# How does the body convert food to fuel? How much do we need? And will running really help with weight?

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Credit: Unsplash/CC0 Public Domain

You have more of it on Saturdays than on Mondays, it seems to evaporate just before any planned gym session, and kids on airplanes

have a seemingly endless supply of it. Energy sustains life and, despite what you may think when you're drained at the end of a workday, our bodies are remarkable engines that continually produce, use, and manage this resource.

At its most basic level, the process is quite straight-forward. We eat, food is digested, and energy is produced. Professor Shane Norris, Director of the Department of Science and Innovation (DSI)-National Research Foundation (NRF) Center of Excellence in Human Development and the Medical Research Council (MRC)/Wits Developmental Pathways for Health Research Unit (DPHRU) explains, "Food has energy locked up in the three macronutrients: proteins, fats, and carbohydrates. [The vitamins and minerals in food are called micronutrients]. After food is digested and broken down to its more basic components, glucose is extracted from the macronutrients and used by the body as fuel."

Whether fat, protein, or carbohydrate, the body breaks food down to the same energy component: glucose—the main sugar found in the blood. But glucose is actually quite toxic, says Norris, so the body must constantly balance glucose demands, use, and excess. To do this, the pancreas adjusts levels of the hormone insulin, which "pushes" glucose out of circulation and into muscles and fat cells.

## Energy intake

But the body is a complicated machine and it's not quite as straightforward as "food in, energy out." Although it can extract and use glucose from all macronutrients, the body prefers to use carbohydrates for energy, says Dr. Thanujj Kisten, Lecturer in nutrition, exercise and energetics in the School of Physiology.

"All the macronutrients can be a source of energy, and fat actually

contains the most energy. But fats and proteins take much longer to break down, so the body prefers carbohydrates. The brain cannot directly use fat as an energy source, and protein is used as a last resort because it has more important jobs as a catalyst for chemical reactions. Unfortunately, the diet industry has created this misconception that all carbohydrates are bad. Simple carbs such as refined sugar are indeed processed very quickly, leading to a large spike in energy and then a crash. But complex carbs such as brown rice are broken down more slowly, resulting in a gradual and sustained release of energy."

But even when carbs aren't available, the body will continue to function by converting fat and protein to use as energy. "This process takes longer, which is why people on keto diets [a popular low carb/high fat weight loss diet] will often feel lethargic," says Kisten.

When you eat also plays a role in energy levels throughout the day, he adds. "Not eating breakfast, for example, could cause lethargy [fatigue] as your body has no immediately available fuel. Research shows that having five smaller meals per day, instead of three big meals, provides more sustained energy throughout the day."

## Energy expenditure

Even when you spend the entire day watching television from your couch, your body uses around 8,700 kilojoules per day to keep you alive. The brain uses the biggest chunk of this number compared to any other organ, says Norris. "Then, functional systems such as the cardiovascular and digestive systems take their cut, maintenance systems that repair or create cells further reduce available energy, and the immune system uses some energy to prevent disease—and much more when fighting an infection.

"Any unused energy is then stored as body fat to be used when extra fuel

is needed."

Activity, of course, alters energy expenditure. A five-kilometer run, for example, burns between 1,300 to 1,500 kilojoules in a person of average height and weight. So, if physical activity burns energy, why do experts recommend exercise to increase energy levels?

"In the short term, exercise uses energy, and you may feel fatigued afterwards," says Kisten. "But in the long term, exercise teaches the body to use energy more efficiently. Over time, it starts using less energy to conduct normal daily activities, leaving you feeling more energetic. This effect can take anywhere from two weeks to two months to occur, depending on the type of exercise and the frequency."

## Finding balance

There is no one-size-fits-all energy template, says Kisten. "A professional athlete will have much higher energy needs than someone who works a desk job. The heavier you are, the more energy your body requires to move. This is one of the reasons why an obese person might fatigue faster than someone of a healthy weight. Conversely, someone who is underweight will not have enough fuel and will also suffer from fatigue."

Your energy needs will depend on your health and wellness goal, and there are many nuances and considerations. According to a Wits Sport and Health (WiSH) webinar, energy availability in athletes can be affected by a number of health factors—some normal, such as female hormones regulating the menstrual cycle, others problematic, such as iron deficiency or psychological challenges. "And newer research shows that even weight loss is not as straightforward as once believed," says Norris.

"Any diet that creates a kilojoule deficit will eventually result in weight loss, though some are healthier than others in the long term. But we are now realizing that a kilojoule deficit creates a biological stress response. The body recognizes something is not right when weight loss occurs, and it activates stress hormones to slow metabolism, while brain centers associated with addiction fire up to increase appetite. Eventually, you will lose weight, but your body tries to fight you along the way."

"On a global scale, obesity is now a bigger problem than hunger—and it will be for a long time," says Norris. In one cohort study of three generations, the increased risk of cardiovascular disease persisted in the grandchildren of obese individuals.

"Whether you're vegan, vegetarian, a meat-eater or live off simple carbs, supply is no longer the world's biggest problem. Now, it's about socioeconomics: Can you afford healthy food and are you getting the nutrients you need? Our work in Soweto shows that around 20% to 36% of adults are anemic, meaning they don't have enough iron to produce blood cells. Today, the challenge is not having more, but finding balance."

## How accurate is the paleo diet?

The premise of one of today's most popular diets, the paleo diet, is that modern eating habits are so far removed from those of our ancestors that our bodies couldn't keep up, resulting in health ailments and weight problems. It cuts out anything "processed"—even some crops produced by modern agriculture such as cereal grains and legumes.

How accurate is this? In a nutshell, it's not, says Dr. Christine Steininger, Project Director of Genus: DSI-NRF Center of Excellence in Palaeosciences. "Even our ancestors ate processed food. Later, Homo sapiens used fire, a processing method, to make food more palatable and

to kill microbes. And as our diets evolved, our gut evolved.

Our ancestors in South Africa, the most common of which was Australopithecus africanus, between 4 and 1.9 million years ago, ate more like chimps, she says. "They ate what was in their immediate environment, such as fruits, nuts, and insects. Early Homo habilis, between 2.4 and 1.6 million years ago, started using tools to eat mammal remains such as bone marrow, likely scavenging it, and the extra protein increased their brain size. Then Homo erectus, our earliest known upright ancestors, were possibly migrating hunters and the additional protein made them taller and stronger. Diet played an important role in evolution."

Provided by Wits University

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