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Título	Triceps surae muscle-tendon properties as determinants of the metabolic cost in trained long-distance runners
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1 **Triceps surae muscle-tendon properties as determinants of the metabolic cost in**
2 **trained long-distance runners.**

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6 **Justification:** The muscle-tendon unit is one of the most important structures for human
7 running due to its role in generating tension and storing (and releasing) elastic energy.
8 During each running stride, the muscles produce force and perform mechanical work,
9 while the lower-limb tendons store and release elastic energy, reducing running
10 metabolic cost (C). However, as the triceps surae muscle generates tension actively, it
11 seems to be the dominant structure determining the C. **Aim:** To determine which triceps
12 surae's muscle architecture and Achilles tendon properties' parameters are related to C
13 in trained long-distance runners. **Methods:** Seventeen trained male long-distance
14 runners (34.2 ± 7.4 years) participated in this study. C was measured during
15 submaximal steady-state running (5 min) at 12 and 16 $\text{km}\cdot\text{h}^{-1}$ on a treadmill. Then,
16 ultrasound was used to determine the gastrocnemius medialis, gastrocnemius lateralis
17 and soleus (SO) muscle architecture [fascicle length, pennation angle (PA) and muscle
18 thickness], and the Achilles tendon cross-sectional area (CSA), resting length and
19 elongation as a function of plantar flexion torque during maximal voluntary isometric
20 contraction. Achilles tendon mechanical (force, elongation and stiffness) and material
21 (stress, strain and Young's modulus) properties were determined. Stepwise multiple
22 linear regressions were used to determine the relationship between independent
23 variables (tendon resting length, CSA, force, elongation, stiffness, stress, strain, Young's
24 modulus, fascicle length, PA and muscle thickness) and C ($\text{J}\cdot\text{kg}^{-1}\cdot\text{m}^{-1}$) at 12 and 16
25 $\text{km}\cdot\text{h}^{-1}$. **Results:** Greater SO's PA and larger Achilles tendon CSA were C determinants
26 (69%) at 12 $\text{km}\cdot\text{h}^{-1}$, whereas greater SO's PA and lower Achilles tendon stress were C
27 determinants (63%) at 16 $\text{km}\cdot\text{h}^{-1}$.

28 **Keywords:** long-distance runners, running economy, calf muscles, muscle architecture
29 and Achilles tendon properties.