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Abstract

Comparative Analysis of Entropy in Accelerations and Muscular Near-Infrared Spectroscopy (NIRS) Signals during Running: Dominant versus Non-Dominant Legs

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Sample entropy (SampEn) is a valuable tool for assessing variability in kinematic patterns and physiological signals during exercise (Estep et al., 2017). This variability may vary between dominant (D) and non-dominant (ND) limbs, particularly under different task-specific conditions. This study aimed to compare the variability in muscle oxygen saturation (SmO_2) and playerload (PL) between the D and ND legs during various running variations. After a familiarisation session, fifteen healthy individuals (age = 31.4 ± 9.3 years) performed six running variations randomly: high-knees (90° knee angle), tethered, shoulder-wide, shoulder-wide coreboard, treadmill (10.9 m/s at 0% slope), and slope treadmill (10.9 m/s at 6% slope). The running was carried out for 90 seconds, interspersed with a 5-minute rest (cadence: 130-150 bpm). To the PL data, two inertial measurement units (Blue Trident, Vicon, NZ) were placed on both ankles, while SmO2 was collected using two NIRS devices fixed on the *vastus lateralis* of both legs. SampEn was calculated from acceleration and physiological data as a measure of variability. A one-way ANOVA was conducted (JASP software version 0.16.4.0) to assess differences between the D and ND leg, considering a significance level of $p \leq 0.05$. No significant differences were found in PL between the D and ND legs across different running variations ($0.3015 \leq p \leq 0.839$). However, the results showed that the D leg exhibited higher SampEn values in three specific variations: high knees (D = 0.090 vs. ND = 0.087), tethered (D = 0.101 vs. ND = 0.096), and shoulder-wide (D = 0.114 vs. ND = 0.109), indicating higher variability. Conversely, the ND leg demonstrated increased complexity and irregularity in movement patterns during running performed on horizontal (D = 0.112 vs. ND = 0.122), sloped (D = 0.119 vs. ND = 0.123), and unstable (D = 0.162 vs. ND = 0.181) surfaces compared to the D leg. Likewise, no significant differences were observed in SmO_2 between D and ND legs across different running variations ($0.101 \leq p \leq 0.882$). However, interestingly, the ND leg generally exhibited higher SampEn values compared to the D leg in most conditions, except for high knees and slope treadmill, where the values were the same (N and ND = 0.017 and 0.014, respectively). This study revealed that the D leg exhibited more complex and unpredictable movement patterns compared to the ND leg, as

evidenced by higher entropy values for accelerations. Surprisingly, the ND leg showed higher muscle SmO_2 variability. These findings emphasise the need to consider limb dominance and task-specific conditions when assessing movement pattern variability, offering valuable insights for sports training and performance optimisation.

References

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