



HUMAN EVOLUTION

What's for Dinner? Researchers Seek Our Ancestors' Answers

To help prevent diseases like diabetes and heart disease today, evolutionary biologists seek to understand the tastes of our diverse ancestors

BERLIN—As evolutionary scientists from around the world loaded their plates with fish, potatoes, and pork at a lunch buffet at the Berlin Medical Historical Museum, talk naturally turned to what's best for humans to eat. Compared with us, our ancestors ate “meat. More protein, less refined carbohydrates, and no milk,” pronounced exercise physiologist Loren Cordain of Colorado State University, Fort Collins, who advocates a similar regimen to prevent disease. (He passed up the pasta.) At a nearby table, though, his colleagues ate ... pudding.

Sixteen researchers from multiple disciplines chewed on the question of whether there is an ideal diet for humans as part of a recent workshop on evolution and modern diseases.* Those focusing on diet hoped to test the common belief that diseases such as obesity, diabetes, and high blood pressure arise because our bodies are poorly adapted to the modern diet, rich in fat, sugar, and salt. “Is there a single Paleolithic diet that is going to be a magic bullet for everyone?” asked biological anthropologist William Leonard of Northwestern University in Evanston, Illinois, who led the diet work-

shop. “Or do we have to tailor diets specifically to regional populations?”

After comparing emerging evidence from ancient humans and diverse modern cultures, the researchers concluded that many factors—including genes, sex, ancestry, and fetal and childhood conditions— influence how we digest foods and store fat. Physiological stress in mothers can leave lingering imprints on descendants for generations. So although it's true that humans evolved to eat a diet relatively high in protein and low in carbohydrates and fat, there's no single Paleolithic prescription for better health. “It is the internal environment inside yourself that is key—how genes are expressed and how you started off in life,” says paleoanthropologist Peter Ungar of the University of Arkansas, Fayetteville.

The first suppers

From the beginning, our ancestors had varied tastes. “Early humans had many choices as they bellied up to the biospheric buffet,” says Ungar. The 3- to 4-million-year-old australopithecines were omnivores who ate a wider range of foods than chimpanzees or other apes, according to microscopic wear patterns on fossil teeth and chemical isotopes in tooth enamel. Soon after the origin of our genus *Homo* about 2 million years ago, our lineage

Daily grind. The Tsimane' people in lowland Bolivia work hard for their food and have thrifty bodies that can survive on fewer calories.

began to eat more meat, butchering it with stone tools (*Science*, 15 June 2007, p. 1558).

By the time modern humans swept into Europe about 40,000 years ago, these hunter-gatherers were adept at hunting large game and had also expanded their palates to dine regularly on small animals and freshwater fish, says Michael Richards of the University of British Columbia, Vancouver in Canada.

By studying the ratios of carbon and nitrogen isotopes from collagen in bones, Richards traced the main sources of dietary protein of 27 early Europeans and Neandertals; fish eaters, for example, have more nitrogen-15 in their bones than meat eaters. Richards found that the oldest known modern human in Europe—the 35,000-year-old jawbone from Peștera cu Oase cave in Romania—got much of his protein from fish. By 30,000 years ago, other modern humans got as much as 20% of their protein from fish. Meanwhile, the isotopes show that Neandertals in Europe stuck to meat from bigger animals, even when they lived at the same time in the same region as modern humans. This is the first direct evidence that Neandertals had a narrower diet, Richards reported in August in the *Proceedings of the National Academy of Sciences*.

The next big dietary shift came about 10,000 years ago, when humans began to domesticate plants and, later, animals. The move to agriculture introduced staples of the Western diet: cereal grains, sugars, and milk after weaning. For most of human evolution, our ancestors seldom ate these foods, says Cordain, who advocates avoiding refined grains and dairy products.

The agricultural revolution favored people lucky enough to have gene variants that helped them digest milk, alcohol, and starch. Those mutations therefore spread among farmers. But other populations remained more carnivorous, such as the Saami of frigid northern Norway, whose ancestors herded reindeer. Among Saami ancestors, genes to digest meat and fat efficiently were apparently favored. One gene variant, for example, makes living Saami less likely to get uric acid kidney stones—common in people who eat high-protein diets—than are people whose ancestors were vegetarian Hindus and lack this gene variant, says geneticist Mark Thomas of University College London (UCL).

But when ethnic groups abandon traditional lifestyles and rapidly adopt Western

*Evolution and Diseases of Modern Environments, at Charité University Medicine Berlin, Humboldt University, 12–14 October.

diets, they often suffer. Researchers have known for more than a decade that the Pima of the southwestern United States have “thrifty phenotypes”: sluggish metabolisms that store fat efficiently and boost survival on low-calorie diets. That’s probably because their ancestors in Mexico underwent frequent famine. When they eat the calorie-rich Western diet, the Pima develop high rates of obesity, diabetes, and high cholesterol, although their blood pressure stays relatively low.

Indeed, an epidemic of obesity is now spreading into ethnic groups from Siberia to Peru, as quickly as grocery stores open their doors. But although fast food is becoming the universal diet, not all people respond alike to this nutritional transition. For example, unlike the Pima, the Evenki reindeer herders and other indigenous peoples of Siberia have very high metabolisms, an adaptation to the cold that allows them to convert fat into energy efficiently. When the Soviet Union collapsed in the 1990s, many Siberians abandoned traditional lifestyles and diets. They too became obese and developed heart disease but in a different way from the Pima: The Evenki retained low levels of cholesterol and diabetes but developed high blood pressure, as University of Oregon, Eugene, anthropologist J. Josh Snodgrass reported recently in the *American Journal of Physical Anthropology*. In terms of disease risk, “the Pima are the mirror image of the Siberians,” says Leonard.

These disparate responses reflect a trend: In general, people who evolved in warm lowland environments where food may be scarce may have slow metabolisms for their body size, probably as adaptations to famine or heat stress; examples include the Pima and the Tsimane’ of lowland Bolivia. Groups that adapted to frigid or high-altitude climates, such as the Evenki or the Quechua of Peru, have high metabolisms, probably to convert fat into energy efficiently. Despite their differences, all of these groups risk disease when they switch to the Western diet. “They are telescoping into one generation trends that rolled out over a century or more in Western countries,” says pediatric nutritionist Jonathan Wells of the UCL Institute of Child Health.

From mother to child

Although we are what our ancestors ate, we are also what they didn’t eat. In India, for example, more than 66% of the population in some regions experienced famine during British colonialism a century ago. Women who survived tended to have low-birth-weight babies, whose bodies were small and

Paleolithic Diet

- High Protein (meat and fish)
- Low in Carbohydrates
- Tubers
- Nuts, Seeds, and Berries



Modern Diet

- High in Sugars
- Refined Carbohydrates
- Dairy
- High Fat



A tale of two diets. Our ancestors ate more protein and less dairy and refined carbohydrates than are included in the modern Western diet, which is also rich in sugar and fat.

efficient at storing fat, says Wells. It’s as though these babies took cues during fetal and early development about their mothers’ lifelong nutritional experience and adjusted their growth and body and organ size accordingly. Human stature often tracks the nutritional status of mothers, and it can take generations for descendants to recover. In India, average height in males dropped at a rate of almost 2 centimeters per century in the decades following colonialism, Wells reported online in October in the *American Journal of Human Biology*.



Fisheater. The owner of this jaw—the earliest known modern human in Europe—ate plenty of fish.

When these small babies gain weight in childhood, though, it stresses their smaller organs, such as the pancreas and heart, making them more susceptible to obesity, diabetes, and heart disease. This is the case in south India today, says Wells. There, many people have thrifty phenotypes with less muscle and more fat per body size. Yet they are shifting rapidly to a high-fat, high-sugar diet. As a result, Wells predicts, “India risks becoming the diabetes capital of the world.” Others agree: “I think there’s no question that people in south India are at higher risk,” says biological anthropologist Chris Kuzawa of Northwestern University, who says this is true of many other popula-

tions that have been poor in the past.

One way to prevent obesity and disease is to improve the diet of pregnant mothers and young children. But feeding pregnant women extra calories alone is not enough, warns Kuzawa, who says that a fetus takes in subtle cues about the quality of the mother’s nutrition, as well as her developmental history and that of her recent ancestors. He is part of a team exploring intergenerational effects in 3000 women in the Philippines.

Cordain proposed that everyone mimic a Paleolithic diet, adding protein and reducing refined carbohydrates and dairy, in a more extreme version of the low-carb Atkins-style diets. “It’s hard to get too fat on a diet without carbohydrates,” he says. He also cited a small study of 14 diabetic men in Sweden whose blood sugar improved on a diet free of carbohydrates and dairy products (*Science*, 13 July 2007, p. 175).

But other researchers argued that the problem is, simply, consuming too many calories. “What is clear is having low weight is positive,” says immunologist Andreas Pfeiffer of the Charité Berlin and the German Institute of Human Nutrition in Berlin. All agreed that controlled studies are needed to see whether all calories are alike or whether the same number of calories from protein, fat, or sugar have different effects.

Others noted that even if one paleodiet proves particularly healthy, it would be hard for people in different cultures to comply with it. “Food is identity,” says Ungar. “You can’t tell an Eastern European Jew to eat pork” or an Italian to skip pasta. The bottom line, says Leonard, is that although some diets are better than others, “there isn’t a perfect diet that is the same for everyone. The nature of our success is to find and make a meal in virtually any environment. But our different responses are structured by the basic biology we bring to the table.”

—ANN GIBBONS