

Pass the SALT?

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LET'S FACE IT: SALT IS DELICIOUS. But when it comes to diet and high blood pressure, salt has long been one of the bad guys. Too much sodium can make your body retain water, increasing pressure within blood vessels and leading to hypertension. And runaway blood pressure can lead to a host of maladies, from kidney damage and vision loss to stroke and heart disease.

Most Americans do eat too much salt—3.5 grams each day, more than 7 times what we need, according to the US Centers for Disease Control and Prevention. But the extra salt doesn't affect everyone equally. According to Richard Wainford, a

School of Medicine assistant professor of pharmacology and medicine, only about half of adults are salt-sensitive: if they eat too much salt, their blood pressure goes up. For the other half, salt has little or no effect on blood pressure. Nobody knows exactly why, and there's no easy way to tell who's who.

"Something has got to be working in your body to get rid of that salt," says Wainford, who heads a laboratory at MED's Whitaker Cardiovascular Institute. "We don't know what that is. So if we don't know what's working in a healthy patient, how can we expect to fix something when it's broken? That's where I come in."

Wainford specializes in the complex science of homeostasis—how

the body maintains a stable balance of substances like sodium, glucose, and iron throughout its tissues—and its impact on blood pressure regulation. His research is funded by two grants from the National Institutes of Health's National Heart, Lung, and Blood Institute and his goal is to develop biomarkers for salt-sensitivity, which could lead to better diagnostics and treatment for high blood pressure.

One of the key organs for homeostasis is the kidney, which helps regulate water, salt, and iron in the blood by excreting certain substances in the urine. Another key organ is the brain, which helps control the kidneys. Wainford studies the kidney-brain conversation by examining a par- → 18

Two New Thoughts about Blood Pressure

SEEKING THE MECHANISMS BENEATH A MAJOR HEALTH PROBLEM / BY BARBARA MORAN

HIGH PROTEIN to lower blood pressure

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NEARLY ONE-THIRD OF AMERICANS suffer from high blood pressure. The condition is so common that we sometimes forget that it's also serious and may lead to heart disease, stroke, and kidney failure.

Some risk factors for high blood pressure, like obesity and smoking, are well established. But there's been increasing controversy about how our diets make our blood pressure go up or down. The National Heart, Lung, and Blood Institute recommends an eating plan called Dietary Approaches to Stop Hypertension—better known as the DASH diet. Devised in the 1990s by Thomas

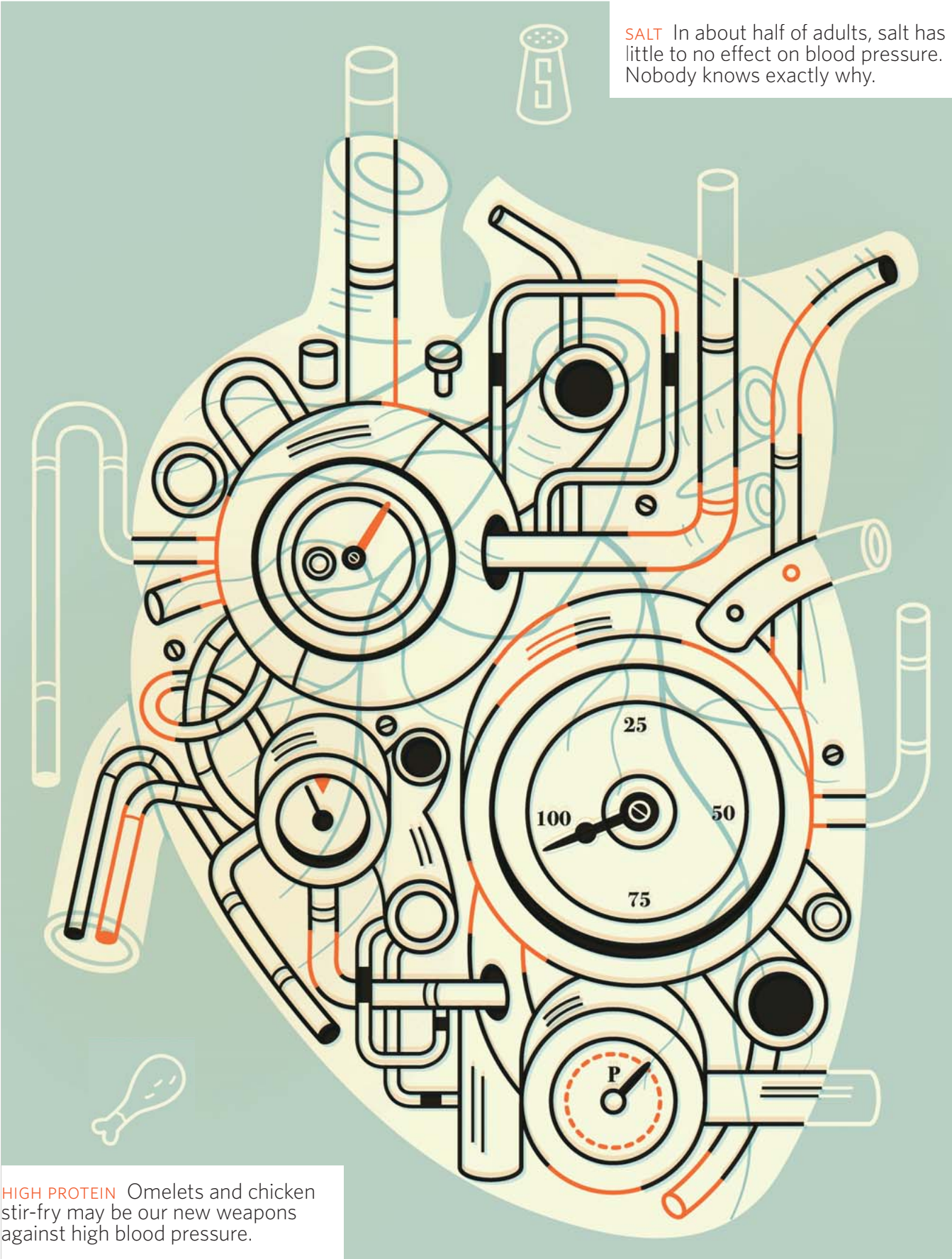
Moore, a School of Medicine professor and associate provost of the Medical Campus, the DASH diet contains plenty of fruits, vegetables, and low-fat dairy products, and is also low in saturated fats and salt.

But now, a team of MED researchers has published a study in the *American Journal of Hypertension* that found a crucial nutrient—protein—may have been overlooked, and could offer a surprising level of protection. Omelets, peanut butter, and chicken stir-fry may be our new weapons against high blood pressure.

"The protein and blood pressure story has been not particularly clear and there really hasn't been that much information about it," says study senior author Lynn Moore (SPH'87,'93), a

MED associate professor of medicine and associate director of the master's and PhD nutrition and metabolism programs. "I started thinking about it because of the DASH diet study results. When low-fat dairy was added to a diet that included lots of fruits and vegetables, the blood pressure-lowering effect was almost double what was seen in the fruit- and vegetable-rich diet alone. There have been a lot of questions about why that is, and one possibility was protein."

Plant proteins had been previously suggested to lower blood pressure. Moore and her colleagues set out to investigate whether *all* types of protein might have beneficial effects. Using data from the Framingham Heart Study's long-running → 18



SALT In about half of adults, salt has little to no effect on blood pressure. Nobody knows exactly why.

HIGH PROTEIN Omelets and chicken stir-fry may be our new weapons against high blood pressure.

← [Salt]

ticular signaling pathway in the brain, one that sends messages through certain molecules, known as *Gai2*-proteins.

When a person ingests salt, signals along this pathway tell the brain to slow down communication to the kidney, and also for the kidney to increase the amount of salt in urine. It's a complicated chain of events, and Wainford studies how it works in rats.

In one of his first experiments, Wainford worked with several breeds of salt-resistant rats, animals that can eat as much salt as they want with no effect on blood pressure. After feeding them salty diets for three weeks, he looked at the expression of the *Gai2*-proteins in their brains, and found a dramatic increase in a region of the brain known to be a "hot spot" for cardiovascular regulation. Wainford then blocked the signal pathway by infusing the rats with a specific



MICHAEL D. SPENCER

➤ **RICHARD WAINFORD** says only about half of all adults are salt-sensitive. For the other half, salt has no influence on blood pressure.

sequence of DNA that prevented them from making the *Gai2*-protein. Then he gave the animals salty food again, but this time, they couldn't get rid of the extra salt. As a result, they got high blood pressure.

"When healthy people eat salt, the activity of their central nervous system is turned down to get rid of it," says Wainford. "When you remove this protein pathway in the brain of salt-resistant rats, they're not able to turn down the activity of the brain to the same extent." He believes this signaling pathway is one of several that affect the control of blood pressure. Other studies in humans have shown that a tiny defect in the gene for this protein—one single base pair off—is linked to hypertension. But Wainford's group is the first to find how it works: a clear molecular mechanism that regulates the communication between the brain and the kidney.

Ingesting salt signals the kidney to increase the amount of salt in urine.



Most Americans eat seven times the salt needed by their bodies.

← [High protein]

Framingham Offspring Study, the researchers found that adults who consumed more protein, whether from dairy, eggs, meat, or plant sources, had lower blood pressure levels after four years of follow-up. People with the highest protein intake—on average 102 grams a day—saw the biggest benefit, with a 40 percent lower risk of developing high blood pressure.

In the offspring study, when the higher-protein eaters also ate lots of fiber, the benefit was even more dramatic: a 40 to 60 percent reduction in the risk of developing high blood pressure. This was true for both people who were obese and those of a normal weight. While plant proteins did have a slightly stronger benefit, all types of proteins seemed to work.

Moore notes that dietary variety is important, so people should try to eat protein from many different sources. For example, a tuna fish

sandwich for lunch, a small handful of nuts or yogurt as a snack, and grilled chicken for dinner is a better choice than 17 eggs or 5 protein bars.

How can protein lower blood pressure? The regulation of blood pressure is a complex process, involving the heart, kidneys, blood vessels, and numerous hormones interacting throughout the body. Scientists don't know all the details yet, but they've found that dairy proteins contain certain compounds that act as natural ACE (angiotensin-converting-enzyme) inhibitors, one of the major types of blood pressure medications. Other animal proteins, especially eggs, contain high levels of arginine, which dilates blood vessels and lowers blood pressure.

"It was a little bit surprising. We expected to see a reduction associated with the protein—I was thinking in particular of eggs and dairy products—because of those known mechanisms. But I didn't expect to see as strong an



JACKIE RICCIARDI

➤ **LYNN MOORE** encourages finding protein in a variety of foods, such as tuna, nuts, yogurt, and grilled chicken.

Wainford did similar tests on salt-sensitive rats, and with a more drastic measure of removing the animals' renal nerves entirely, severing all communication between the brain and the kidneys. Surprisingly, this kept the rats' blood pressure low and seemed to have no other ill effects. (Similar trials on humans have had mixed results.)

"Clearly the impact of the renal nerves on blood pressure regulation in human subjects is complicated," says Wainford. "I think the removal of the renal nerves is a very powerful technique; it just needs to be done right, and studied right, and in the right population. Ultimately, our goal is to more fully understand the mechanisms of how the brain and the kidney interact to regulate blood pressure. The more we understand that, the better we can treat patients."

Oversimplified dietary messages have persuaded people to cut out protein.



effect as we did," says Moore. "There may be other mechanisms that we're not even aware of. It's still an active area of investigation."

Doctors and nutritionists don't usually tell people with high blood pressure to avoid protein per se. But our culture's pervasive (and oversimplified) low-fat dietary message may have caused some people to inadvertently cut out protein.

"Fat was considered sort of an evil thing for many years," says Moore. "The message became: don't drink milk, don't eat eggs, don't eat meat—that way you would reduce your fat intake. The belief was that if we reduced the fat in the diet, obesity would go away and heart disease risk would dramatically decline. But there's good evidence that protein is beneficial throughout the life span. In older adults, it's important in maintenance of muscle strength, and there's no evidence that it's harmful in terms of blood pressure."

ALLISON CUNEO



Archaeologist Michael Danti was digging high in the jagged Zagros Mountains of Iraqi Kurdistan in June when Kurdish workmen gave him the news: the Islamic State, also called ISIS or ISIL, had stormed the northern city of Mosul. Tens of thousands of people were fleeing for their lives.

"I started to immediately contact my friends in Mosul," says Danti, a College of Arts & Sciences assistant professor of archaeology, who in 2012 started a joint program with Iraqis to revitalize archaeological education in the country. "The rumors came in that ISIS had seized armories and were now armed to the teeth, and then that they had seized the major gas refinery in Baiji. There were lines of cars on the

In 2013, the Kurdistan Regional Government awarded CAS' Michael Danti (standing, above; below) and his Rowanduz Archaeological Program a five-year permit for archaeological surveys and excavations in two ancient cities carved out of rock in the Zagros Mountains. The Zagros stretch from Iran to Iraq and link northwestern Iran to northern Mesopotamia.



JACQUE RICCIARDI

roads that stretched for miles....When you're living and working in the mountains, you don't have a lot of information."

Months later, Danti says the Iraqi professors he worked with on the Mosul Archaeology Program (MAP) still feel threatened by ISIS. "MAP had been the number-one archaeology program in Iraq," he says. "It was designed to set the standard of how archaeologists in the country would be trained."

Danti, a codirector at the American Schools of Oriental Research, a Boston University-based consortium of institutions dedicated to Near Eastern archaeology, has devoted his career to archaeological pursuits in the Middle East—and that hasn't been easy. Wars and political upheaval

Digging in the Shadow of Death

CAS ARCHAEOLOGIST WORKS TO KEEP ARTIFACTS OUT OF THE CLUTCHES OF ISIS / BY AMY LASKOWSKI