

UC SANTA BARBARA

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## Hormones in the Crosshairs

While small-scale horticulture is a relatively recent addition to the human repertoire of food provisioning, hunting has deep evolutionary roots. In practically every society, hunting ability correlates with reproductive success — the better the hunter, the more children he is likely to father.

Studying physiological data including testosterone and cortisol levels collected from members of the Tsimane, an indigenous group of forager-farmers and hunters in central Bolivia, UC Santa Barbara anthropologists Ben Trumble and Michael Gurven and colleagues at the University of Washington and the University of New Mexico have found evidence suggesting that testosterone and cortisol levels increase when men successfully hunt an animal, and remain high as they return home with meat. Their research appears online today in the [Proceedings of the Royal Society B](#).

The research Trumble and colleagues conducted on short-term testosterone spikes among Tsimane hunters follows previous studies examining similar increases resulting from chopping down trees — another physically demanding task that is critical to successful farming and food production.

“Until recently, the testosterone literature has been largely focused on mating and male-male competition,” said Trumble, the paper’s lead author. “But that’s really oversimplifying the male life history strategy. It’s a lot more nuanced than simple male-male competition. Offspring provisioning is also an important aspect of male behavior. In mammals, competing against other males is the key to gaining access to females and increasing reproductive success. But humans are different — female choice plays an important role, and in most subsistence societies, women prefer men who are better providers.”

The acute spikes in testosterone increase the muscle’s ability to take in blood sugar, which, in turn, enhance performance during physically active production strategies such as tree chopping for farming, or hunting. “If you’re better able to pull blood sugar into your muscle tissue, and better able to use that energy, you’ll perform better,” Trumble explained.

Cortisol can play a similar role. Short-term increases in that particular hormone are beneficial for energy mobilization in the body. “If you come across a predator and need to be able to mobilize your energy reserves quickly, you would definitely benefit from a spike in cortisol,” he continued. “While associated with the acute stress response, this can be a good thing. But organisms face serious trade-offs, and often times what’s good in the short term can have deleterious effects long term.”

Regarding the role of testosterone in male provisioning strategies, little research has been conducted to date. “There was a study a couple of years ago that looked at day traders in the stock market,” said Trumble. “The researchers found that on days the traders had a higher than average profit-to-loss margin, meaning they made more money that day, they showed greater increases in testosterone and cortisol.

“Day trading isn’t physically vigorous, but it is a high-variance activity,” he

continued. "Hunting is high variance, but also very physical. On 60 percent of hunts you're successful, and on the rest you aren't. So that's a really high variance rate. Sometimes you come back with a couple hundred pounds of meat, and sometimes you come back with nothing."

Most studies examining testosterone variability are conducted on college campuses with young men who have high, potentially novel levels of testosterone compared to what would have been experienced during human evolution. "Our industrial lifestyle is quite different from the experiences faced by hunter gatherers throughout most of human existence," Trumble noted.

Testosterone levels are highly reactive to environmental factors, including pathogens, parasites and food scarcity. "If you get sick at all, you see a decrease in testosterone," said Trumble. "If you have low energy coming into the system, you see decreased testosterone. If you don't have enough calories coming into the system, you see decreased testosterone. If you're expending too much energy, you see decreased testosterone."

In industrial populations, we have relieved many of these pressures. Grocery stores make it possible to collect thousands of calories without any physical activity, and that's why a group like the Tsimane is very interesting. "The Tsimane experience higher exposure to parasites and pathogens and less food security, thus they face a tradeoff between investing energy to maintain good immune function and spending energy to high levels of testosterone, which result in more muscle mass," Trumble explained. "Having a large muscle mass is costly because it accounts for about 20 percent of the male resting metabolic rate. Energy has to be spent just to maintain it, which is not so easy when you have to hunt or you're your own food."

The key, he added, is to keep muscle functional and usable, but not maintain so

much mass as to require additional energy. “That’s one of the ways these short-term testosterone spikes are beneficial,” he said. “You have these low levels of testosterone that spike when necessary. So you still get the benefit without having to pay the high cost of excessive testosterone all the time.”

When it comes to hunting, anthropologists and evolutionary scientists have long wondered — and debated — what, exactly, is the motivating factor behind hunting. Do men take down game for the purpose of feeding their families, or is there an element of showmanship and the hope of gaining access to healthier, more fertile mates?

“One of the things we have the ability to do is look at the data from a hormonal perspective,” said Trumble. “Do men show bigger increases in testosterone and cortisol when they return from a successful hunt and a lot of people see them coming back? If they’re trying to show off and they have a large audience, we should see a bigger spike in testosterone and cortisol. But we don’t find any evidence of that.”

Similarly, Trumble continued, if the hunters bag an exceptionally large animal that could potentially be shared among multiple families — and thereby highlights their hunting prowess — the data should demonstrate an increase in testosterone and cortisol. And it doesn’t. “We didn’t find any evidence that the animal size mattered,” he said. “Hunters could return with two really big peccaries — think wild boar — or they could come back with a squirrel monkey. These men showed similar increases in testosterone and cortisol, regardless of what they brought back. All that mattered is that they returned with meat.”

Additionally, Trumble and colleagues found that the hunters didn’t have to make the kill themselves for their testosterone and cortisol levels to rise. “There were a couple

of cases where they were hunting with a son or with a cousin,” he said. “If your son kills something and you help him bring back the meat, that doesn’t have any signaling value for you. It doesn’t mean you’re a better hunter — all you’re doing is carrying the meat back.”

However, the researchers explained, if providing food for their families is the dominant force behind hunting, we would expect that these men would still show acute increases in testosterone and cortisol when returning with any meat, whether they killed it, or simply participated in the process. “And that is what the evidence suggested,” Trumble said.

Other contributors to the study include Hillard Kaplan of the University of New Mexico and Eric A. Smith and Kathleen O’Connor of the University of Washington.

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