



University of
Salford
MANCHESTER



Force plate assessment before arduous military Training: Expert-informed recommendations for test and metric selection

Peter Ladlow ^{1,2 *}, Nicholas J Ripley ³, Damjana V. Cabarkapa ^{4,5 #}, Dimitrije Cabarkapa ^{4,6 #}, Dale W. Chapman ^{7 #}, Mary Claire Geneau ^{8,9 #}, G. Gregory Haff ^{10,11 #}, Lachlan P. James ^{12 #}, Paul Jones ^{3 #}, Jason, P. Lake ^{13 #}, Christopher J. Sole ^{14 #}, Anthony Turner ^{15 #}, Marina De Vecchis ^{1 *}, Natalie Masters ^{1 *}, Charles Coussens ^{16 *}, Robyn Holton ^{17 *}, Russell J Coppack ^{1,2 *}, Colin Suffield ^{15 *}, Paul Comfort ^{3,10}.

¹ Academic Department of Military Rehabilitation (ADMR), Defence Medical Rehabilitation Centre (DMRC) Stanford Hall, Loughborough, UK. ² Department for Health, University of Bath, Bath, UK. ³ Directorate of Psychology and Sport, University of Salford, Salford, UK. ⁴ D2 Lab, Novi Sad, Serbia. ⁵ Faculty of Physical Education and Sports Management, Singidunum University, Belgrade, Serbia. ⁶ Jayhawk Athletic Performance Laboratory – Wu Tsai Human Performance Alliance, University of Kansas, Lawrence, KS, USA. ⁷ School of Allied Health, Curtin University, Perth, Australia. ⁸ School of Exercise Science, Physical & Health Education, University of Victoria, Canada. ⁹ Canadian Sport Institute Pacific, Victoria, Canada. ¹⁰ Strength and Power Research Group, Edith Cowan University, Western Australia, Australia. ¹¹ Exercise Medicine Research Institute, Edith Cowan University, Western Australia, Australia. ¹² Sport, Performance, and Nutrition Research Group, School of Allied Health, Human Services, & Sport, La Trobe University, Melbourne, VIC, Australia. ¹³ Chichester Institute of Sport, Nursing, and Allied Health, University of Chichester, Chichester, UK. ¹⁴ Department of Health and Human Performance, The Citadel – The Military College of South Carolina, Charleston, South Carolina, USA. ¹⁵ Faculty of Science and Technology. London Sport Institute, Middlesex University, London, UK. ¹⁶ Royal Army Physical Training Corps (RAPTC), Aldershot, UK. ¹⁷ HQ Royal Army Medical Services (RAMS), Staff College, Camberley, UK

BACKGROUND

Physically arduous military training and selection courses impose substantial physical demands and are associated with musculoskeletal injury (MSKI), voluntary withdrawal and course failure. Conventional pre-course assessments provide important information on physical readiness but typically quantify performance outcomes rather than the neuromuscular strategies underpinning them.

Force plate testing can characterise maximal and rapid force production and provide insight into *how* performance is achieved. However, military research demonstrates considerable variation in the tests and metrics reported, with no established minimum dataset for pre-course profiling.

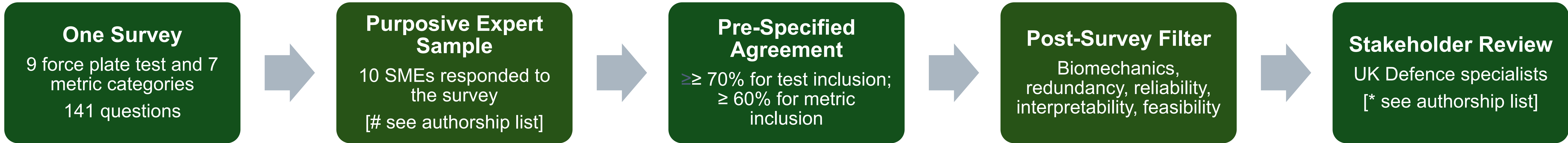
Aim: To identify an expert-informed minimum set of force plate tests and metrics that could complement existing physical-readiness assessments before personnel undertake physically arduous military training.

METHODOLOGY

Nine types of force plate tests were included in the survey: bodyweight tests, single joint and multi-joint isometric tests, countermovement jump (CMJ), squat jump, rebound jump tests and drop landings.

For each ‘type’ of test recommended, a drop-down list of metrics was provided for responders to select. These metrics were categorised as ‘outcome-based’, ‘force-based’, ‘power-based’, ‘rate of force development-based’, ‘impulse-based’, ‘velocity-based’, and ‘time-based’ metrics.

If a responder answered ‘yes’, a comprehensive and standardised list of force plate derived metrics would appear. Responders were asked to select metrics from this list that they considered important to report.



RESULTS

Clear agreement emerged for test selection. Initial metric selection demonstrated considerably less agreement, particularly for dynamic tests.

Three of nine force plate test categories reached the predefined inclusion threshold, with 9/10 responders recommending each test:

- Multi-joint isometric testing (e.g., IMTP)**
→ maximal and rapid isometric force production
- Countermovement jump (CMJ)**
→ ballistic / slow stretch-shortening cycle function
- Drop jump**
→ reactive / fast stretch-shortening cycle function

Following biomechanical and practical evaluation, the final minimum dataset (Figure 1) prioritised a combination of **performance outcomes and strategy-based metrics**.

Key measures included; IMTP, relative and net peak force and force at specific time points; CMJ, jump height alongside braking / propulsive force-time characteristics; and drop jump, jump height, ground contact time, drop height and landing / propulsive characteristics.

DISCUSSION

Combining the IMTP, CMJ and drop jump provides complementary assessment of maximal isometric, slow stretch-shortening cycle and fast stretch-shortening cycle force-production characteristics.

Assessment should extend beyond headline outcomes such as peak force or jump height to include selected strategy-based variables describing *how* that performance was achieved.

The proposed minimum dataset (Figure 1) provides a standardised framework for neuromuscular profiling, longitudinal monitoring and evaluation of physical-preparation interventions. It should complement, not replace, established assessments of aerobic fitness, strength, muscular endurance, load carriage and occupational performance.

These recommendations are not currently validated as pass/fail criteria or predictors of individual MSKI or course completion. Prospective military studies are required to establish reliability, responsiveness, incremental predictive value and criterion thresholds before force plate outcomes are used to inform candidate-selection decisions.

Recently published online. Ladlow et al. (2026) Selecting force plate tests and metrics to complement physical preparation strategies prior to commencing strenuous military training courses. *Frontier in Sport and Active Living*. 8:1891717.



Recommended force plate tests and metrics to inform pre-military course selection criteria

Isometric Mid-Thigh Pull (IMTP)		
Outcome-Based		Strategy-Based
➤ Peak Force (N) ➤ Relative Peak Force (N.kg⁻¹)		Force at specific time points (range 50 to 250 ms) (N)
Countermovement Jump (CMJ)		
Outcome-Based		Strategy-Based
➤ Jump Height (m)*		➤ Braking Phase Duration (s) ➤ Propulsive Phase Duration (s) ➤ Countermovement Depth (m) ➤ Avg. Relative Propulsive Force (N.kg⁻¹) ➤ Avg. Relative Braking Force (N.kg⁻¹) ➤ Time to Take-Off (s)*
Drop Jump		
Outcome-Based		Strategy-Based
➤ Jump Height (m)* ➤ Drop Height (m)#		➤ Ground contact time (s)* ➤ Propulsive phase duration (s) ➤ Braking phase duration (s) ➤ Avg. relative braking force (N.kg⁻¹) ➤ Avg. propulsive force (N) ➤ Landing stiffness (N.m) ➤ Countermovement depth (m)
All forces should represent net force (i.e., gross force - body mass).		
* indicates the two component metrics required for calculating RSI(modified) for the CMJ and RSI for the drop jump		
# Drop/fall height should be reported, not box height		

Figure 1. Expert-informed minimum force plate dataset proposed to complement physical-readiness assessment before physically arduous military training.