

Relationships Between Ground Reaction Force Impulse and Kinematics of Sprint-Running Acceleration

J.P. Hunter, University of Auckland; R.N. Marshall, University of Auckland and Eastern Institute of Technology; P.J. McNair, Auckland University of Technology
Journal of Applied Biomechanics, 2005, 21, 31-43.

The literature contains some hypotheses regarding the most favorable ground reaction force (GRF) for sprint running and how it might be achieved. This study tested the relevance of these hypotheses to the acceleration phase of a sprint, using GRF impulse as the GRF variable of interest. Thirty-six athletes performed maximal-effort sprints from which video and GRF data were collected at the 16-m mark. Associations between GRF impulse (expressed relative to body mass) and various kinematic measures were explored with simple and multiple linear regressions and paired *t*-tests. The regression results showed that relative propulsive impulse accounted for 57% of variance in sprint velocity. Relative braking impulse accounted for only 7% of variance in sprint velocity. In addition, the faster athletes tended to produce only moderate magnitudes of relative vertical impulse. Paired *t*-tests revealed that lower magnitudes of relative braking impulse were associated with a smaller touchdown distance ($p < 0.01$) and a more active touchdown ($p < 0.001$). Also, greater magnitudes of relative propulsive impulse were associated with a high mean hip extension velocity of the stance limb ($p < 0.05$). In conclusion, it is likely that high magnitudes of propulsion are required to achieve high acceleration. Although there was a weak trend for faster athletes to produce lower magnitudes of braking, the possibility of braking having some advantages could not be ruled out. Further research is required to see if braking, propulsive, and vertical impulses can be modified with specific training. This will also provide insight into how a change in one GRF component might affect the others.

© Human Kinetics Publishers, Inc.