

New triggers for weight gain: Researchers focus on air pollution, sleep deprivation

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As obesity rates soar worldwide, the antidote may seem obvious: Eat less! Move more! But the common-sense approach hasn't been terribly effective, prompting some scientists to question the simplicity of the formula.

Although personal decisions and self-control certainly play a large role in weight gain, a burgeoning area of research suggests that other factors, from air pollution to sleep deprivation, might be subtly helping humans pack on the pounds.

Obesity, it turns out, is a complex condition that involves multiple genes and pathways. Scientists are finding that certain exposures or conditions can change the body's metabolism, disrupt the trillions of microbes working in the gut and alter hormonal levels in ways that affect a person's weight.

Studies have identified nearly a dozen factors besides [overeating](#) and inactivity that can help make people fat, including chemicals in the environment. A recent study in the [Journal of the American Medical Association](#) found that children and teens with higher levels of the chemical bisphenol A in their urine were more likely to be overweight or obese than others. It's next to impossible to avoid BPA, which is used to make shatterproof plastics and resins and is found in some [food packaging](#), toys, cash register receipts and thousands of other products.

"It's an epidemic of 1,000 paper cuts," said Andrew Rundle, a professor

of epidemiology at Columbia University's Mailman School of Public Health, whose research explores environmental triggers of obesity. "For some people, appeals to personal responsibility will work. For others, we have to think about all the systemic things going on. I don't discount personal choice and responsibility. It's just way more complicated than that."

Current public health initiatives on obesity tend to aim at just two targets: Americans' lack of physical activity and the [marketing practices](#) of the food industry. That "somewhat obsessive" focus has come at a cost, said David Allison, director of the Nutrition Obesity Research Center at the University of Alabama at Birmingham.

Though the "big two" play a role, taking a myopic view "has led to the neglect of other plausible mechanisms and (to) well-intentioned but ill-founded proposals for reducing [obesity rates](#)," Allison wrote in a 2006 study published in the International Journal of Obesity, one of the first to offer creative explanations for weight gain.

Lauren Brush, of Chicago, is one of many who have tried following the conventional advice with little success. Though she says she sticks to a strict 1,200-calorie diet and exercises regularly with a heart-rate monitor, the 24-year-old is still heavier than she'd like to be.

"I always thought of weight loss as a simple format - calories in and calories out," said Brush, who is 5-foot-4 and weighs 160 pounds. "I've found that's not the case whatsoever."

Brush has been fighting to lose weight since childhood. In college, she worked with nutritionists on portion size and making smart food choices. She has been tested for food allergies and tried gluten- and dairy-free diets. She has counted calories and, when that didn't work, ignored them. Doctors have ruled out thyroid issues and problems with her metabolism,

she said.

"I'm somewhat convinced at this point that it might have something to do with an insulin resistance, because diabetes is prevalent in my family," she said. "But it's very frustrating to work your butt off and not get results, like wanting something you can't have."

Here's a closer look at three factors researchers say contribute to weight gain:

AIR POLLUTION:

The air a pregnant woman breathes could predispose her child to obesity, according to an emerging field of research that looks at prenatal exposure to diesel exhaust.

In one of the first human studies, researchers found that pregnant women in New York City exposed to higher concentrations polycyclic aromatic hydrocarbons, or PAHs, were more than twice as likely than other women to have children who were obese by age 7.

"Not only was their body mass higher, but it was higher due to body fat rather than bone or lean muscle mass," said Robin Whyatt, study co-author and deputy director of the Columbia Center for Children's Environmental Health.

PAHs, a group of more than 100 chemicals, are byproducts of burning coal, oil, gas, tobacco and garbage. Most people are exposed through vehicle exhaust, smoke, soot and foods that are grilled, barbecued or smoked. Common indoor sources include cigarette smoke, candles and incense and home heating fuels.

The findings, published in April in the American Journal of

Epidemiology, fit with evidence gleaned from previous research on animals and cell cultures. In pregnant mice, exposure to PAHs causes weight gain in their babies. Rundle and Whyatt's work found PAHs may affect the functioning of fat cells.

"Fat cells are like a storage container for lipids," Rundle said. "As they swell, they get heavier because more is being stored. When you start to exercise or diet, the fat cells are supposed to release lipids; that's how you lose weight. There's some data showing PAHs interfere with that process."

Like many pollutants, PAHs can mimic the effects of estrogen, meaning they can influence the body's hormonal signaling system. "Estrogen is ... extremely important during fetal development and in the reproductive system," Whyatt said.

More research is needed to strengthen the link between air pollution and obesity. But for people with poor diets and sedentary lives, prenatal exposure to air pollution may make them even more susceptible, Rundle said.

GUT BACTERIA:

The human digestive tract is a lush ecosystem containing microorganisms that play a crucial role in digestion. But research shows that changing the delicate mix of bacteria may lead to weight gain.

Antibiotics, which wipe out both harmful and helpful bacteria, are one of the most common ways to upset the balance.

Studies suggest that microbes in the intestines affect the way the body metabolizes food. Early exposure to antibiotics may kill off healthy bacteria that influence the absorption of nutrients and help keep people

lean, said Dr. Leonardo Trasande, an associate professor in pediatrics, environmental medicine and health policy at the New York University School of Medicine.

Trasande's team recently looked at more than 10,000 children and found that infants who had received antibiotics in their first six months were more likely to be overweight or obese as toddlers than other babies. The timing mattered; children given antibiotics between 6 months and 14 months of age didn't show a similar effect, according to the research, published last month in the *International Journal of Obesity*.

Another study, published last month in *Nature*, found that mice treated with antibiotics packed on up to 15 percent more body fat than those who weren't. The antibiotics seemed to shift the balance of certain gut microbes and affected hormones related to metabolism, the researchers found.

The microbes found in mice that ate antibiotics produced more short-chain fatty acids, a type of fat that cells use for energy, said lead author Ilseung Cho, assistant professor of medicine at the NYU's School of Medicine. "Ultimately, we were able to affect body composition and development in young mice by changing their gut microbiome through (antibiotic) exposure," he said.

The fattening effect parallels what is already seen with livestock. Farmers commonly use small doses of antibiotics to plump up cattle, pigs and chickens without increasing calories.

But antibiotics might not be the only thing changing the body's microbiome. Overconsumption of fructose and artificial sweeteners can affect microbes in the gastrointestinal tract and may contribute to metabolic disorders and obesity, according to a study published last month in *Obesity Reviews*.

Fructose, found in honey, fruits, table sugar, corn syrup, root vegetables and other sources, is easily absorbed by the body. But researchers found that when too much fructose is consumed, it reduces the diversity of the bacteria in the gastrointestinal tract.

SLEEP DEPRIVATION:

Sleeping less than six hours a night doesn't just make people irritable. It can mess up the systems in the brain that regulate metabolism, said the University of Chicago's Kristen Knutson, an assistant professor of medicine who recently reviewed published research on the topic in the American Journal of Human Biology.

Sleep deprivation can alter the circulating levels of the hormones that control hunger. "For example, after a short sleep, ghrelin, which stimulates appetite, is higher, and leptin, which signals satiety or fullness, is lower," Knutson said.

Sleep-restricted people also report greater levels of hunger, particularly for calorie-dense foods, Knutson said.

A lack of sleep may also decrease resting metabolic rates, or the number of calories burned while doing nothing, said sleep loss expert Dr. Orfeu Buxton, a neuroscientist at Brigham and Women's Hospital in Boston and assistant professor in the division of sleep medicine at Harvard Medical School.

Buxton's latest research, published in April in the journal Science Translational Medicine, showed that getting less sleep - five or six hours a night - and having disrupted circadian rhythms also increased the glucose concentration in the blood after meals. High blood sugar increases a person's risk of Type 2 diabetes, a condition closely correlated with obesity.

During the nine days that volunteers received recovery sleep and had their body clocks realigned, their metabolism normalized.

Sleep loss could also lead to weight gain in simpler ways: It gives people more time to eat, and it can make people tired and lethargic, reducing physical activity.

"Diet, sleep and exercise are the three pillars of health," Buxton said. "Start with diet to maintain or lose weight. Sleep supports a healthy diet - if you're rested, a salad will appeal more than the stale doughnut with the pink frosting in the break room. Once that's stable, then you can increase physical activity."

OTHER FACTORS IN WEIGHT GAIN

In addition to [air pollution](#), gastrointestinal bacteria and sleep deprivation, a number of other overlooked factors that may affect weight have been identified by researchers:

Maternal age, weight:

Women are waiting longer to have children, and children of older women are more likely to become obese. Overweight pregnant women, meanwhile, can unwittingly pre-program their offspring for obesity, research shows.

More carbon dioxide in the atmosphere:

According to one hypothesis, outlined in the journal *Nutrition & Diabetes*, inhaling increased amounts of carbon dioxide makes the blood more acidic (or decreases its pH level). In the brain, a lower pH level may cause appetite-related neurons to fire more frequently, leading to increased appetite and decreased activity.

Indoor heat:

Colder temperatures can activate brown adipose tissue, which burns rather than stores calories. According to a study published last year in the journal *Obesity Reviews*, room temperatures have increased in both the U.S. and Britain since the 1960s. In mildly cold conditions (such as a chilly room), people generate extra heat without shivering. This may trigger brown fat to consume calories to keep the body warm. Studies suggest that increased time spent in warm conditions may lead to a loss of brown fat and a reduced capacity to burn energy.

Air conditioning:

When it's hot, people eat less. Air conditioning could also keep people indoors, reducing outdoor exercise.

Endocrine disrupters:

Chemical compounds that mimic or block the body's hormonal actions, including bisphenol A and phthalates, have been linked to obesity in young children. Research suggests prenatal exposure to some chemicals may affect weight later in life.

Viruses:

Adenoviruses cause respiratory or gastrointestinal infections. One called adenovirus 36 has been linked to weight gain; a study found it may infect fat cells, making them grow more quickly and multiply in greater numbers than normal. Further research is needed.

Pharmaceutical drugs:

Weight gain is associated with several commonly used medicines,

including drugs for depression, diabetes, allergies, hypertension, contraception and mental illness.

Decreased smoking:

In the short term, nicotine increases energy expenditure and may reduce appetite. This could explain why light smokers tend to have lower body weight than do nonsmokers and why people often gain weight after quitting.

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