

What We Think We Know About Metabolism May Be Wrong

A new study challenges assumptions about energy expenditure by people, including the idea that metabolism slows at middle age.

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Everyone knows conventional wisdom about metabolism: People put pounds on year after year from their 20s onward because their metabolisms slow down, especially around middle age. Women have slower metabolisms than men. That's why they have a harder time controlling their weight. Menopause only makes things worse, slowing women's metabolisms even more.

All wrong, according to a [paper published Thursday in Science](#). Using data from nearly 6,500 people, ranging in age from 8 days to 95 years, researchers discovered that there are four distinct periods of life, as far as metabolism goes. They also found that there are no real differences between the metabolic rates of men and women after controlling for other factors.

The findings from the research are likely to reshape the science of human physiology and could also have implications for some medical practices, like determining appropriate drug doses for children and older people.

"It will be in textbooks," predicted Leanne Redman, an energy balance physiologist at Pennington Biomedical Research Institute in Baton Rouge, La., who also called it "a pivotal paper."

Rozalyn Anderson, a professor of medicine at the University of Wisconsin, Madison, who studies aging, wrote [a perspective](#) accompanying the paper. In an interview, she said she was "blown away" by its findings. "We will have to revise some of our ideas," she added.

But the findings' implications for public health, diet and nutrition are limited for the moment because the study gives "a 30,000-foot view of energy metabolism," said Dr. Samuel Klein, who was not involved in the study and is director of the Center for Human Nutrition at the Washington University School of Medicine in St. Louis. He added, "I don't think you can make any new clinical statements" for an individual. When it comes to weight gain, he says, the issue is the same as it has always been: People are eating more calories than they are burning.

Metabolic research is expensive, and so most published studies have had very few participants. But the new study's principal investigator, Herman Pontzer, an evolutionary anthropologist at Duke University, said that the project's participating researchers agreed to share their data. There are more than 80 co-authors on the study. By combining efforts from a half dozen labs collected over 40 years, they had sufficient information to ask general questions about changes in metabolism over a lifetime.

All of the research centers involved in the project were studying metabolic rates with a method considered the gold standard — doubly labeled water. It involves measuring calories burned by tracking the amount of carbon dioxide a person exhales during daily activities.

The investigators also had participants' heights and weights and percent body fat, which allowed them to look at fundamental metabolic rates. A smaller person will burn fewer calories than a bigger person, of course, but correcting for size and percent fat, the group asked, Were their metabolisms different?

“It was really clear that we didn't have a good handle on how body size affects metabolism or how aging affects metabolism,” Dr. Pontzer said. “These are basic fundamental things you'd think would have been answered 100 years ago.”

Central to their findings was that metabolism differs for all people across four distinct stages of life.

- There's infancy, up until age 1, when calorie burning is at its peak, accelerating until it is 50 percent above the adult rate.
- Then, from age 1 to about age 20, metabolism gradually slows by about 3 percent a year.
- From age 20 to 60, it holds steady.
- And, after age 60, it declines by about 0.7 percent a year.

Once the researchers controlled for body size and the amount of muscle people have, they also found no differences between men and women.

As might be expected, while the metabolic rate patterns hold for the population, individuals vary. Some have metabolic rates 25 percent below the average for their age and others have rates 25 percent higher than expected. But these outliers do not change the general pattern, reflected in graphs showing trajectory of metabolic rates over the years.

The four periods of metabolic life depicted in the new paper show “there isn't a constant rate of energy expenditure per pound,” Dr. Redman noted. The rate depends on age. That runs counter to the longstanding assumptions she and others in nutrition science held.

The trajectories of metabolism over the course of a lifetime and the individuals who are outliers will open a number of research questions. For instance, what are the characteristics of people whose metabolisms are higher or lower than expected, and is there a relationship with obesity?

One of the findings that most surprised Dr. Pontzer was the metabolism of infants. He expected, for example, that a newborn infant would have a sky-high metabolic rate. After all, a general rule in biology is that smaller animals burn calories faster than larger ones.

Instead, Dr. Pontzer said, for the first month of life, babies have the same metabolic rate as their mothers. But shortly after a baby is born, he said, “something kicks in and the metabolic rate takes off.”

The group also expected the metabolism of adults to start slowing when they were in their 40s or, for women, with the onset of menopause.

But, Dr. Pontzer said, “we just didn’t see that.”

The metabolic slowing that starts around age 60 results in a 20 percent decline in the metabolic rate by age 95.

Dr. Klein said that although people gain on average more than a pound and a half a year during adulthood, they can no longer attribute it to slowing metabolisms.

Energy requirements of the heart, liver, kidney and brain account for 65 percent of the resting metabolic rate although they constitute only 5 percent of body weight, Dr. Klein said. A slower metabolism after age 60, he added, may mean that crucial organs are functioning less well as people age. It might be one reason that chronic diseases tend to occur most often in older people.

Even college students might see the effects of the metabolic shift around age 20, Dr. Klein said. “When they finish college they are burning fewer calories than when they started.”

And around age 60, no matter how young people look, they are changing in a fundamental way.

“There is a myth of retaining youth,” Dr. Anderson said. “That’s not what the biology says. In and around age 60, things start to change.”

“There is a time point when things are no longer as they used to be.”