

EXERCISE AND SPORT SCIENCES REVIEWS



ESSR Journal Club

Covered Article: “Understanding Muscle Energetics in Locomotion: New Modeling and Experimental Approaches” by Brian R. Umberger and Jonas Rubenson
Exercise and Sport Sciences Reviews. 39(2):59-67, April 2011.

1. Two major approaches are highlighted for estimating energy consumption by individual muscles in locomotion — computational modeling and muscle blood flow measurement. What are the advantages and drawbacks associated with each of these two techniques? To what extent could these techniques be used in a complementary fashion in future research?
2. Recent studies based on both muscle blood flow and modeling techniques indicate that muscle actions associated with swinging the leg represent about 25% to 30% of the cost of locomotion. Why are these findings so important for our basic understanding of locomotor energetics?
3. In what ways is muscle fiber type distribution an important determinant of the energy cost of locomotion?
4. For weight loss, increasing muscle energy consumption during physical activity would be beneficial. How do you think knowledge of the relationships between muscle mechanics and energetics could be used to develop new, safe exercise routines for optimizing (maximizing) energy expenditure?
5. In some settings, such as with strenuous occupations, reducing muscle energy consumption would be beneficial. As we learn more about how muscles consume energy during movement, do you think it will be possible to design technology to reduce, or even eliminate, the energy requirements of physical activity? How would you approach this issue?
6. The importance of understanding the link between locomotor mechanics and energetics in impaired gait is stressed in the article. What are some of the musculoskeletal disorder groups that might benefit from this knowledge, and how do you think such knowledge could be translated into improved locomotor function in these groups?
7. Energy consumption due to generating muscle force versus producing mechanical work is discussed in the article and has been the focus of previous theories in locomotor energetics. Do you suspect that certain muscles consume energy during locomotion primarily by producing force isometrically, whereas others consume energy primarily due to muscle fiber work production? If so, which ones?
8. The function of the Achilles tendon at the ankle joint is implicated in more than one section of the article as an important energy-savings mechanism. Why do you think that we have not developed similar capabilities at our other major lower limb joints?