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Asymmetry of Ground Contact Times and Flight Times during Running at Different Speeds

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The ratio of flight time (FT) to ground contact time (CT) during running can provide an estimate of the vertical ground reaction force (GRF). However, there is an implicit assumption of symmetry that has not been verified. **PURPOSE:** To determine if there is asymmetry of the CT and FT during running at different steady speeds in both novice and competitive runners. **METHODS:** Two male novice runners, 2 male competitive sprinters, and 4 female competitive sprinters were filmed at 240 frames per second while running 50 m on a rubber track for three trials at speeds of 3.0 m·s⁻¹, 4.5 m·s⁻¹, 6.0 m·s⁻¹, and each participant's maximum running speed. The CT and FT were determined for each trial from the video. For each speed, the average CT and FT were found for the right and left legs, and then these were recoded as greater and lesser sides in order to capture absolute symmetry. Comparisons were made using a 3-way (group x speed x side) repeated measures ANOVA. Effect sizes for the differences between the greater and lesser sides were calculated for each speed using Cohen's d. **RESULTS:** The greater and lesser sides were significantly different from one another for both CT (p=0.0002) and FT (p=0.0002). Speed was also a significant factor for both CT (p<0.0001) and FT (p=0.0022). There were no significant differences between groups and no significant interactions between any of the variables. Effect sizes for CT ranged from 0.21-0.39. Effect sizes for FT ranged from 0.28-0.72. **CONCLUSIONS:** The differences in CT and FT between limbs ranged from small to moderate, but they were consistent and significant. Great care should be used when using CT and FT to estimate the GRF during running.

<u>Speed</u>	<u>Contact Time (mean±sd, ms)</u>			<u>Flight Time (mean±sd, ms)</u>		
	<u>Greater Side</u> [†]	<u>Lesser Side</u>	<u>Effect Size</u>	<u>Greater Side</u> [‡]	<u>Lesser Side</u>	<u>Effect Size</u>
3.0 m·s ⁻¹	284.4 ± 25.8	274.6 ± 27.4	0.34	107.8 ± 35.6	88.1 ± 30.2	0.69
4.5 m·s ⁻¹	212.4 ± 24.0	202.3 ± 24.3	0.39	148.9 ± 13.4	141.6 ± 17.9	0.28
6.0 m·s ⁻¹	170.0 ± 17.5	166.1 ± 17.0	0.21	145.7 ± 16.7	132.3 ± 14.7	0.72
Max Speed (7.39±0.98 m·s⁻¹)	143.6 ± 14.6	139.5 ± 13.9	0.27	128.6 ± 17.6	118.7 ± 12.1	0.64

Table 1. Contact times and flight times during running at different speeds.

† - Significantly different from lesser side, p=0.0002.

‡ - Significantly different from lesser side, p=0.0002.