

Studying water polo for kicks

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Scientists at the University of Tsukuba measure the propulsive force of water polo players while executing highly efficient “eggbeater” kicks, paving the way to improved sports performance and new undersea transportation methods. Credit: BrunoRosa/Shutterstock

Researchers at the University of Tsukuba used high-speed cameras and pressure sensors to quantify the force created by water polo players during kicking motions. They found that the high efficacy of the 'eggbeater' technique exceeds the predictions of conventional biomechanical theories, which may be due to turbulent water flow. This research may help improve our understanding of both the biophysics of sports, as well as lead to new ways to travel through the water more easily.

While polo played with horses may seem genteel and relaxing, the same cannot be said of water polo. It is a grueling competition in which players must constantly expend energy just to stay in a position to catch or throw the ball. A common swimming technique that allows players to tread water while upright is called an eggbeater kick, in which the legs make large circles, just like the kitchen gadget. In fact, they spend about half their time in the water performing this motion, which allows players to elevate themselves from the surface without becoming exhausted.

To understand why this method is so efficient, researchers at the University of Tsukuba studied six male water polo players.

"Sports are often a good place to look for highly optimized techniques," Senior author Professor Hideki Takagi says. "We captured the kicking motions using three [high-speed cameras](#), and we attached four pairs of pressure sensors to the dorsal and plantar surfaces of each participant's right foot."

The [video recording](#) allowed the scientists to know the position, velocity, and acceleration at each moment of time, and the force could be calculated using the pressure sensors.

Surprisingly, the researchers found that the force created by the eggbeater kick was greater than would be expected if one just applied Newton's laws and hydrodynamics. "Our study hints that [water polo](#) players are actually taking advantage of complex physics, including unstable vortices, to achieve this increased efficiency," explains Professor Takagi. "In addition to improving [sports performance](#), the results of this research may lead to optimized underwater propulsion."

More information: Eisuke Kawai et al, Propulsive forces on water polo players' feet from eggbeater kicking estimated by pressure distribution analysis, *Sports Biomechanics* (2020). [DOI: 10.1080/14763141.2020.1797152](#)

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