Load Effects Assessment Program (LEAP): Sensitivity of LEAP to Operationally-Relevant Clothing and Equipment Conditions

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Background. Several nations are implementing the Load Effects Assessment Program (LEAP) to help understand and mitigate the effects of soldier load on operational performance and survival on the battlefield. LEAP comprises a series of timed obstacles, plus several accompanying accessory test stands, each of which represents operationally-relevant soldier tasks, or helps to characterize the soldier system (e.g., weight, stiffness, bulk, range of motion).

Objective. The objective of this study was to determine the sensitivity of LEAP outcomes (time to complete the obstacle course, individual obstacle completion times, distance jumped, marksmanship scores, etc) to the weight and weight distribution of Canadian soldier baseline clothing and equipment.

Method. Several indoor LEAP studies have been undertaken by Canada across a range of soldier clothing and equipment configurations. This sensitivity analysis takes the following studies into consideration:

Fall 2012 Baseline Study: 29 regular force fit combat arms soldiers completed LEAP in 7 baseline Canadian soldier incremental clothing and equipment conditions, using a repeated measures counterbalanced study design at an ambient temperature of 15.3±1.4°C. Conditions ranged from combat fatigues alone (5 kg above nude weight) to full fighting order with body armour, ballistic plates, C7A2 weapon and 10x 32-round magazines (28.4 kg load).

Winter 2014 Weapon Study: 34 regular force combat arms soldiers completed LEAP in 8 different simulated weapon weight and length conditions, using a repeated measures counterbalanced design at an ambient temperature of 16.7±0.8°C. Conditions included 3 baseline conditions (combat fatigues only, full fighting order (FFO) with in-service C7A2 weapon, repeat of FFO with C7A2) and five simulated future small arms configurations (weighted weapon test rigs of either C7 or C8 length, or 4.6, 6.9 or 8.4 kg weight).

Results.

Fall 2012 Baseline Study: Results indicate a strong correlation between condition weight and overall obstacle course completion time ($r = 0.97$). A repeated-measures ANOVA of total obstacle course time identified a significant difference between load order conditions ($n=29$, $F(6,168)$, $p=0.0000$). A Duncan's post-hoc analysis revealed that all conditions were significantly different from each other at $p \leq 0.05$, except for Conditions B & C (addition of CG639 helmet to combat fatigues plus weapon). Similar results were obtained for many but not all of the individual obstacle/test stands, suggesting changes to the LEAP protocol.

Winter 2014 Weapon Study: Soldier performance overall, and for many individual obstacles/test stands, was generally negatively affected as heavier rifles were carried. Certain obstacles were better able to discriminate between weapon weight or length as the contributing factor in mobility task performance.

Conclusions. Overall performance on the LEAP is sensitive to subtle changes in the load characteristics of representative soldier system ensembles and loads. Individual obstacles and test stands vary in their sensitivity to load parameters, suggesting modifications to LEAP protocol for the purposes of load effects modeling, although the LEAP, in its current configuration, remains relevant for the comprehensive objective testing of soldier system usability or "fightability" assessment.

DRDC-RDDC-2014-N26