risk and could generate several thousand additional cases of melanoma in the United States alone over the next few decades, estimates Madronich.

Other atmospheric chemists, however, say discussions of health problems are premature because scientists remain unsure whether the eruption will spur *any* significant ozone decrease. "We don't really have the models or the measurements that would allow us to confidently make such predictions," says Michael J. Prather, an atmospheric chemist at NASA's Goddard Institute for Space

Studies in New York City. According to Prather, only about half of the atmospheric-research community is currently betting the volcano will significantly decrease ozone levels.

The answer should become clearer this winter, after the aerosols spread toward the North Pole. Long before the eruption, scientists began planning a major research campaign to probe the fate of ozone in the stratosphere over the northern mid-latitudes and polar regions. They want to understand why wintertime ozone levels have declined by 6 to 8 percent over the mid-latitudes during the last decade. The planned measurements should also detect effects of the volcanic aerosols, providing the data needed to make better predictions of the possible summertime ozone thinning, Prather says.

The same veil of sulfuric acid aerosols that threatens ozone also reflects sunlight back toward space, slightly dimming light reaching the Earth's surface. Climate experts say the Pinatubo aerosols will lower average world tempera-

tures during the next several years, temporarily reversing the warming trend of the last two decades.

Global temperatures may not fall significantly in 1991 and 1992, because an El Niño developing in the Pacific will help warm the Earth, slightly offsetting the aerosol cooling. But when the El Niño wanes in about a year, Pinatubo aerosols could chill the Earth by about 0.5°C, says James Hansen of NASA's Goddard Institute.

Before the eruption, Hansen and others had predicted that the behavior of global temperatures during the 1990s would provide a good test for theories forecasting a global warming from greenhouse-gas pollution. Because Pinatubo's cooling should temporarily mask any long-term warming trend, the eruption will make the climate record more complex and difficult to interpret. But even with several years of cooling, the 1990s should still turn out warmer than the 1980s if the greenhouse warming is currently underway, Hansen says.

— R. Monastersky

Tea-totaling mice gain cancer protection

Green tea helps shield mice against tumors of the liver, lung, skin and digestive tract, and may do the same for people, U.S. and Japanese researchers reported this week at the Fourth Chemical Congress of North America, held in New York City.

"This green tea cannot prevent every cancer, but it's the cheapest and most practical method for cancer prevention available to the general public," asserts Hirota Fujiki, a chemist at the National Cancer Center Research Institute in Tokyo.

In 1987, preliminary evidence that the popular Asian beverage provides anticancer benefits led Fujiki to pinpoint (-)-epigallocatechin gallate (EGCG) as the key protective ingredient. He and others speculate that this antioxidant may protect against tumor development by destroying highly reactive atoms or molecules, called free radicals, that could otherwise attack DNA and disrupt normal cell processes.

Alternatively, EGCG may prevent the activation of certain carcinogens so that the free radicals never form, suggests Fung-Lung Chung, a chemist at the American Health Foundation in Valhalla, N.Y.

Fujiki now reports that EGCG, given orally in concentrations equivalent to those consumed daily by tea drinkers in Japan, reduced the number of liver tumors — sometimes preventing them altogether — in mice specially bred to develop liver cancer. And in mice given a carcinogen that affects the digestive tract, 20 percent of the animals treated

with EGCG developed intestinal cancer, compared with 63 percent of mice that did not get EGCG.

Researchers at Rutgers University in Piscataway, N.J., describe similarly encouraging effects on skin cancer rates in female hairless mice. The team exposed some mice to ultraviolet light only, and others to ultraviolet light plus a compound known to induce skin tumors. Mice that drank green tea instead of plain water for about 10 days before and then during the exposure period proved less susceptible to skin damage from the light alone, they report. Mice exposed to both the light and the carcinogen developed up to 87 percent fewer skin tumors, with an average of 50 percent fewer tumors, says Rutgers biochemist Mou-Tuan Huang.

"These broad effects of the green tea are quite interesting," says study director Allan H. Conney. "There aren't that many things that have as broad a spectrum [as green tea]."

Even so, he hesitates to advise people to drink more green tea. "The results are encouraging, but I think it would be premature to extrapolate these studies to humans," Conney says. "We're using the same concentration [in mouse experiments] as what people are drinking, but for mice, it's their sole source of drinking water. Any kind of chemical or material that is ingested in large amounts has potential risks."

To obtain protective benefits, it seems a person would need to drink about 10 small teacups of the beverage per day, says Fujiki, who notes that

many Japanese routinely consume that amount.

Green tea may also help explain why cigarette smokers in Japan have a lower rate of lung cancer than smokers in the United States, Chung says. He investigated the protective potential of green tea and its components against the nitrosamine NNK, a powerful carcinogen in cigarette smoke. Chung's group exposed mice to the tobacco nitrosamine three times a week for 10 weeks, for a dosage equivalent to the inhalations of a typical smoker over six years. Mice that drank only tea during that time developed 12 to 16 lung tumors per mouse, while mice that drank plain water wound up with an average of 22 tumors. "What this shows is that drinking green tea might be beneficial to protect the smoker from getting lung cancer," Chung says.

Taking a different tack, chemist Chi-Tang Ho of Rutgers measured the amount of EGCG in green tea, oolong tea (popular in China) and black tea (the type most commonly consumed in the United States). To bring out black tea's strong flavor, manufacturers allow the leaves to ferment almost completely. Oolong tea undergoes partial fermentation. As a result, oolong retains about 40 percent of the EGCG in green tea, while black tea retains only 10 percent. "In black tea, you can almost not find it," Ho reports. However, black tea contains other compounds with antioxidant potential that may also offer some protection against cancer, he says. Manufacturers might be able to develop a way to bring out the taste without destroying the EGCG, Ho suggests. — E. Pennisi