TRAINING AND BIOENERGETIC CHARACTERISTICS IN ELITE MALE AND FEMALE KENYAN RUNNERS

By investigating the very best Kenyan female and male runners yet studied, Billat and her Parisian colleagues confirm that, like all great distance runners, the Kenyans are light (~50 kg), with men about 10% heavier than the women. Expectedly, they have a very high capacity for oxygen transport. Whether or not this is the cause or the consequence of their superior running ability cannot be determined by a cross-sectional study design.

Perhaps their most remarkable feature is their ability to run at a very high (~94%) percentage of their peak treadmill velocity during races of 10 km. What biological factors, yet to be studied, might help explain this unique ability?

My cursory analysis suggests that their ability to increase their pace in the last 10–20% of a race distinguishes the world’s best runners. For example, in his two most recent world 10,000-m records, Ethiopian Haile Gebrselassie ran fastest in the final 2 km, with the final km the fastest by about 3–5% (4). This is paradoxical. How is it possible to run your fastest when, according to our current physiological models (5), you should be slowing down because of exhaustion?

The popular theory is that the exercise pace is controlled by that delicate balance in oxygen supply and demand, which determines the rate of accumulation of those metabolites that purportedly regulate skeletal muscle contractile function (11). This explanation requires that all available motor units in the exercising limbs are active during exhaustive exercise. Or how else can these chemicals regulate the function of those quiescent motor units that have yet to be recruited?

Yet any pace increase must indicate that all available motor units in the exercising limbs were not previously recruited. Or how else can those muscle fibers whose function is already limited by the regulatory metabolites, suddenly increase their individual force production? Rather this example suggests that the pacing strategy during exercise is determined by the regulated recruitment and de-recruitment of motor units (3,10) so that the highest levels of recruitment produce the fastest speeds.

Accordingly, elite Kenyan runners may run so fast because they recruit a greater number of motor units in their lower limbs during competition. This could result from a superior capacity for oxygen utilization or other adaptations that reduce afferent sensory information to a supposed central brain controller (6) that regulates motor unit recruitment during exercise.

Paavolainen et al. (9) have shown that integrated electromyographic (iEMG) activity reflecting neuromuscular recruitment is altered during running. Thus, iEMG activity in the lower limb muscles fell during a 10-km running trial, causing ground contact time to increase and stride length and running velocity to fall. But chemical effectors acting directly in the exercising muscles cannot cause these iEMG changes. Rather purported chemical regulators may act via afferent sensory feedback to unidentified control centers in brain and spinal cord.

Subsequent studies have shown that neuromuscular factors also predict 5-km running time (8) and that explosive strength training improves 5-km running performance by altering these neuromuscular characteristics without changing aerobic capacity (7).

Sir (Dr.) Roger Bannister, the first human to run the mile in less than 4 min, has written: “Though physiology may indicate respiratory and cardiovascular limits to muscular effort, psychological and other factors beyond the ken of physiology set the razor’s edge of defeat or victory and determine how closely the athlete approaches the absolute limits of performance” (1). More recently he has concluded that: “It is the brain not the heart or lungs, that is the critical organ, it’s the brain” (2).

Perhaps it is now time to test, in those very athletes who have become his modern counterparts, the 50-yr-old theory first proposed in his youthful vigor, by one of running’s legendary icons.

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REFERENCES


