OVERUSE MUSCLE DAMAGE IN RUNNERS
ARE THE PERFORMANCE EFFECTS "ALL IN THE HEAD?"

Scientists say muscle overuse changes RPE but not lactate threshold .....

Exercise scientists have not been certain about the effects of exercise-induced muscle damage (EIMD) on endurance running performance. In mice forced to run downhill for extended periods of time (an activity which creates mayhem in the murids' quads), endurance capacity falls by about 65 percent during subsequent, sub-maximal running efforts (1). In human runners, however, the results have been quite different. Several different studies have revealed that EIMD has no negative impact at all on key physiological variables associated with endurance performance, including running economy, energy metabolism during running, heart rate, and oxygen consumption (2, 3, & 4). There is a failing in this research, though: The human runners have not been asked to complete time trials or actual competitions. Thus, it's possible that EIMD might have little impact on the "usual suspects" (the variables traditionally associated with performance) and yet still could hurt competitive times.

To learn more about the effects of EIMD on running performance, Sam Marcora and A. Bosio from the School of Sport at the University of Wales-Bangor in the United Kingdom recently worked with 30 adult runners (24 men and six women). These athletes averaged 31 years of age, were fairly fit (VO2max = 54.2), were moderately lean (13-percent body fat), and trained four to five times each week with an average workout duration of 48 minutes (5).

EIMD was induced in half (15) of the runners via the completion of 100 "drop jumps." For each drop jump, a runner stood on a 35-centimeter-high bench (- 14 inches high), from which he/she dropped to the floor with both feet, squatted to a 90-degree knee angle, and then jumped in place as high as possible. After 10 such drop jumps, a one-minute recovery was enforced, followed by nine more sets of 10 drop jumps, with one-minute recoveries between sets. Thus, the whole workout was 10 sets of 10 reps, with one-minute recoveries. Research has shown that drop jumping can produce significant EIMD, particularly in runners who have had little experience with the maneuver (6).

No muscle biopsies were performed after the drop-jumping, but four markers were employed to detect the presence of underlying EIMD:

(A) Subjective assessments of delayed-onset muscle soreness (DOMS) in the buttocks, groin, thighs, hamstrings, calves, and shins,

(B) Blood concentrations of creatine kinase, an enzyme which is usually elevated when muscle problems occur,

(C) Mid-thigh circumferences (an indicator of swelling of the quads and hams), and

(D) Knee-extensor (quad) strength.

48 hours after the drop jumps, running economy was measured as the runners cruised at a velocity of 11.4 kilometers per hour (about 8:30 per mile tempo). The runners also completed a 30-minute time trial during which they ran as far as possible (these tests were also conducted 24 to 48 hours before the drop-jumping took place).

The 10 X 10 drop-jump workout produced increases in three of the four indirect markers of EIMD. Two days after the drops, DOMS increased 11-fold, creatine-kinase concentration more than doubled, and knee-extensor strength dropped by 12 percent (there was no significant change in thigh girth). Nonetheless, EIMD was linked with no change at all in heart rate, oxygen-consumption rate (and thus running economy), or blood-lactate level during the 11.4-km per hour running.

The EIMD was connected with a significant decrease in performance during the 30-minute time trial, however. Drop-jumped runners ran a 4-percent shorter distance during the time trial, compared with before the drop-jumping (just 6631 vs. 6781 meters). Meanwhile, the 15 control runners (who had participated in no drop-jumping at all) slightly increased the distance covered in 30 minutes (from 6545 up to 6652 meters).

What actually caused this time-trial fall-off in the EIMD runners? Heart rate was not to blame, as it stayed at 171 beats per minute during the trial, before and after the muscle-macerating drop-jumping. A change in lactate threshold was not the problem, either, since lactate levels were exactly the same, before and after jumping. Rather, the difficulty was related to an increase in perception of effort in the muscle-damaged runners. RPE (rating of perceived effort) was actually the same during the 30-minute time trial after the bout of drop-jumping, even though time-trial pace was slower (compared with the velocity of the time trial conducted before the drop jumps). Basically, the EIMD runners compensated for an increased sense of effort (caused by the EIMD) by adopting a slower running speed during the second time trial, thus keeping RPE the same as before.

These results coincide with findings from other research which reveal that athletes estimate muscular force production based on their overall sense of effort (7, 8, & 9). In studies in which one arm has incurred muscle damage while the other has remained normal, subjects who are asked to match with the damaged arm the force produced by the control arm almost always underestimate force production. Similarly, individuals asked to match with the control arm the force produced by the damaged arm generally overestimate force production. This means that athletes with EIMD perceive higher effort while producing a given amount of force (compared with before damage occurred) - and produce less force when perceived effort is held constant. Runners with EIMD, then, will run at slower speeds than usual in order to avoid elevating perceived effort, which may be tightly controlled by the brain.

How does the brain know that EIMD has occurred? Obviously, the muscles can't talk to the brain, but a chemical called interleukin-1B can increase in response to muscle damage, and interleukin-1B can produce symptoms of fatigue in humans. High concentrations of interleukin-1B have been found in the brains of animals which have reduced running performances associated with EIMD. Research also indicates that blocking the activity of interleukin-1B decreases the harmful effect of EIMD on performance, while artificially induced upswings in interleukin-1B, even without actual muscle damage, produce drop-offs in endurance running capacity which are similar to those associated with EIMD (10).

The bottom lines? When you or the runners you coach experience significant drop-offs in pace during training runs and/or competitions, the possibility of underlying EIMD is significant. This is especially true if RPE (perceived effort) is as high as usual (or even higher). The cause of the EIMD may be overtraining and/or a lack of running-specific strength. A solution is to rest for an adequate period of time and then to engage in a systematic program of running-specific strength training, which will minimize muscle damage associated with subsequent, challenging workouts. The other solution is to follow religiously the four principles of muscle preservation:

(A) Fueling up properly on a daily basis, taking in adequate quantities of carbohydrate (about four grams of carbs per pound of body weight per day) and total calories,

(B) Recovering well between workouts, getting adequate sleep and taking at least one day off from training each week,

(C) Avoiding challenging sessions when muscles feel tight and sore, and

(D) Progressing gradually with volume and intensity of training.

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If you would like to be coached by Owen Anderson, please send Owen a note at owen@runningresearchnews.com

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