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## **Plastic Taints Most Bottled Water, Study Finds**

**RESEARCHERS DON'T KNOW WHETHER DRINKING THE MICROPLASTIC BITS MIGHT POSE HEALTH RISKS**

Sharon Oosthoek – April 23, 2018



Tiny plastic bits contaminate bottled water sold around the world, a new study finds. For now, scientists can only guess at the source of the plastic. Whether ingesting it might pose any risk also remains unknown.

Researchers tested more than 250 bottles of water. They came from nine countries and were sold under 11 different brands. These included Nestle Pure Life, Aquafina, Dasani, Evian, San Pellegrino and Gerolsteiner. Plastic turned up in 93 out of every 100 of the bottles.

Each tainted liter (almost one quart) held an average of 10 particles wider than a human hair, along with 300 smaller particles. But some bottles contained more — thousands of the floating specks. These really tiny bits are often referred to as microplastic fibers.

Many of these particles “are small enough to be transported through our bodies and end up in our organs,” says Sherri Mason. She is a chemist at the State University of New York in Fredonia.

Mason and her team tested the water on behalf of Orb Media, a nonprofit journalism group based in the United States. Orb Media’s partners include the British Broadcasting Corporation (BBC) and the Canadian Broadcasting Corporation (CBC). Both of those outlets published stories about the research last month. To date, the results have not yet been *peer reviewed* or published in a scientific journal. The researchers did, however, post details of their study online March 14.

### **A continuing problem**

Plastic pollution in the environment is nothing new. Tiny bits of plastic have turned up in rivers, lakes and oceans. Finding them has been easy. Figuring out their source has been harder.

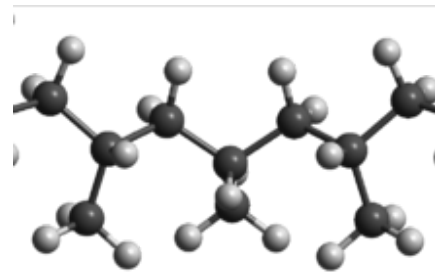
Microplastics in water can come from larger pieces of plastic that break down in landfills and oceans. Sunlight and ocean waves also help break up pieces of plastic. Even clothes can shed microplastics. Fabrics

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such as fleece and nylon are made from plastic. When washed, they shed bits of plastic lint. It travels from the wash water down household drains and eventually into rivers, lakes and oceans.

Other microplastic beads go in some toothpastes and skin-care products. These beads help scrub away tooth plaque and dead skin cells. Then they, too, wash down the drain.

The most common type of plastic that Mason and her team found in bottled water was polypropylene (Pah-lee-PROH-puh-leen). This is the same type used in bottle caps. They also found bits of nylon and polyethylene terephthalate (Pah-lee-ETH-uh-leen Tair-eh-THAAL-ayt), also known as PET. PET is the main plastic used in water bottles.



So how do they get into bottled water? Once plastic bits go down the drain, it will wash into — and then out of — water treatment plants (because they were not designed to filter the plastics out). These facilities release their water into rivers and the ocean. Some of that water may move into groundwater, which some companies use for bottled water. Other companies may use city tap water. And earlier studies had found plastic bits could come out in tap water. The source of that plastic, too, might be contaminated lakes or rivers.

The new study is the first to find microplastics in bottled water, its authors say. In fact, Mason notes, her team found at least twice as many particles in bottled water as earlier tests had found in tap water. Scientists aren't sure what ingesting the tiny bits of plastic might do to our health. "But we know it probably isn't good," Mason says.

Plastics are made from many types of chemicals. There isn't yet enough research to know how many of these might affect human health. After all, they were never designed to be eaten. Plastic also acts like a sponge, soaking up many types of chemicals. For example, pesticides and other toxic compound have been found in plastics floating in the ocean. So plastic particles might ferry such pollutants into bottled water, too.

### Dyes mark the plastic

Andrew Mayes is a chemist in England at the University of East Anglia, in Norwich. This is the largest study of bottled water he says he's ever seen. "The main message from the study is that microplastics are all around us," says Mayes. And, he adds, they "are getting into everything we eat, drink and probably breathe."

Mayes helped to develop the method Mason and her team used to detect the microplastics. He has now reviewed how Mason's group did its research and agrees with its findings.

Here's what they did. They added a dye known as Nile Red to the bottled water. That dye sticks to plastic surfaces. (Some of the dye stuck to the insides of the bottles, too.) When viewed under blue light, the dye will glow. The researchers then poured the bottled water through a special type of paper. Water flows right through it, but larger molecules such as plastic get caught on the paper's surface. The researchers put that paper under a microscope and shone a blue light on it. Then they counted the glowing plastic bits.

"It's a bit like the glow-in-the-dark stars many kids have on their ceilings," says Mason. "We counted the bright spots."

The new study doesn't say where the plastic bits in bottled water are coming from, Mayes notes. But it's possible, he says, that they come from the bottle caps or the bottles themselves during processing and packing. Mason worries that more and more plastic is turning up in the environment. Part of the problem, she says, is that we use a lot of disposable plastic. Plastic bags, bottles and straws are the major culprits.

"Say 'no' to straws, because they suck," Mason recommends. "And don't use plastic bags for wrapping sandwiches. There are reusable products you can use instead."

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## Power Words

- **average** (in science) A term for the arithmetic mean, which is the sum of a group of numbers that is then divided by the size of the group.
- **cell** The smallest structural and functional unit of an organism. Typically too small to see with the unaided eye, it consists of a watery fluid surrounded by a membrane or wall.
- **chemical** A substance formed from two or more atoms that unite (bond) in a fixed proportion and structure. For example, water is a chemical made when two hydrogen atoms bond to one oxygen atom. Its chemical formula is  $H_2O$ . Chemical also can be an adjective to describe properties of materials that are the result of various reactions between different compounds.
- **environment** The sum of all of the things that exist around some organism or the process and the condition those things create. Environment may refer to the weather and ecosystem in which some animal lives, or, perhaps, the temperature and humidity (or even the placement of components in some electronics system or product).
- **filter** (in chemistry and environmental science) A device or system that allows some materials to pass through but not others, based on their size or some other feature. (in physics) A screen, plate or layer of a substance that absorbs light or other radiation or selectively prevents the transmission of some of its components.
- **journal** (in science) A publication in which scientists share their research findings with experts (and sometimes even the public). Some journals publish papers from all fields of science, technology, engineering and math, while others are specific to a single subject. The best journals are peer-reviewed: They send all submitted articles to outside experts to be read and critiqued. The goal, here, is to prevent the publication of mistakes, fraud or sloppy work.
- **landfill** A site where trash is dumped and then covered with dirt to reduce smells. If they are not lined with impermeable materials, rains washing through these waste sites can leach out toxic materials and carry them downstream or into groundwater. Because trash in these facilities is covered by dirt, the wastes do not get ready access to sunlight and microbes to aid in their breakdown. As a result, even newspaper sent to a landfill may resist breakdown for many decades.
- **media** (in the social sciences) A term for the ways information is delivered and shared within a society. It encompasses not only the traditional media — newspapers, magazines, radio and television — but also Internet- and smartphone-based outlets, such as blogs, Twitter, Facebook and more. The newer, digital media are sometimes referred to as social media. The singular form of this term is medium.
- **microplastic** A small piece of plastic, 5 millimeters (0.2 inch) or smaller in size. Microplastics may have been produced at that small size, or their size may be the result of the breakdown of water bottles, plastic bags or other things that started out larger.
- **microscope** An instrument used to view objects, like bacteria, or the single cells of plants or animals, that are too small to be visible to the unaided eye.
- **molecule** An electrically neutral group of atoms that represents the smallest possible amount of a chemical compound. Molecules can be made of single types of atoms or of different types. For example, the oxygen in the air is made of two oxygen atoms ( $O_2$ ), but water is made of two hydrogen atoms and one oxygen atom ( $H_2O$ ).
- **nylon** A silky material that is made from long, manufactured molecules called polymers. These are long chains of atoms linked together.
- **organ** (in biology) Various parts of an organism that perform one or more particular functions. For instance, an ovary is an organ that makes eggs, the brain is an organ that makes sense of nerve signals and a plant's roots are organs that take in nutrients and moisture.
- **particle** A minute amount of something.
- **peer review** (in science) A process in which scientists in a field carefully read and critique the work of their peers before it is published in a scientific journal. Peer review helps to prevent sloppy science and bad mistakes from being published.

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- **pesticide** A chemical or mix of compounds used to kill insects, rodents or other organisms harmful to cultivated plants, pets or livestock; or unwanted organisms that infest homes, offices, farm buildings and other protected structures.
- **plaque** (in dental medicine) A biofilm, or community of bacterial species, that grows on teeth and other surfaces in the mouth.
- **plastic** Any of a series of materials that are easily deformable; or synthetic materials that have been made from polymers (long strings of some building-block molecule) that tend to be lightweight, inexpensive and resistant to degradation.
- **polyethylene** A plastic made from chemicals that have been refined (produced from) crude oil and/or natural gas. The most common plastic in the world, it is flexible and tough. It also can resist radiation.
- **polyethylene terephthalate** A commonly used type of plastic, usually referred to simply as **PET**. It can be produced as strong, stable fibers for use in making clothing. It also is the basis of many plastic beverage bottles (such as milk jugs) and semi-hard food packages (often used for produce). When used in fabrics, it's simply known as polyester. To identify these plastics in goods other than clothing, they tend to carry a labeled on the bottom or side with the number 1 surrounded by the triangular "chasing arrows" symbol and the acronym PET or PETE below the triangle.
- **polypropylene** The second most common plastic in the world. It is tough and durable. Polypropylene is used in packaging, clothing and furniture (such as plastic chairs).
- **toxic** Poisonous or able to harm or kill cells, tissues or whole organisms. The measure of risk posed by such a poison is its toxicity.
- **United Kingdom** Land encompassing the four "countries" of England, Scotland, Wales and Northern Ireland. More than 80 percent of the United Kingdom's inhabitants live in England. Many people — including U.K. residents — argue whether the United Kingdom is a country or instead a confederation of four separate countries. The United Nations and most foreign governments treat the United Kingdom as a single nation.



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## **How the Body Protects Us From Potentially Toxic Amounts of Sugar**

A STUDY IN MICE CHALLENGES ASSUMPTIONS ABOUT HOW THE BODY PROCESSES THE SUGAR

Laurel Hamers – March 14, 2018



Too much sugar can cause liver damage and raise the risk for other medical problems. Now, researchers studying mice have learned that the small intestine protects the liver from exposure to one type of sugar, called *fructose*. But the small intestine has its limits, the study finds. High doses of fructose overwhelm the intestine's ability to process the sugar. Researchers reported those results February 6 in *Cell Metabolism*.

Fructose is a type of simple sugar. It's found in honey and fruits, as well as in table sugar and in many sweetened foods and drinks. To use fructose for energy, the body needs to convert it into another type of simple sugar, called glucose, or into other smaller molecules. But too much fructose puts a strain on the body. For example, in people it puts the liver at risk for conditions such as fatty liver disease. It also raises the risk of obesity and type 2 diabetes (DIE-uh-BEAT-eez).

Scientists knew fructose could be broken down and absorbed in both the liver and the small intestine. But they believed the liver was mainly responsible for the process. The new study suggests otherwise. It finds that moderate doses of fructose are transformed in the small intestine. The liver steps in only when the dose of fructose is too high for the small intestine to handle.

In that way, the small intestine shields the liver from dangerously high doses of fructose, says Joshua Rabinowitz. One of the study authors, he works at Princeton University in New Jersey. He studies how the body breaks down chemicals.

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But how much fructose is too much is still up in the air. Rabinowitz and colleagues fed mice a sugar mix that contained equal parts glucose and fructose. (That's the ratio in basic table sugar.) Some mice got a lower dose of sugar, and some got a higher dose.

The researchers used a special technique to chemically "label" the sugar molecules they gave to the mice. The method involved swapping certain carbon atoms out for a slightly heavier form of carbon. That allowed the researchers to track which sugars were being transformed and where their by-products were ending up.

Later, the researchers collected samples from different mouse organs. Then they separated out the sugar by-products by weight and identified the molecules with heavier carbon.

At lower sugar doses, researchers found lots of by-products from labeled fructose molecules in the small intestine. But they found only small amounts in the liver. The same was true in the vein that connects the small intestine to the liver. Lots of glucose molecules were found in this vein, though. The chemical labels showed some had been transformed from fructose molecules in the small intestine.

At high sugar doses, the small intestine couldn't keep up. The vein connecting the intestine and liver had a much higher ratio of fructose to glucose than at lower sugar doses. That suggests the small intestine was passing some fructose along to the liver.



Translating these findings into dietary recommendations for people could be challenging because mice burn more energy relative to their body weight than people do, cautions Luc Tappy. He's a physiologist at the University of Lausanne in Switzerland. He wasn't part of the study. He notes that it's hard to compare sugar doses between humans and mice.

Plus, Rabinowitz adds, scientists don't know whether the small intestine is a safer place than the liver to process fructose. His lab plans to research that next.

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### Power Words

- **carbon** The chemical element having the atomic number 6. It is the physical basis of all life on Earth. Carbon exists freely as graphite and diamond. It is an important part of coal, limestone and petroleum, and is capable of self-bonding, chemically, to form an enormous number of chemically, biologically and commercially important molecules
- **cell** The smallest structural and functional unit of an organism. Typically too small to see with the unaided eye, it consists of a watery fluid surrounded by a membrane or wall. Depending on their size, animals are made of anywhere from thousands to trillions of cells. Most organisms, such as yeasts, molds, bacteria and some algae, are composed of only one cell.
- **chemical** A substance formed from two or more atoms that unite (bond) in a fixed proportion and structure. For example, water is a chemical made when two hydrogen atoms bond to one oxygen atom. Its chemical formula is  $H_2O$ . Chemical also can be an adjective to describe properties of materials that are the result of various reactions between different compounds.
- **compound** (often used as a synonym for chemical) A compound is a substance formed when two or more chemical elements unite (bond) in fixed proportions. For example, water is a compound made of two hydrogen atoms bonded to one oxygen atom. Its chemical symbol is  $H_2O$ .
- **diet** The foods and liquids ingested by an animal to provide the nutrition it needs to grow and maintain health.
- **extract** (v.) To separate one chemical (or component of something) from a complex mix. (noun) A substance, often in concentrated form, that has been removed from its natural source. Extracts are often taken from plants (such as spearmint or lavender), flowers and buds (such as roses and cloves), fruit (such as lemons and oranges) or seeds and nuts (such as almonds and pistachios). Such extracts, sometimes used in cooking, often have very strong scents or flavors.
- **fatty liver disease** A condition that results when too much fat builds up inside the liver. People who are obese or drink too much alcohol risk developing this condition. Left untreated and allowed to worsen, it can eventually lead to life-threatening liver failure.
- **fructose** A simple sugar, which (along with glucose) makes up half of each molecule of sucrose, also known as table sugar.
- **glucose** A simple sugar that is an important energy source in living organisms. As an energy source moving through the bloodstream, it is known as "blood sugar." It is half of the molecule that makes up table sugar (also known as sucrose).
- **literally** A term that the phrase that it modifies is precisely true. For instance, to say: "*It's so cold that I'm literally dying,*" means that this person actually expects to soon be dead, the result of getting too cold.
- **liver** An organ of the body of animals with backbones that performs a number of important functions. It can store fat and sugar as energy, break down harmful substances for excretion by the body, and secrete bile, a greenish fluid released into the gut, where it helps digest fats and neutralize acids.
- **metabolism** (adj. metabolic) The set of life-sustaining chemical reactions that take place inside cells and bigger structures, such as organs. These reactions enable organisms to grow, reproduce, move and otherwise respond to their environments.
- **molecule** An electrically neutral group of atoms that represents the smallest possible amount of a chemical compound. Molecules can be made of single types of atoms or of different types. For example, the oxygen in the air is made of two oxygen atoms ( $O_2$ ), but water is made of two hydrogen atoms and one oxygen atom ( $H_2O$ ).
- **nutrient** A vitamin, mineral, fat, carbohydrate or protein that a plant, animal or other organism requires as part of its food in order to survive.
- **obesity** (adj. obese) Extreme overweight. Obesity is associated with a wide range of health problems, including type 2 diabetes and high blood pressure.
- **organ** (in biology) Various parts of an organism that perform one or more particular functions. For instance, an ovary is an organ that makes eggs, the brain is an organ that makes sense of nerve signals and a plant's roots are organs that take in nutrients and moisture.

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- **physiologist** A scientist who studies the branch of biology that deals with how the bodies of healthy organisms function under normal circumstances.
- **ratio** The relationship between two numbers or amounts. When written out, the numbers usually are separated by a colon, such as a 50:50. That would mean that for every 50 units of one thing (on the left) there would also be 50 units of another thing (represented by the number on the right).
- **risk** The chance or mathematical likelihood that some bad thing might happen. For instance, exposure to radiation poses a risk of cancer. Or the hazard — or peril — itself. (For instance: *Among cancer risks that the people faced were radiation and drinking water tainted with arsenic.*)
- **toxic** Poisonous or able to harm or kill cells, tissues or whole organisms. The measure of risk posed by such a poison is its toxicity.
- **type 2 diabetes** (see also diabetes) A disease caused by the body's inability to effectively use insulin, a hormone that helps the body process and use sugars. Unless diabetes is controlled, a person faces the risk of heart disease, coma or death.
- **vein** Part of the body's circulation system, these tubes usually carrying blood toward the heart.



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## **Explainer: What are Opioids?**

THESE DRUGS MIMIC A NATURAL COMPOUND IN YOUR BRAIN – WITH ADDICTIVE AND DANGEROUS IMPACTS

Bethany Brookshire – March 27, 2018



The “opioid crisis” has made a lot of news — and for good reason. In 2016 alone, more than 42,000 people in the United States died from overdosing on these drugs. Another 2.1 million people became addicted to these painkillers. The drugs’ deadliness comes from the way they affect the brain and other parts of the body. But these drugs have great value, too. They are, after all, some of the best painkillers known.

*Opioids* include drugs such as morphine, heroin, fentanyl and oxycodone. The term “opioid” comes from the word “opium.” It’s a chemical that comes from poppies. For thousands of years, opium has been used to treat pain. And through the years, people also have used and abused it for pleasure.

All of these drugs work by impersonating brain chemicals known as endorphins (En-DOR-fins). Endorphins serve as messengers between nerve cells. As such, they are *neurotransmitters*.

When one brain cell releases endorphin molecules, they float across a gap to another cell. There they bind to *receptor* molecules. These sit on the outside of the target cell. The endorphin’s shape fits into the receptor like a key into a lock. When they connect, the receptor now can turn on — or off — activities inside its host cell.

Receptors for endorphins exist in the brain’s pleasure center and on nerve cells that relay pain signals. So when the body releases its natural endorphins, they not only fight pain but also contribute to a feeling of pleasure.

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Opioids, however, are much, much more powerful than our puny endorphins. People who take opioids can experience intense pleasure and even joy. Opioids also fight pain far more effectively than do our bodies' natural chemicals.

### Here's the problem

The intense pleasure that opioids produce means that people may want to try them again. And again. As someone takes these drugs more and more often, the body will grow *tolerant* of the drug. With time, the body will need more and more of an opioid to feel good again.

Each time the effect of an opioid wears off, the person will suffer from *withdrawal*. Symptoms of withdrawal can include nausea, vomiting, diarrhea, sleep problems, anxiety and more.

What relieves those symptoms? More opioids. The longer a person takes an opioid, they will often need to take more — and bigger — doses to avoid feeling sick. They may then become *addicted* to the drugs and unable to control their use.

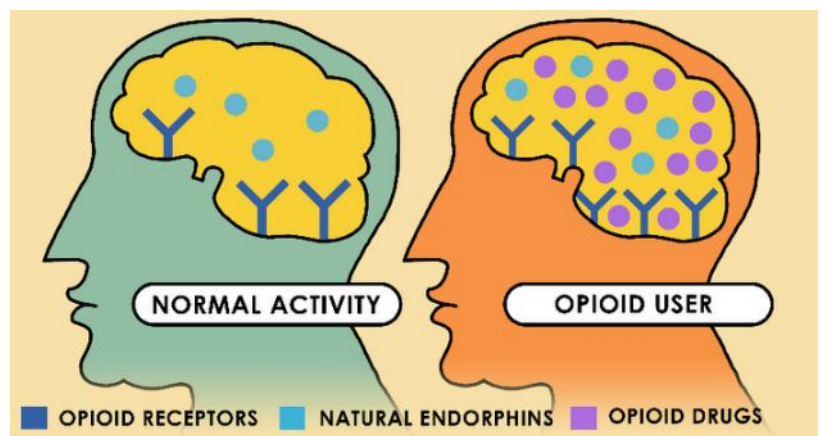
Opioid addiction isn't cured easily. Some doctors prescribe drugs like *methadone* (METH-uh-doan) or *buprenorphine* (BU-preh-NOR-feen) to treat opioid addiction. These drugs are also opioids, but they work very slowly, which helps opioid addicts avoid the misery of withdrawal. These drugs also can't provide the "high" people get from fentanyl or heroin. Doctors might also prescribe *naltrexone* (Naal-TREX-oan). This drug blocks receptors so that opioid drugs can't enter them. Naltrexone thus keeps users from deriving pleasure from opioids.

It's very easy to overdose on opioids. And here's one reason. There are opioid receptors on areas of the brain called the *medulla* and the *pons*. Both areas help control how deeply and frequently someone breathes. By binding to these receptors, opioid drugs can slow breathing. At high enough doses, breathing will stop.

To prevent this, doctors and emergency workers may inject a drug called *naloxone* (Nah-LOX-oan), or Narcan. This is an opioid *antagonist*. That means it binds to the opioid receptors but does not turn them on. By taking the place of the opioid drugs, naloxone can speed breathing back up again — and save someone's life.

If opioids are so dangerous, why do doctors continue to prescribe them? Pain control. These are simply some of the best painkillers available, especially for severe pain.

Scientists are searching for safer painkillers. An ideal drug would eliminate pain without offering the pleasure of opioids. But it may be many years before such treatments become available.



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### Power Words

- **addict** An individual that suffers from a disease that provokes the uncontrolled use of a habit-forming drug or uncontrolled or unhealthy habit (such as video game playing or phone texting). Their illness is triggered by brain changes that occur after using some drugs or engaging in some extremely pleasurable activities. People with an addiction will feel a compelling need to use a drug (which can be alcohol, the nicotine in tobacco, a prescription drug or an illegal chemical such as cocaine or heroin), even when the user knows that doing so risks severe health or legal consequences.
- **addicted** Unable to control the use of a habit-forming drug or to forego an unhealthy habit (such as video game playing or phone texting). It results from an illness triggered by brain changes that occur after using some drugs or engaging in some extremely pleasurable activities. People with an addiction will feel a compelling need to engage in some behavior, such as using a drug (which can be alcohol, the nicotine in tobacco, a prescription drug or an illegal chemical such as cocaine or heroin) — even when the user knows that doing so risks severe health or legal consequences.
- **antagonist** (in medicine or biology) A substance that blocks or interferes with the normal biological action of another chemical.
- **anxiety** A nervous reaction to events causing excessive uneasiness and apprehension. People with anxiety may even develop panic attacks.
- **cell** The smallest structural and functional unit of an organism. Typically too small to see with the unaided eye, it consists of a watery fluid surrounded by a membrane or wall. Depending on their size, animals are made of anywhere from thousands to trillions of cells.
- **chemical** A substance formed from two or more atoms that unite (bond) in a fixed proportion and structure. For example, water is a chemical made when two hydrogen atoms bond to one oxygen atom. Its chemical formula is H<sub>2</sub>O. Chemical also can be an adjective to describe properties of materials that are the result of various reactions between different compounds.
- **diarrhea** Loose, watery stool (feces) that can be a symptom of many types of microbial infections affecting the gut.
- **endorphins** Any of a group of chemicals secreted within the brain and nervous system. As neurotransmitters, they relay messages within the nervous system. They also activate the feel-good receptors in the body and can raise an individual's threshold for pain.
- **heroin** A highly addictive and illegal drug derived from morphine, a potent pain killer. People often take heroin as a narcotic — something that dulls the senses, relieves pain and makes them sleepy or unmotivated to do anything other than lay in a slump.
- **medulla** A site in the brain located where the brain meets the spinal cord. It controls breathing, heart rate and blood pressure.
- **methadone** An opioid drug used to treat addiction to more dangerous opioids, such as morphine, heroin or fentanyl. This drug is used to treat pain as well. Methadone binds to the same receptors as other opioids. But it binds very slowly so that the person taking it does not derive pleasure from it. Methadone also lasts a very long time, so a patient will not experience withdrawal. Patients take methadone so that they can stay away from other opioid drugs.
- **molecule** An electrically neutral group of atoms that represents the smallest possible amount of a chemical compound. Molecules can be made of single types of atoms or of different types. For example, the oxygen in the air is made of two oxygen atoms (O<sub>2</sub>), but water is made of two hydrogen atoms and one oxygen atom (H<sub>2</sub>O).

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- **naloxone** A drug that works as an antidote to help people who take dangerous amounts of heroin or some other opiate drug. Naloxone works by binding to the same features on brain-cell surfaces that heroin or related drugs do. This reduces or turns off the pleasurable sensations that opiate drugs would normally produce.
- **nausea** Feeling sick to one's stomach, as though one could vomit.
- **nerve** A long, delicate fiber that transmits signals across the body of an animal. An animal's backbone contains many nerves, some of which control the movement of its legs or fins, and some of which convey sensations such as hot, cold or pain.
- **neurotransmitter** A chemical released at the end of a neuron to carry a message to a neighboring cell. This chemical travels across the space between two cells, and then binds to molecules on a neighboring cell to transmit a message. Neurotransmitters are released from neurons, and can bind to neurons or to other types of cell, including those that make up muscles or glands.
- **opioid** Drugs or natural substances that act on receptors (cell molecules) that can block pain signals from traveling along nerves. It can also cause euphoria, intense, pleasurable feelings of well-being. Opioids take their name from opium, a strong painkiller, which was first made from poppies, a types of flower.
- **overdose** To eat or drink more than the recommended amount of something that may be toxic, such as alcohol or medicines.
- **pons** A part of the brain that helps to control sleep, breathing, swallowing, urination, hearing, taste and more. It is a spot deep inside at the very base of the brain.
- **receptor** (in biology) A molecule in cells that serves as a docking station for another molecule. That second molecule can turn on some special activity by the cell.
- **symptom** A physical or mental indicator generally regarded to be characteristic of a disease. Sometimes a single symptom — especially a general one, such as fever or pain — can be a sign of any of many different types of injury or disease.
- **tolerance** (In medicine) A condition that can develop in response to repeated doses of a drug, whereby an organism now becomes less sensitive to — more **tolerant** of — the drug's effects. A person or animal now needs to take more of a drug than before to achieve the same effect. Tolerance can be one sign of drug abuse.
- **withdrawal** (in medicine) An almost disease-like syndrome that can develop after animals (including people) attempt to stop using a drug (including alcohol) to which they have become addicted. Shaking, sweating, trouble sleeping, anxiety, diarrhea, vomiting, abdominal cramping, muscle aches and flu-like symptoms can occur and last for days.



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## **Vaping May Stiffen The Heart and Blood Vessels**

VAPING STUDY IN MICE SUGGETS E-CIGARETTE USE MIGHT LEAD TO HEART DISEASE

Meenakshi Prabhune – November 14, 2017



Smoking's ill effects on human health are well known. But electronic cigarettes have only been around for about 15 years. So there hasn't yet been time to demonstrate any long-term risks. Still, short-term data already point to vaping's risks to the lungs and DNA. Now a mouse study shows that even brief exposure to e-cigarette vapors hurts blood vessels.

Effects seen in mice after eight months of vaping were striking. Even more concerning: Just five minutes of vaping damaged their blood vessels. These types of injury increase the risk of developing heart disease. The findings therefore add to a growing list of harm being linked to vaping.

I. Mark Olfert works at West Virginia University in Morgantown. As a physiologist, he studies how the body works. His research focuses on the lungs, heart and blood circulation. Doctors in his state have been considering recommending vaping as a way to help their patients quit smoking. This concerned Olfert. When it came to the heart, he notes, "There really wasn't any information whether e-cigarettes were safe."

So his team decided to test the effects of long-term vaping in mice. They placed the animals in a chamber filled with e-cigarette vapor for four hours daily. They continued this for eight months. The exposures these mice got was no higher than what an average vaper now experiences, Olfert reports. Mice live for two to three years. So their eight months of vaping was about the same as 20 years of vaping by a human.

Arteries carry blood from the heart to the blood vessels that feed cells in even the most distant tissues of the body. The researchers measured the stiffness of a primary artery running from the heart into the lower chest.

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Mice exposed to the vapors had arteries that were 2.5 times stiffer than normal. Stiff blood vessels can lead to life threatening heart disease.

However, in these tests, just five minutes of vaping also had a clear impact. When muscles in an artery's walls are stimulated, they contract. This temporarily reduces the size of the tube's interior. That also ups an individual's blood pressure. So it's important that blood vessels don't stay contracted for too long. But after a mouse had vaped, its artery responded more slowly than normal to chemicals that instruct it to relax, or *dilate*. The artery's slow response could weaken the heart over time, Olfert says.



Taken together, he concludes, these data suggest that even brief vaping is not safe for the heart. His team described its findings online November 2 in the *Journal of Applied Physiology*.

Mice are different from people, Olfert points out. But often, not that much different. For instance, cigarette smoking has similar effects in mice and people. That's one reason his team expects its rodent data may predict human heart impacts from vaping. And while it would be nice to have actual human data for comparison, it could take 20 or 30 more years before long-term vaping data would be available from people, he notes.

### Importance for teens

Vaping research is especially important for young people, who might unknowingly put their health at risk. "With adolescents, we are really concerned," stresses Olfert, "because right now the message they get is that these things are safe." In fact, he notes, a wealth of emerging data suggest e-cigarettes aren't.

Holly Middlekauff agrees. She is a heart doctor at the University of California in Los Angeles who did not take part in the new study. Many people today view vaping as harmless. And that, she says, is a mistake. Such a belief, she worries, may lead teens who would otherwise not have tried traditional tobacco cigarettes to experiment with vaping.

The next step is to find out which part of an e-cigarette's vapor is responsible for the artery and blood-vessel impacts. "Is it the nicotine," asks Olfert? "Is it the base chemicals that are in the [vaporized] liquid? Or is it the flavoring?" Right now, he notes, "we don't know."

Middlekauff suspects *nicotine* might be the heart-toxic component. Nicotine is a natural chemical in tobacco that makes cigarettes addictive. The toxicity of smoking is usually blamed mostly on the tars that form when tobacco is burned. As e-cigarettes "burn" nothing, some people had assumed vaping was harmless. But the safety of inhaled nicotine is not proven, Middlekauff points out. In fact, there are reasons to believe that nicotine may be particularly harmful to teens.

Her team recently tested the effects of e-cigarettes with and without nicotine in human volunteers. People who inhaled vapors containing nicotine showed fluctuating heart rates. That is what people would expect from nicotine. So the new data seem to affirm that nicotine "may underlie the adverse effects on the heart," she says. Her team reported its findings in the September *Journal of the American Heart Association*.

Olfert's group is continuing to study long-term effects of vaping on blood vessels. These researchers have even begun a study in people based on their results in mice. For now, Middlekauff urges, teens should know that vaping is not harmless. "If you are a non-smoker," she says, you definitely "should not start using electronic cigarettes."

## PLEASE DO NOT WRITE ON THE ARTICLE!

### Power Words

- **addictive** An adjective to describe something that become habit-forming in an uncontrolled or unhealthy way. This can include a drug or some habit (such as video game playing or phone texting). Such addictions reflect an illness triggered by brain changes that occur after using some drugs or engaging in some extremely pleasurable activities. People with an addiction will feel a compelling need to use a drug (which can be alcohol, the nicotine in tobacco, a prescription drug or an illegal chemical such as cocaine or heroin), even when the user knows that doing so risks severe health or legal consequences.
- **adolescent** Someone in that transitional stage of physical and psychological development that begins at the onset of puberty, typically between the ages of 11 and 13, and ends with adulthood.
- **animal model** A nonhuman animal used to stand in for people in research testing. Which animal a lab uses will depend on how closely parts of its body or chemical-signaling systems match those in people.
- **artery** Part of the body's circulation system. There are several. Each is a major tube running between the heart and blood vessels that will move blood to all parts of the body.
- **average** (in science) A term for the arithmetic mean, which is the sum of a group of numbers that is then divided by the size of the group.
- **blood vessel** A tubular structure that carries blood through the tissues and organs.
- **chemical** A substance formed from two or more atoms that unite (bond) in a fixed proportion and structure. For example, water is a chemical made when two hydrogen atoms bond to one oxygen atom. Its chemical formula is H<sub>2</sub>O. Chemical also can be an adjective to describe properties of materials that are the result of various reactions between different compounds.
- **component** Something that is part of something else (such as pieces that go on an electronic circuit board or ingredients that go into a cookie recipe).
- **e-cigarette** (short for electronic cigarette) Battery-powered device that disperses nicotine and other chemicals as tiny airborne particles that users can inhale. They were originally developed as a safer alternative to cigarettes that users could use as they tried to slowly break their addiction to the nicotine in tobacco products. These devices heat up a flavored liquid until it evaporates, producing vapors. People use these devices are known as vapers.
- **heart rate** Heart beat; the number of times per minute that the heart — a pump — contracts, moving blood throughout the body.
- **information** (as opposed to data) Facts provided or trends learned about something or someone, often as a result of studying data.
- **journal** (in science) A publication in which scientists share their research findings with experts (and sometimes even the public). Some journals publish papers from all fields of science, technology, engineering and math, while others are specific to a single subject. The best journals are peer-reviewed: They send all submitted articles to outside experts to be read and critiqued. The goal, here, is to prevent the publication of mistakes, fraud or sloppy work.
- **model** A simulation of a real-world event (usually using a computer) that has been developed to predict one or more likely outcomes. Or an individual that is meant to display how something would work in or look on others.
- **nicotine** A colorless, oily chemical produced in tobacco and certain other plants. It creates the "buzz" associated with smoking. Highly addictive, nicotine is the substance that makes it hard for smokers to give up their use of cigarettes. The chemical is also a poison, sometimes used as a pesticide to kill insects and even some invasive snakes or frogs.
- **physiologist** A scientist who studies the branch of biology that deals with how the bodies of healthy organisms function under normal circumstances.
- **risk** The chance or mathematical likelihood that some bad thing might happen. For instance, exposure to radiation poses a risk of cancer. Or the hazard — or peril — itself. (For instance: *Among cancer risks that the people faced were radiation and drinking water tainted with arsenic.*)

## ***PLEASE DO NOT WRITE ON THE ARTICLE!***

- **rodent** A mammal of the order Rodentia, a group that includes mice, rats, squirrels, guinea pigs, hamsters and porcupines.
- **tar** A thick, viscous black flammable goo, often derived from plants (such as wood) or plant-based materials (such as coal). Tar consists of a range of hydrocarbons, resins, alcohols and more.
- **tissue** Made of cells, any of the distinct types of materials that make up animals, plants or fungi. Cells within a tissue work as a unit to perform a particular function in living organisms. Different organs of the human body, for instance, often are made from many different types of tissues.
- **tobacco** A plant cultivated for its leaves, which many people burn in cigars, cigarettes, and pipes. Tobacco leaves also are sometimes chewed. The main active drug in tobacco leaves is nicotine, a powerful stimulant (and poison).
- **toxic** Poisonous or able to harm or kill cells, tissues or whole organisms. The measure of risk posed by such a poison is its toxicity.
- **vaping** (v. to vape) A slang term for the use of e-cigarettes because these devices emit vapor, not smoke. People who do this are referred to as **vapers**.
- **vaporize** To convert from a liquid to a gas (or vapor) through the application of heat.
- **vapors** Fumes released when a liquid transforms to a gas, usually as a result of heating.