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Commentary on *Train-Low Compete-High* in the ACSM Report

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The ACSM report touches on the fascinating progress connecting the training stimulus to cytokines and other extra- and intracellular signals. Bente Pedersen's lab is at the forefront, along with the group at University of Bern, Swizerland, headed by Hans Hoppeler and Martin Flück. In the last two years, when I have lectured on endurance training organization, I have introduced the findings from Hansen et al. (2005) by asking this question: *is part of the reason that modern elite athletes "need" so much training volume that they "eat so well?"* Antioxidants, glycogen loading, carbohydrate drinks, etc. all may dampen the cellular signalling impact of the exercise stimulus and perhaps lengthen the exercise duration necessary for an optimal signalling effect. Since we often seem to chase the elusive "Kenyan performance secrets", the published findings that Kenyan runners are vitamin deficient and undernourished are interesting in this context.

Long duration, low intensity exercise bouts seem to be at least as good–and perhaps better than–shorter more intense loading as a driving signal for key metabolic adaptations at the cellular level, according to several recent studies. I think this idea makes sense from an evolutionary perspective. For our distant ancestors, exercise was presumably often associated with an energy-depleted state and the pursuit of food. Long, low intensity bouts (plus the occasional very high intensity bout to avoid being eaten or trampled) would dominate the prehistoric periodization plan, not 30-minute running bouts performed at the lactate threshold. Is it a coincidence that elite endurance athletes across several sports *polarize* their training by avoiding anaerobic-threshold intensity? (See, for example, Seiler and Kjerland, 2006.) I had assumed that the explanation for this self-organization pattern (emerging from training experience, not sport science) was found within the rubric of "reducing the sympathetic stress load and avoiding overtraining". Now we may also see that there are fundamental adaptive signalling issues that also dictate increased duration and decreased intensity for a lot of the total training load.

Meanwhile, there is plenty of anecdotal evidence that some famous athletes (like Miguail Indurain in his day) train intentionally with low carbohydrate availability in preparation for competitions, where they eat lots of carbohydrate. I contend that these behaviours by athletes are Darwinistic in the sense that they represent a selection process towards some optimum achieved over years of trial and error in the elite athlete population.

Professor Pedersen's wonderful lecture tantalized us with the promise that, finally, research is emerging that may ultimately help link molecular signalling to monthly training plans and athlete nutrition. So paradigm shift or not, there is fun stuff happening.

Hansen AK, Fischer CP, Plomgaard P, Andersen JL, Saltin B, Pedersen BK (2005). Skeletal muscle adaptation: training twice every second day vs. training once daily. Journal of Applied Physiology 98, 93-99

Seiler S, Kjerland GO (2006). Quantifying training intensity distribution in elite endurance athletes: is there evidence for an ''optimal'' distribution? Scandinavian Journal of Science and Medicine in Sports 16, 49-56

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