

# Scientists measure how energy is spent in martial arts

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An athlete wears a portable gas analyzer during a judo match. Credit: © *Journal of Visualized Experiments*

Two judo fighters face off, one in a white judogi (the traditional judo uniform) and one in blue. They reach for each other's shoulders and lock arms, in what looks like an awkward dance, before the fighter in blue throws his opponent head-over-feet onto the mat.

Judo and mixed martial arts have become increasingly popular over the past few years and scientists have taken note. The two fighters were actually filmed as part of a [science experiment](#) that demonstrates how researchers can quantify exactly how the athletes are spending their energy. The video will be published in *JoVE, the Journal of Visualized Experiments*.

Previously, researchers have only been able to study predictable sports that are easy to replicate in the laboratory, such as running. With this new method, scientists will be able to study the team and individual sports that have previously been neglected.

"Each sport has specific characteristics which confer different [metabolic demands](#) to them," said

paper-author Dr. Emerson Franchini. "One of the most important aspects of the metabolic demand is the relative contribution of the energy systems."

Three energy systems are used in exercise: the aerobic metabolism, which uses oxygen to convert nutrients into energy; lactic anaerobic metabolism, which doesn't require oxygen and makes energy exclusively from carbohydrates, with lactic acid as a by-product; and alactic anaerobic metabolism, which makes energy without oxygen and doesn't produce lactic acid.

In this article, the researchers chose to study judo, a complex and unpredictable sport. To figure out the relative contributions of each [energy system](#), the researchers recorded the participants' resting [oxygen consumption](#), and used a portable gas analyzer (which looks a little bit like a mini jet-pack) to measure exercise oxygen consumption. The researchers took these measures, as well as post-exercise oxygen consumption, rest lactate concentration, and peak lactate concentration post-exercise, and used various mathematical formulas to determine how much each individual energy system contributed.

"One amazing aspect of this method is that it can provide information regarding the energy demands of specific components within a sport," said JoVE Content Director, Dr. Aaron Kolski-Andreaco. "For example, the relative contributions of the [energy](#) systems can be calculated for different Judo throws, and the authors elegantly demonstrate this in their article."

As the authors point out, the problems with assessing unpredictable or team sports in the laboratory has meant that less attention has been paid to those sports by scientists. They hope that this method will help change that.

**More information:** To watch the full video article, please follow the link:

[www.jove.com/video/3413/determ ... tems-during-exercise](http://www.jove.com/video/3413/determ...tems-during-exercise)

Provided by The Journal of Visualized Experiments

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