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The Limits of Running Endurance



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The Limits of Human Performance
Brian R. Umberger, Ph.D.

Kinesiology

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Maximum Endurance

- Maximum endurance is hard to define
- The maximum duration one can run is different for different speeds
 - your endurance when running at 5 m/s will be less than for running at 4 m/s
- We'll consider the upper end of running distance/ duration that can be completed in a single bout
 - marathon: 26.2 mi
 - ultramarathon: 50/100 mi or 24/48 hr

The Limits of Human Performance 2

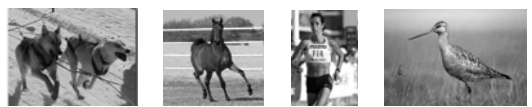
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Who Are The Top Endurance Runners?

- Top sustained speeds for marathon distances:
 - Sled Dog 5.5 m/s (12.3 mph)
 - Arabian Horse 6.0 m/s (13.4 mph)
 - Human 6.5 m/s (14.5 mph)

As the distance increases beyond the marathon, no other running animals can keep up with humans

- The real endurance champion
 - Bar-tailed Godwit, flies ~7000 mi (Alaska to New Zealand) in ~10 days without stopping to eat or sleep



The Limits of Human Performance 3

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Why Are We Such Good Endurance Runners?

We have a number of adaptations that aid endurance running performance

- Heat dissipation
 - Lots of sweat glands
 - Limited body hair (no fur)
- Musculoskeletal
 - Long, thin legs
 - Muscle tendon springs
 - Lots of slow-twitch muscle fibers

The Limits of Human Performance 4

How Did We Get This Way?

- One theory: early human ancestors survived by engaging in “persistence hunting”
 - Quite simply, prey are run to death in the heat of the day
- Currently only practiced by the Kalahari bushmen and the Tarahumara people of Mexico
- However, this practice may have been critically important in our evolution by providing meat and marrow in the diet



Bramble & Lieberman, 2004

What Limits Human Running Endurance?

- The answer is quite complicated, and depends on many “what if’s”
- Endurance performance is determined mainly by:
 - VO_2 max
 - Lactate threshold
 - Economy of movement
- The athlete with the “best” combination of these factors will have the advantage in the traditional marathon (WR: 2:03, theoretical limit: 1:58)
- Can’t overlook the role of mental “toughness”

What Limits Human Running Endurance?

- In the ultramarathon, fuel use and availability becomes major factors
- Carbohydrate is in limited supply in the body (~40 kcal/kg), fat is in great supply (~1400 kcal/kg)
- Physiological make-up and selection of proper running speed can spare carbohydrate use
- Ingestion of carbohydrate in proper form at right times can greatly enhance endurance
- Many other factors also come into play!

Up next ...

- Anabolic steroids
- End of semester wrap-up