Health & Medicine

The Secret Science Behind Feeling Great

Columbia biologists propose a more holistic framework for measuring health — asking not what ails you, but what makes you thrive.

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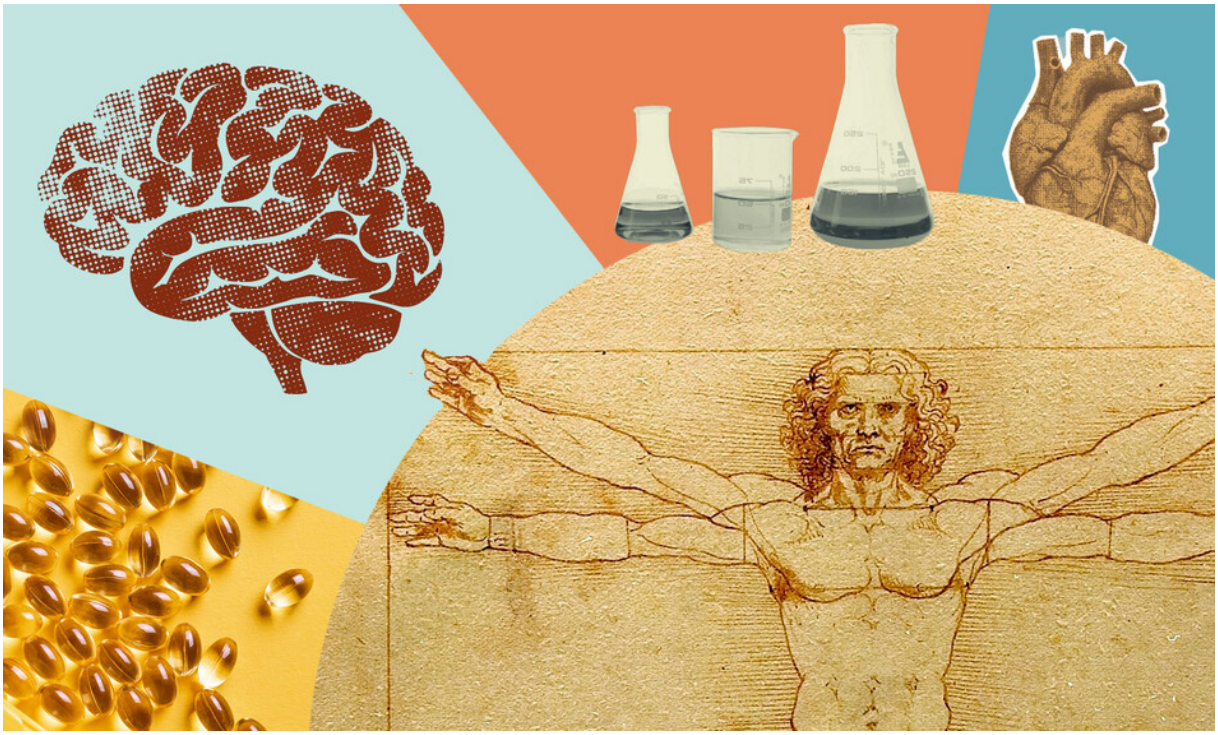


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Do you wake up most mornings feeling truly well-rested — with your mind clear and calm, your body strong, and a sense of boundless energy carrying you out the door? If so, you could be in even better shape than your doctor gives you credit for. Studies have shown that how healthy we *feel* is often a surprisingly good predictor of how long we'll live — sometimes even better than clinical tests. That's

led scientists to suspect that behind our gut instincts are real biological signals that modern medicine just hasn't learned to detect yet. If researchers could identify the factors that give rise to these feelings of vitality, they say, it could change how we take care of ourselves.

Until recently, the prospect of defining and measuring health as a distinct biological state — rather than merely inferring it in the absence of disease — was seldom discussed in medical circles. Doctors have long focused on what goes wrong in the body, because dysfunction is easier to describe and quantify than well-being. But advances in data science are now beginning to illuminate how complex physiological systems work together in healthy organisms, inspiring a growing number of researchers to believe that health itself can finally be studied objectively. At the forefront of this emerging "science of health" are several faculty members at Columbia University Irving Medical Center, who have spent years investigating the biological factors that allow our bodies to function smoothly. In a new paper in *Science Advances*, they lay out the most detailed framework to date for understanding optimal health — or "intrinsic health," as they call it — offering both a conceptual foundation and a roadmap for how scientists might learn to measure it.

The authors, led by integrative biologists Alan A. Cohen and Martin Picard, propose that intrinsic health is a "field-like state," a kind of emergent property that arises from the dynamic interplay of systems involved in energy processing and communication across all levels of physiology — from molecular signaling within cells to coordination amongst organs. When energy is flowing freely and metabolic pathways are buzzing with crosstalk, they argue, we enter a state of "dynamic equilibrium" that enables our bodies to adapt seamlessly to changes in our environment — whether we're encountering microbes, toxins, predators, or extreme temperatures. To illustrate, the authors offer the metaphor of a tightrope walker: just like balancing on a highwire requires constant, finely tuned muscular adjustments working in harmony throughout the body, they say, maintaining great health depends on continuous dialogue among our organ systems, so that their responses to ever-changing conditions can be coordinated. When these adjustments are well-integrated and efficient, we feel good. When they falter, so does our health.

One of the most important insights in biology over the past couple of decades is that communication between cells, tissues, and organ systems is a key driver of health and disease. Cohen and Picard, whose new paper is coauthored by Linda Fried, John Beard, Daniel Belsky, and several other faculty members at Columbia's Mailman

School of Public Health, have helped to shape this evolving view. Picard's team, for example, has shown that our immune, nervous, cardiovascular, and muscular systems are more closely intertwined than previously thought, and that when communication among them breaks down, our chances of developing conditions like cancer, heart disease, Alzheimer's, and chronic fatigue increase. Similarly, Cohen's group has found that when regulatory networks governing inflammation and metabolism fall out of balance — a shift he calls homeostatic dysregulation — we become more susceptible to a whole host of chronic diseases.

The human body, seen through the eyes of these Columbia scientists, is breathtakingly complex. And yet Cohen and Picard say that with recent breakthroughs in AI and new methods of collecting molecular data, it's also decodable. Their teams, which frequently collaborate, have already learned to spot signs of discord among organ systems that may portend disease years, or even decades, in advance. Picard and his team members can do this by analyzing the integrity of mitochondria, tiny organelles best known as our cells' energy producers, which the Columbia researchers have discovered also play critical roles in biochemical signaling throughout the body. Cohen's group, meanwhile, can identify signs of decline in the body's overall capacity for self-maintenance by statistically analyzing large pools of routine health data like blood sugar, cholesterol, inflammatory proteins, and measures of liver and kidney function.

Identifying the root causes of these regulatory imbalances isn't the researchers' immediate goal. Rather, Cohen and Picard are focused on building the scientific foundation that will one day enable researchers and clinicians to detect when the body's networks start to go awry, long before symptoms appear, and to subsequently trace such disruptions back to their source. They say that healthcare workers might then be able to help patients course-correct before illness sets in. Even now, though, potential causes are starting to surface. Cohen's statistical models suggest that early-life adversity like emotional trauma and poverty, as well as unhealthy behaviors like smoking and poor diet, can undermine the body's capacity for self-regulation, setting the stage for illness much later in life. Likewise, Picard's work suggests that psychological stress plays a major role in impairing mitochondrial function, which in turn can disrupt energy flow and intracellular communication within the brain and between it and other organs. His findings have been widely credited with deepening our understanding of mind-body links — helping to explain, for example, why people with severe anxiety and depression are

prone to other diseases. “How mind and body communicate to shape our long-term health remains one of the biggest mysteries in medicine,” Picard said in a recent TEDx talk on the subject. “And that’s not a problem of genes, but one of energy and communication.”

Eventually, Cohen and Picard hope to find ways of tracking a person’s intrinsic health with nothing more than a wearable device or a standard blood test. “The goal is to create a simple, affordable snapshot of your body’s resilience, one that could be repeated over time to assess how well your diet or lifestyle choices are working for you,” says Cohen. This could enable preventive care to go beyond a one-size-fits-all approach, he says. “It would also allow us to shift the conversation away from disease altogether, and focus instead on how well we’re building, maintaining, and restoring health.”

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