

# High-mileage runners expend less energy than low-mileage runners

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Runners who consistently log high mileage show more neuromuscular changes that improve running efficiency than their low-mileage counterparts, according to researchers from Liverpool John Moores University in the United Kingdom. The paper is published in the *Journal of Applied Physiology*.

Jasper Verheul, Adam C. Clansy and Mark J. Lake studied two groups of runners. One group ran fewer than nine miles a week ("low mileage"), while the second group ran more than 27 miles weekly ("high mileage"). All of the volunteers had been running for at least six months prior to the study. The researchers measured the activity of thigh muscle groups and the knee joint motion of the runners through a combination of electromyography (EMG), 3-D motion capture cameras and a platform that measured force and speed. The volunteers ran trials at four different speeds between five miles per hour (mph) and 12 mph.

"Given the importance of the knee joint in running, it was hoped that by examining knee joint stiffness and muscle activation levels (those muscles that act about the knee joint) across a range of running speeds, the adaptations of neuromuscular factors due to running training could be closely explored for the first time," the researchers wrote. The stiffness of the knee joint varies at different speeds in all runners in part to protect against injury from the force of landing and to run efficiently, explained the authors.

The high-mileage [runners](#) had less muscle activity and higher stiffness in the knee just after landing compared to the low-mileage group. The difference in [muscle activity](#) increased with speed. The research team also noticed a spring-like behavior of the tendons in the high-mileage group, which helped propel the body forward more efficiently. "From this, we concluded that high-mileage training leads to changes in the muscles and

tendons that likely reduce energy expenditure during [running](#), and these adaptations are enhanced the faster you go," the researchers wrote.

**More information:** Jasper Verheul et al. Adjustments with running speed reveal neuromuscular adaptations during landing associated with high mileage running training, *Journal of Applied Physiology* (2016). [DOI: 10.1152/jappphysiol.00801.2016](#)

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