Comparing fatigue and recovery following marathon and trail running of equivalent effort: insights from neuromuscular function, energy cost of running and force-velocity profile

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Résumé

INTRODUCTION:

Marathon and trail running are two popular endurance running disciplines. Sabater et al. (2022) showed that elite trail runners train less but compete more often than road runners. Fatigue during and recovery from both marathon (Kyröläinen et al., 2000; Nicol et al., 1991; Petersen et al., 2007) and trail running (Besson et al., 2021; Koral et al., 2022; Lloria-Varella et al., 2022; Millet et al., 2003) have been studied, yet no direct comparison between the two disciplines exists. A comparison would facilitate more training and recovery strategies. The study aimed to compare fatigue and recovery following marathon and trail running through assessments of neuromuscular function, energy cost of running, and force velocity profiles.

METHODS:

Thirty-one well-trained male and female runners, specialized in road or trail running, performed either a 42.7-km treadmill marathon (MAR, n=6), a 29-km treadmill trail run (TS, n=13) or a 29-km outdoor trail run (TN, n=12) with ± 1,400 m elevation. The following assessments were conducted before (PRE), immediately after (POST), one (D+1), two (D+2) and seven days (D+7) after the run: maximal isometric voluntary contraction of the knee extensor (MVCKE) and plantar flexor (MVCPF) muscles; maximal theoretical force (F0),

*Intervenant

velocity (V0) and power (Pmax) derived from maximal 8-s cycle ergometer sprints; and energy cost of running (Cr) at +12%, -12% and 0% treadmill incline at a speed corresponding to 75% of at second ventilatory threshold.

RESULTS:

No significant group differences or group × time interaction was observed for any variable but MVCKE, yet post hoc analyses did not reveal significant between-group differences for MVCKE. MVCKE and MVCPF for the three groups decreased significantly POST-race (ΔMVCKE: -21.3%; ΔMVCPF: -20.7%; $p < 0.001$) and recovered by D+2 and D+7, respectively. Cr tended to increase POST-race during flat ($p=0.05$) and downhill ($p=0.07$), with no significant change in uphill. F0 decreased significantly (ΔF0: -6.0%; $p=0.001$), V0 increased significantly (ΔV0: +6.7%; $p < 0.001$) and Pmax did not change POST-race. F0 and V0 recovered by D+2 and D+1, respectively.

DISCUSSION:

The 21% strength loss supports previous findings confirming substantial but transient neuromuscular fatigue following intense running (Besson et al., 2021). Although a significant group × time interaction was found for MVCKE, the lack of between-group differences suggests a comparable fatigue magnitude across race types. Cr increased slightly on flat and downhill conditions, but no change was observed uphill suggesting that the measure of durability in trail running should also consider slope at which Cr is measured. Unlike Koral et al. (2022), who observed reduced Pmax after trail running, Pmax did not change in our study, likely due to shorter distances. However, changes in the force-velocity profile suggest a temporary redistribution in power production capacity, with reduced F0 and increased V0 POST-race. Recovery timelines suggest a quick recovery for all variables, regardless the type of terrain: V0 recovered by D+1, MVCKE and F0 by D+2 and MVCPF by D+7.

CONCLUSION/PERSPECTIVE:

The present study is the first to compare the effects of marathon effort on road vs trail. Both disciplines led to fatigue in both isometric and dynamic modes, with full recovery within 2-7 days and no group differences or interaction. A slight increase in Cr in flat and downhill running, and a temporary shift in power production were also observed. These preliminary results must nevertheless be confirmed as type II errors are possible at this stage (n=6 for MAR).

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