The effects of load carriage on the ground reaction force loading rates and physiological responses of soldiers

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Current evidence suggests that the limits for acceptable load carriage are currently being exceeded by U.S. soldiers serving in combat theaters. This overloading may potentiate the risk for overuse injuries. Therefore, it is important to understand the biomechanical and physiological responses of loaded marching in order to establish a relationship with overuse injuries. **Purpose:** To investigate the effects of a simulated road-march to fatigue on the ground reaction force loading rates (GRF_{LR}) and physiological responses of soldiers during load and rifle carriage. **Methods:** Six men (age: 25.6 ± 4.1 years; mass: 83.7 ± 7.3 kg) with military backgrounds and experience with both rifle and load carriage agreed to participate. The subjects completed simulated road-marches to volitional fatigue using a graded treadmill protocol at 1.5 m/s under four experimental conditions: 1) unloaded marching, 2) marching with a rifle (carrying a 3.1 kg simulated rifle), 3) marching with a load (carrying a fighting load of 29 kg), and 4) marching with a load + rifle. GRF data were collected prior to and immediately following the simulated road-march performed under each condition. Physiological data (VO_2) were collected prior to, throughout, and following the simulated road-march using a portable metabolic system. **Results:** There was a significant (mean difference: 9.75-33.9%; $p = 0.028$) increase in GRF_{LR} caused by the rifle and load carriage conditions prior to the simulated road-marches. There was a significant reduction in time to fatigue (mean difference: 40.4-47.9%; $p = 0.002$) and an increase in pre road-march VO_2 (mean difference: 20.9-21.1%; $p = 0.006$) caused by the load and rifle carriage conditions. **Conclusion:** Load, rifle, and the combination of load + rifle carriage were shown to increase the energetic cost of walking and altered GRF parameters, which may potentiate the risk for overuse injuries. Future research is warranted on the biomechanical interaction between load and rifle carriage, and their relationship to overuse injuries.