Sex Impacts Leg Stiffness When Increasing Stride Length to Run with Body Borne Load

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Abstract
Military personnel routinely run at a fixed cadence with body borne load, which may increase leg stiffness and potential injury risk - particularly for females. Seventeen males and ten females had leg stiffness quantified when running with four loads (20, 25, 30, and 35 kg) and three stride lengths (preferred, and ±15% of preferred). Participants increased leg stiffness ($P=0.006$), and potentially injury risk when running with load. But, a sex dimorphism in stiffness was evident with changes in stride length. Males exhibited reduced leg stiffness with longer strides ($P>0.05$).
INTRODUCTION
During military activities, personnel often run at a fixed cadence with heavy body borne loads weighing between 20 and 40 kg. These loads can increase injury risk by altering lower limb biomechanics [1].

When running with load, personnel increase leg stiffness to attenuate larger ground reaction forces (vGRF) and prevent collapse of the lower limb, elevating risk of musculoskeletal injury (MSI) [2]. During unloaded running, individuals decrease leg stiffness when using longer strides [3]. Military personnel, however, may not possess the lower limb strength to similarly decrease leg stiffness as they lengthen their stride to run at a fixed cadence with heavy body borne loads.

Female military personnel, who are weaker than males [4], may be especially at risk for injury as they may lack the strength to safely attenuate large GRFs.

PURPOSE
To quantify leg stiffness for male and female participants as they lengthened their stride to run with body borne load.

METHODS
27 (17 M/10 F) participants (21.2 ± 2.3 years, 1.7 ± 0.1 m, 75.5 ± 11.3 kg) had 3D lower limb biomechanics quantified while running with four body borne loads: 20 kg, 25 kg, 30 kg and 35 kg (Fig 1).

RESULTS
Both body borne load (P=0.001) and stride length (P<0.001) had a significant effect on peak vGRF (Fig. 3).

ACKNOWLEDGEMENTS
We would like to thank the Battelle and Natick Soldier RD&E Center for providing funding for this work.