TACSM Abstract

Do Horizontal Forces Matter for Horizontal Running?

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ABSTRACT

Introduction: The application of ground force is widely recognized as the critical determinant of running speed. At maximal speeds, 90-98% of the total force applied is directed vertically into the running surface while horizontal (fore-aft) contributions are relatively small. Despite their small magnitude, horizontal forces are clearly essential for balance and may be important for other reasons. However, the pattern of horizontal force application across faster speeds is not well understood. Objective: For moderate to top speeds, we aimed to determine whether: 1) the horizontal forces required increase substantially, and 2) horizontal forces become larger relative to vertical forces. Participants: Two male and three female athletes volunteered for the study (age: 19.0 ± 0.6 years, height: 1.75 ± 0.06 m, mass: 71.0 ± 8.2 kg). Data Collection: Trials were completed on a high-speed, three-axis force treadmill (AMTI, Watertown, MA), with ground force data acquired at 1,000 Hz. Data was analyzed from each individual's top speed and submaximal trials at 5.0 and 7.0 m/s. Top speed was determined by the fastest speed where the participant could complete eight steps without drifting backward 0.2 m. Outcome Measures: Because center of mass motion is determined by the mass-specific force applied and the time of force application, (i.e. impulse, or product of average force and time of application, or area under the force-time curve), we analyzed both average vertical and horizontal forces and impulses for every step. Average horizontal forces and impulses were calculated as the absolute value for the braking and propulsive phases of the horizontal force-time curve. Forces were standardized to body weight (Wb) and impulses calculated in body weight • seconds (Wb•s). The ratio of average vertical impulse to average horizontal impulse was calculated for each runner across speeds. Results: From 5.0 m/s to top speed, mean vertical and horizontal forces increased from 1.70 to 1.99 Wb and 0.29 to 0.34 Wb, respectively, and mean vertical and horizontal impulses decreased from 0.30 to 0.24 Wb•s and 0.05 to 0.04 Wb•s, respectively. From 5.0 m/s to top speed, the ratio of vertical to horizontal impulses varied by only 5.2% on average over a 1.5 to 2.0-fold range of speeds for the individuals tested and did so without consistent direction. Conclusions: The average horizontal forces and the ratio of vertical to horizontal impulses did not vary appreciably across a range of faster running speeds in a small sample of athletic subjects.

TEXAS CHAPTER
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