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Profile of ultra-endurance runners: physiological differences from long-distance runners

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INTRODUCTION:

While ultra-endurance sports are growing in popularity, the prerequisites for successful participation and adaptation to such training remain vague. The aim of the study was to compare physiological profile between ultra-distance runners and long-distance runners.

METHODS:

Road runners competing in 24-h races (ULTRAs, n=13) or distances 10 km to marathon (LDRs, n=12) arrived to the laboratory in an overnight fasted condition and performed resting metabolic rate measurement followed by oral glucose tolerance test. Anthropometric, muscle and tendon ultrasonography as well as muscle force and power tests were then conducted, after which athletes performed a progressive 4-min step treadmill test to exhaustion to assess the lactate curve, heart rate response, running economy, and fat oxidation, as well as to determine maximal oxygen uptake ($\dot{V}O_{2\max}$). Additionally, blood volume, plasma volume and total hemoglobin (Hb) mass were measured using the CO rebreathing.

RESULTS:

Despite being of similar competitive level (personal bests for IAAF scores), age, training experience and body weight ($p>0.05$ for all), ULTRAs had more body fat (mainly due to larger upper body skinfold thickness, $p<0.001$), even if they had been training by substantially larger volume in terms of distance run and hours spent training ($p<0.01$ for both).

Both absolute and relative to body weight plasma volume ($p<0.01$) and blood volume ($p<0.05$) were larger in LDRs, while Hb concentration, total Hb mass and Hb mass per body weight did not differ between the groups ($p>0.05$ for all). Resting metabolic rate was similar and relative fat oxidation identical between the groups. There were no obvious differences in glucose handling and associated lactate disposal rate between the groups during oral glucose tolerance test.

Heart rate and lactate response to exercise were the same for the two groups, while maximal oxygen uptake was larger in LDRs (66.7 (5.1) vs. 59.1 (6.4) ml/kg/min, $p=0.004$). In our conditions, neither maximal fat oxidation rate, nor the associated running speed differ between ULTRAs and LDRs. Running economy was comparable between the groups (206 (19) and 214 (22) ml/kg/km in ULTRAs and LDRs, respectively, $p=0.347$).

Contractile properties of knee extensors and muscle power measured as different vertical jump parameters did not differ between the groups. Achilles tendon and calf muscle structural properties as well as passive stiffness of plantar flexors were also similar between the groups.

CONCLUSION:

Ultra-distance runners exhibit largely similar physiological profile as long-distance runners, but do not have that large maximal oxygen uptake, at least to some extent due lower total blood volume and higher percentage of upper body fat.

Topic: Physiology

Presentation Oral

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