

High on Grass? Influence of Terrain on Human Walking Economy

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Category: *Professional-in-Training*

ABSTRACT

Introduction: The metabolic energy cost of human walking has been extensively studied. However, the influence of terrain on the metabolic costs incurred across commonly encountered surfaces is not well understood. **Objective:** Our objective was to test whether the metabolic cost of walking would vary between treadmill, asphalt, and grass surfaces. We hypothesized that the metabolic energy cost of walking would not differ between the three common level walking conditions: (standard) commercial treadmill, firm asphalt and well-groomed grass field. **Methods:** Five subjects walked on a level treadmill at speeds ranging from 0.4 m·s⁻¹ to 1.9 m·s⁻¹. Indirect calorimetry was used to measure rates of oxygen uptake under steady-state conditions (Parvo Medics TrueOne 2400, Sandy, UT). The same five subjects walked at 1.0, 1.3, and 1.6 m·s⁻¹ on a 50 meter oval course set up both in a parking lot and in a well-maintained field with short grass. Expired air was collected in Douglas bags during steady-state conditions at each of the three speeds and the gas composition (Parvo Medics TrueOne 2400, Sandy, UT) and gas volume (Dry Gas Meter, Harvard Apparatus, Holliston, MA) were measured for each bag. **Analysis:** Oxygen uptake was calculated based on gas analysis and volume measurements for the asphalt and grass walking tests, and was obtained from the Parvo Medics system for the treadmill tests. The relative oxygen uptake (ml·kg⁻¹·min⁻¹) at 1.0, 1.3, and 1.6 m·s⁻¹ was compared across the treadmill, asphalt, and grass walking conditions. **Results:** Oxygen uptake was similar between treadmill and asphalt walking across all speeds; however, oxygen uptake was greater when walking on grass (14.1 ± 0.7 ml·kg⁻¹·min⁻¹) than on the treadmill (13.5 ± 0.6 ml·kg⁻¹·min⁻¹) or on asphalt (13.2 ± 0.6 ml·kg⁻¹·min⁻¹) by 5.2% and 6.6%, respectively. Further, the difference between walking on grass and walking on the treadmill or on asphalt was more pronounced at faster speeds. **Conclusion:** We conclude that the metabolic energy cost of walking on well-groomed level grass is greater than either walking on a treadmill or on asphalt.

