Compendium of Male and Female Physical Performance Data

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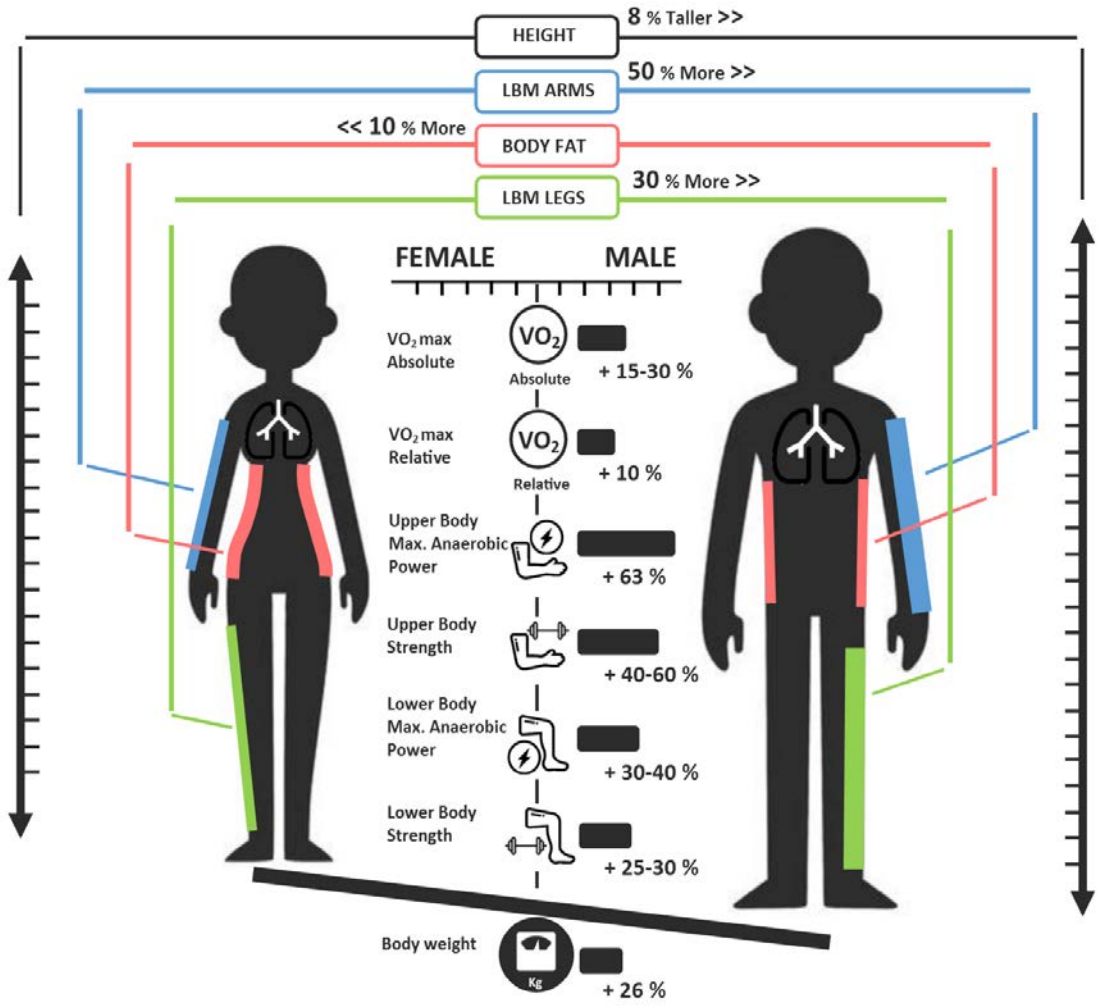
Background

- Physical and physiological sex differences in physical performance pose one of the greatest barriers to incorporating women into the combat arms.
- Sex differences in physical abilities are larger than any other difference relevant to personnel selection. (Ployhart et al, 2006 in Courtright et al, 2013)
- Adverse impact can occur if the sex differences in physical selection tests are greater than the sex differences in job performance.
- Need to identify methods to reduce sex bias in physical selection tests.

PURPOSE: To describe two databases of military physical performance data and demonstrate their potential for reducing bias in Physical Employment Standards Assessment.

Physical and Physiological Sex Differences



Adapted from Roberts D., Gebhardt, D., Gaskill, S., Roy, T., Sharp, M. APMN 2016

- Men tend to be taller, have more muscle mass and less body fat, which results in better physical performance.
- This does not mean women can't perform adequately.
- If Minimum Acceptable Performance Standard (MAPS) is below the maximal performance level of a woman she can perform the job.

Physical Employment Standards Assessment

- Types of tests
  - Physical Fitness Tests (PFTs): sit-ups, vertical jump
  - Job Simulation Tests (JSTs): road march, casualty evacuation
- Fairness concerns
  - **SEX BIAS** in physical selection tests is nearly unavoidable (female/male performance differential)
  - **ADVERSE IMPACT** occurs when the percentage of women passing the test is less than 80% of the percentage of men passing.
  - Need to consider % women who can perform the critical job tasks at the MAPS.

Previous Research

- Courtright et al (2013) Examined sex differences in physical fitness tests and job simulation tests. Included 113 studies, 41% military.
  - Large sex differences in PFTs of strength and cardiovascular endurance (CVE)
  - Large variation in sex differences in PFTs of strength across body regions
  - **Sex differences are similar between JSTs and systems of PFTs as opposed to a single PFT.**

- Hauschild et al (2016) Examined weighted mean correlations between categories of PFTs and categories of occupational task performance (OTP) included 27 studies, 48% military
  - CVE had strong correlations with OTP
  - UB and LB Strength and Endurance correlations with OTP were moderate
  - Recommends CVE (timed runs), LB strength (jump tests) and UB endurance (push-ups)
  - **Insufficient data to consider sex in the relationships**

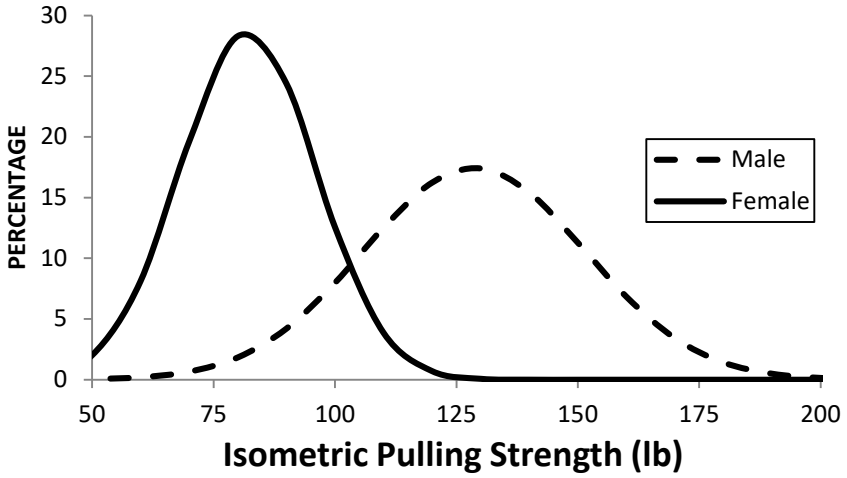
- Hydren et al (2017) Meta-analysis of predictors of maximal lift capacity in military personnel. Included 9 military studies.
  - Lean body mass and dynamic strength measures were most predictive of lift capacity
  - **Of 17 predictors of lifting capacity with moderate correlations or better, only 7 PFTs maintained fair correlations for single sex data**
  - Handgrip and push-up demonstrated sex bias

Database Development

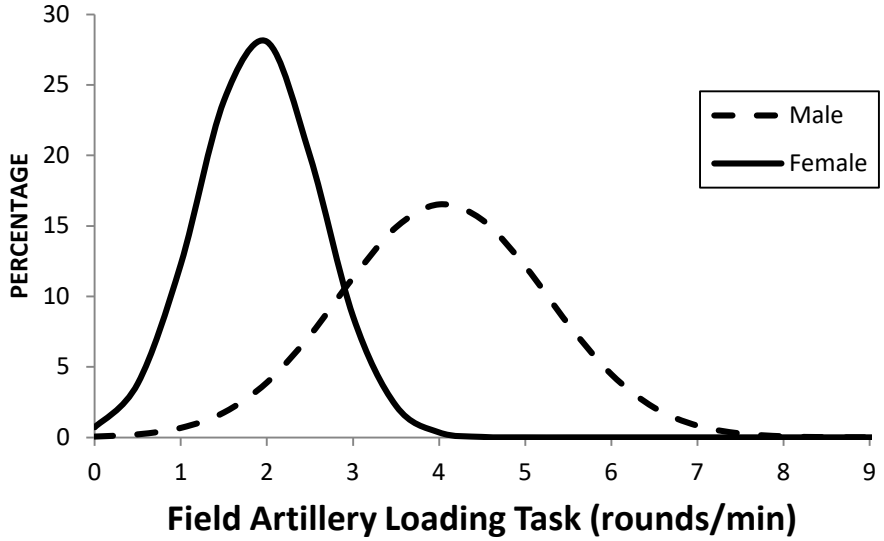
Goal: Share military data comparing male and female performance on PFT and JST.

- Source of data: Peer reviewed and technical publications as well as unpublished data from 11 countries (AU, CA, DK, FR, DE, IL, NL, NZ, NO, UK, and US)
- Methods: For PFTs, weighted means and probability density curves created to show male/female overlap.
- For PFTs with training data, change in percent overlap with training is shown.
- For JSTs listed the task variables and sex specific means.

Sex Differences in PFTs and JSTs

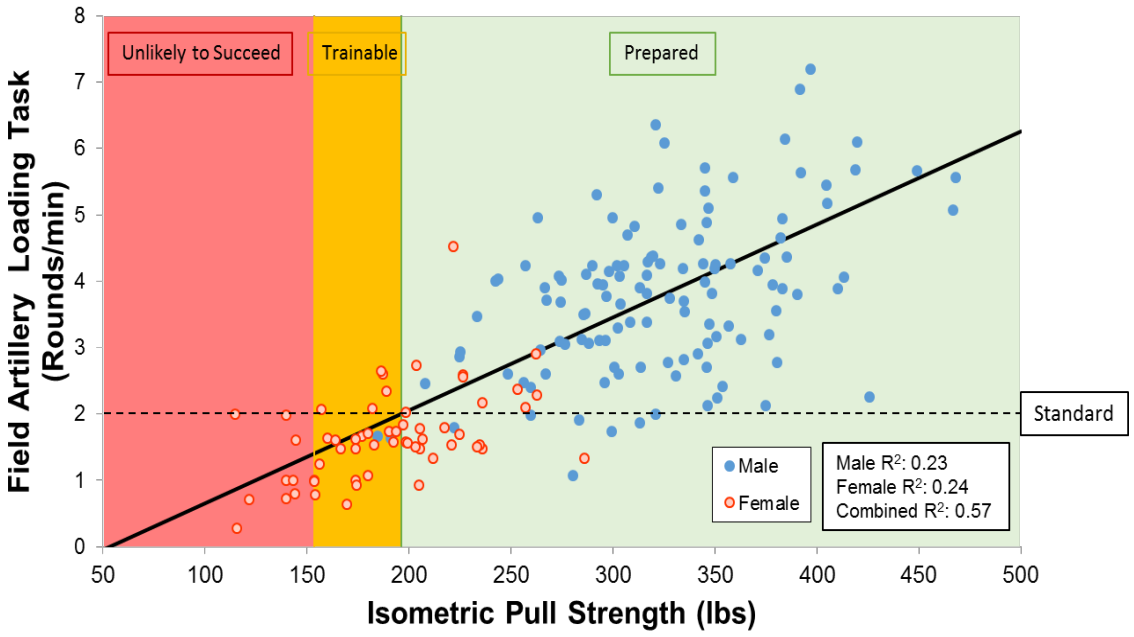


Isometric Pulling Strength



Field Artillery Loading Task

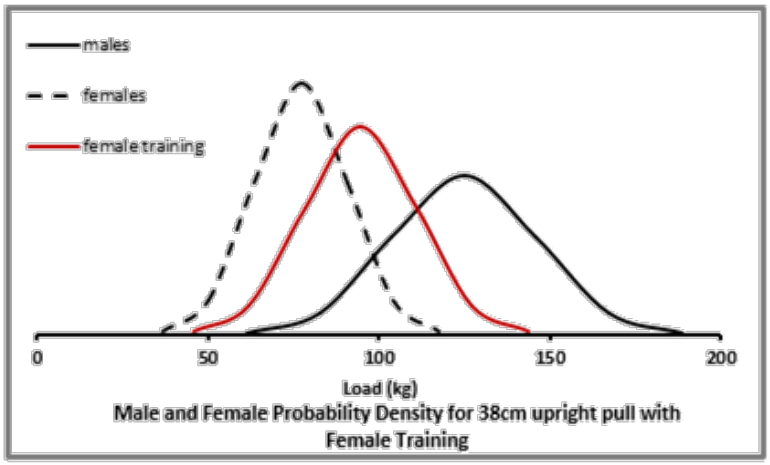
Relationship Between Lifting Strength and Ammunition Loading Task



- The predictive capacity r^2=0.57 is reduced to an equivalent extent in single gender analysis (r^2 men=0.23, r^2 women=0.24).
- The slope and intercept of the gender-specific equations were not statistically different.
- In this case, there is no adverse impact and the isometric lifting strength test could be used to predict performance of men and women on the field artillery ammunition loading task.

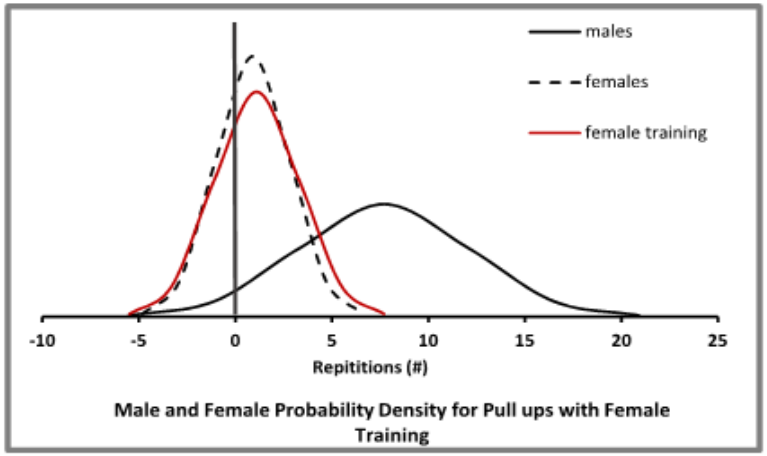
Training Effect on M-F Overlap

Upright Pull Strength for women (trained and untrained) and men



41.7%	1566	+23%	30 kg
M-F Overlap	Sample Size	% F-F Δ with Training	M-F Δ Mean

Pull-up repetitions for women (trained and untrained) and men



31.1%	2546	+22%	6.6 reps
M-F Overlap	Sample Size	% F-F Δ with Training	M-F Δ Mean

Job Simulation Test Data

- Task categories:
  - Lift: Single maximal and Repetitive
  - Lift and carry: Continuous and Repetitive
  - Casualty rescue: drag, vehicle evacuation, and litter carry
  - Load carriage
  - Digging
  - Fire and movement, Move to Cover
  - Obstacle course
- More difficult to generalize due to task variations (object shape and load, distance moved, start and end lift height, speed, etc.)

Fire and Movement Variations

Country	Task Specifications	Male Mean	Female Mean	F:M Ratio
Australia	Prone start, 5 x 30 m sprint, return to start. 44-sec cycle Uniform	5.9 (0.4) sec	7.1 (1.0) sec	83%
	Prone start, 5 x 30 m sprint, return to start. 44-sec cycle 21.6-kg load	7.6 (0.7) sec	9.6 (1.6) sec	79%
United Kingdom	8 x 22 m run, 1 x 3m crawl For time.	140 sec	211 sec	66%
New Zealand	8 x 22 m run, 5-sec rest 20-kg load	99% pass	97% pass	98%
United States	Prone start, 15 x 6.6 m run, 5-sec rest, alternating kneeling and prone with each rest period. 37.5-kg load	134 (9) sec	155 (117) sec	86%
Canada	Run 10 m, kneel (7-sec rest), run 50 m, drop to prone and leopard crawl 10 m, run 30 m.	47 (8) sec	65 (15) sec	72%

Repetitive Lift and Carry Tasks

Country	Task Variables	Uniform Load	Metric	Male Mean	Female Mean	F:M Ratio
AUS Army	Jerry can 2 x 22-kg, 6 x 25m shuttles, set speed		m	444.3 (198.8)	204.1 (97.5)	46%
UK Army	10-kg ammo box, 10-m carry, 1.45-m lift, return, up to 60 min		sec	3574	2311	65%
UK Army	22-kg ammo box, 10-m carry, 1.45-m lift, return, up to 60 min		sec	3578	1048	29%
UK Army	20-kg sandbags, 30-m carry, 1.1-m lift, AMAP in 10 min		# of sandbags	17.7	13.4	76%
US Navy	34 kg box, 51 m, 2 x 5 min (1 min rest), AMAP carries		Watts	305 (39)	271 (37)	89%
NZ Army	2, 20kg jerry cans, 8 x 25 m, 5-sec rest between shuttles, 4.5 km/hr		Pass/Fail	Na	Na	78%
US Army	16, 18-kg sandbags, carry 10 m	29 kg	Time	1.7 (0.3)	3.0 (1.1)	58%
US Army	30, 45-kg FA projectiles, carry 5 m, floor to shoulder lift in 15 min	22 kg	rounds/min	3.8 (1.2)	1.6 (0.7)	43%
US Army	Carry 18, 25-kg Armor rounds 5 m, lift to 163 cm	29 kg	rounds/min	7.6 (1.3)	3.4 (1.8)	44%
CAF	20-kg sandbags, carry 50 m, AMAP* in 10 min		# of sandbags	12.1 (2.6)	9.5 (1.4)	79%
US Army	25-kg box, carry 5 m, AMAP in 5 min		# of carries	37.2 (7.4/min)	23.7 (4.7/min)	63.71%
US Army	25-kg box, carry 5 m, AMAP in 10 min		# of carries	66.7 (6.7/min)	41.2 (4.1/min)	61.77%
US Army	45-kg box, carry 5 m, AMAP in 5 min		# of carries	20.6 (4.1/min)	9.4 (1.9/min)	45.63%
US Army	45-kg box, carry 5 m, AMAP in 10 min		# of carries	36.6 (3.7/min)	17 (1.7/min)	46.45%

Conclusions/Future Directions

- The choice of PFT and JST may substantially affect the sex bias and females' chance of successfully passing the test
- Examination of the data available prior to developing a test may help to avoid adverse impact issues
- Living data compendiums
- Will be made available to others in and outside of NATO