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The effects of load carriage on joint work at different running velocities

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Abstract

Running with load carriage has become increasingly prevalent in sport, as well as many field-based occupations. However, the "sources" of mechanical work during load carriage running are not yet completely understood. The purpose of this study was to determine the influence of load magnitudes on the mechanical joint work during running, across different velocities. Thirty-one participants performed overground running at three load magnitudes (0%, 10%, 20% body weight), and at three velocities (3, 4, 5 m/s). Three dimensional motion capture was performed, with synchronised force plate data captured. Inverse dynamics was used to quantify joint work in the stance phase of running. Joint work was normalized to a unit proportion of body weight and leg length (one dimensionless work unit = 532.45 Joules). Load significantly increased total joint work and total positive work and this effect was greater at faster velocities. Load carriage increased ankle positive work (β coefficient = rate of 6.95 x 10^{-4} unit work per 1% BW carried), and knee positive (β = 1.12 x 10^{-3} unit) and negative work (β = -2.47 x 10^{-4} unit), and hip negative work (β = -7.79 x 10^{-4} unit). Load carriage reduced hip positive work and this effect was smaller at faster velocities. Inter-joint redistribution did not contribute significantly to increased total work within the spectrum of load and velocity investigated. Hence, the ankle joint contributed to the greatest extent in