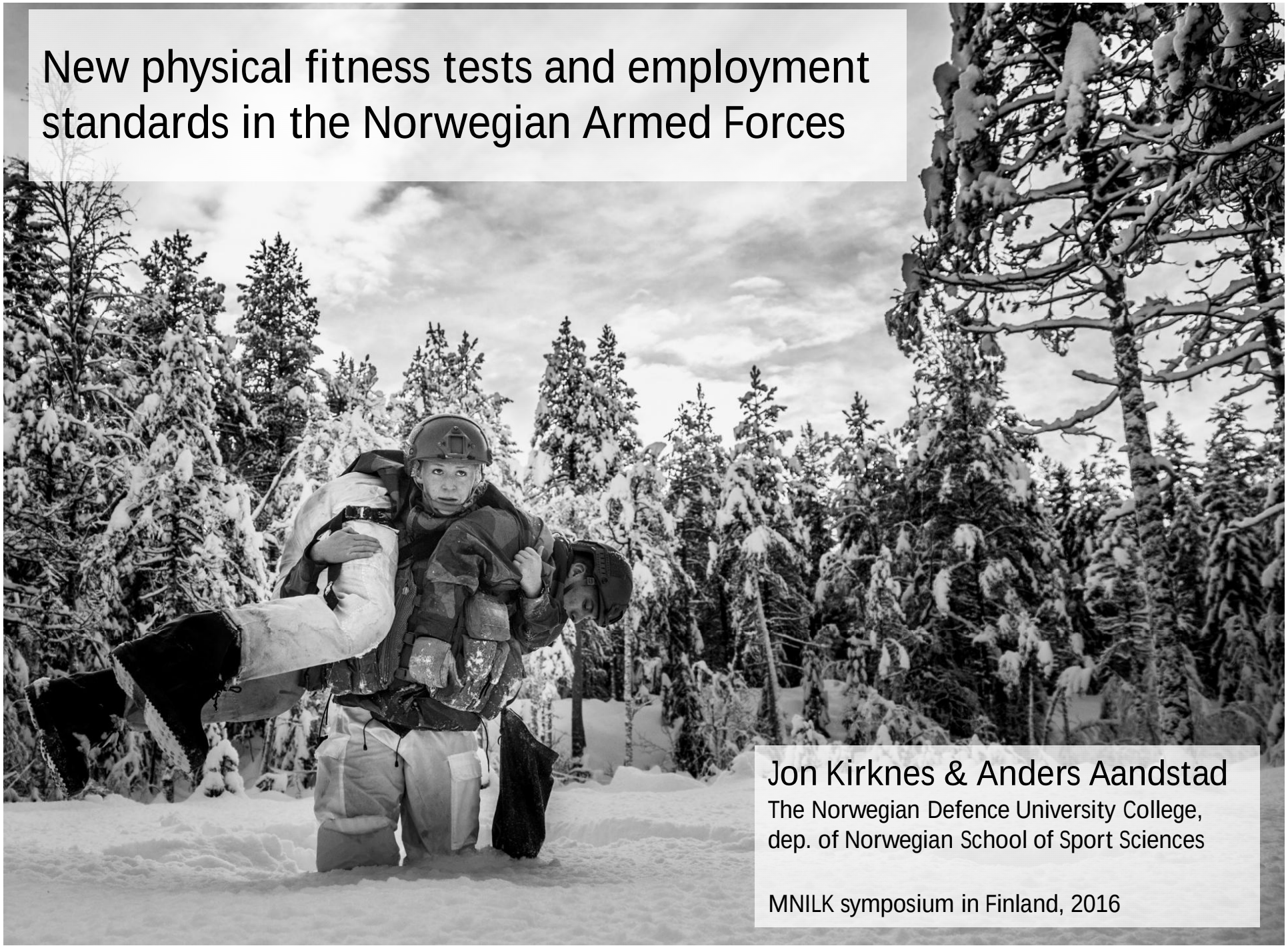
New physical fitness tests and employment standards in the Norwegian Armed Forces



Jon Kirknes & Anders Aandstad
The Norwegian Defence University College,
dep. of Norwegian School of Sport Sciences

MNILK symposium in Finland, 2016

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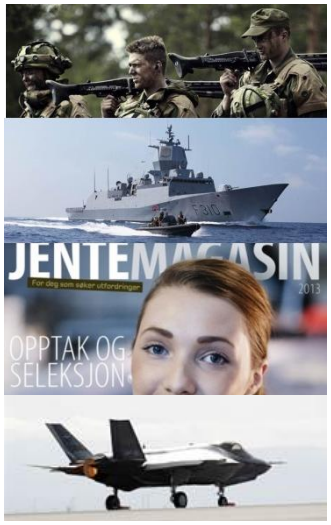
Assignment

I) Develop a new differentiated selection system (Defence staff/personnel div, 2012)



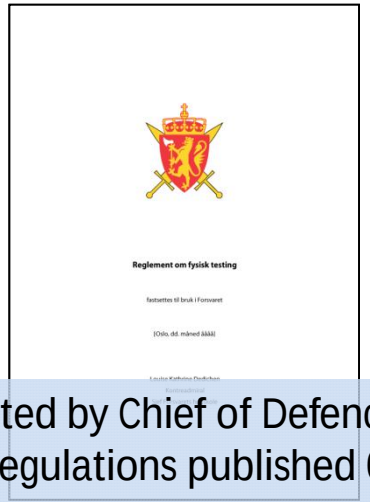
Psychological selection

Medical selection

Physical fitness selection

II) Revise the system for physical fitness testing for the entire Armed Forces

2014



Accepted by Chief of Defence
New regulations published 03/2016

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Background

Occasion	Persons	Tests	Total plots
Conscript selection ("sesjon")	18876	3	56.628
Conscript service	8632	4	34.528
Officer school & enlisted selection	5216	4	20.864
Annual test officers & enlisted	6687	1	6.687
Totalt	39411		118.707

Data from year 2014

Challenges with current test system

- Todays regulations on physical fitness testing in the NDF was developed in the 1970's

- No major revisions after that
  - Frequent minor changes and additions → not a complete document

- Challenges with current system:
  - Validity and reliability of some strength and endurance tests
    - E.g. sit-ups, push-ups, 10 km cross-country, 500 m swimming, proficiency tests
  - Different strength tests at conscript selection and later conscript service
    - Maximal strength vs. muscular endurance
  - Generally gender differentiated PES – but not at conscript selection
  - No strength tests for officers and enlisted soldiers
  - No actual PES for personnel > 50 yrs
  - PES are generally not differentiated related to job demands

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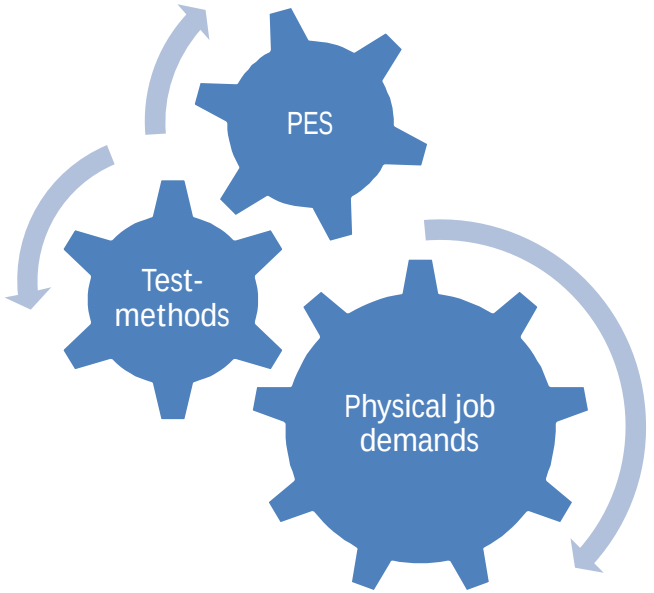
Methods

- Meetings/interviews with branches
- Meetings with chief sports-officers
- Review of existing literature
- Survey to soldiers & officers (n >1000)
- Scenario descriptions
- Hearing to all 21 branches
- Nordic workshop and ICSPP
- Validation studies and pilot screenings



"Regulations on physical fitness testing"

03/2016

Regulations will be Implemented 1st of Jan. 2017

Physical job demands

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Physical job demands

- Only a few studies on Norwegian military personnel
  - HG
  - Cadets
  - Officers & enlisted (questionnaire)

- NATO (2009):
  - Lift/carry
  - Loaded marching
  - Digging

} ...but more difficult to establish the necessary intensity

... a more broad recruitment and differentiated selection is needed. Different jobs in the military ask for different intellectual and physical abilities.

(Meld. St. 14, 2013 – "kompetanse for en ny tid")

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Military performance and physiological characteristics

We have identified 24 studies:

Authors	Sample description	Dependent variable (criterion measure)	Independent variable (test)	Independent variable (physiological characteristics)	Correlation (r) test. vs. criteria
Bilzon et al. [2]	British Naval personnel 52 men (28±5 yrs) 41 women(29±6 yrs)	Evacuation of manikin (37 kg) in a course on a shipboard. Performance measure: speed (m/sec)	BIA-LBM/fatmass + manikin weight (ratio)	Anthropometrics	0,87**
			Standing long jump (cm)	Strength	0,84**
			1 RM isometric lift; upright pull, (N)	Strength	0,77**
			BIA-LBM (kg)	Anthropometrics	0,76**
			BIA-fat %)	Anthropometrics	0.75**
			Pull-ups (n)	Muscular endurance	0,72**
			Gripstrength(N)	Strength	0,71**
			Push-ups (n)	Muscular endurance	0,69**
			20 m SRT (est. VO_{2max} in $ml \cdot kg^{-1} \cdot min^{-1}$)	Aerobic capacity	0,67**
			Body height(cm)	Anthropometrics	0,64**
			1.5 mile run (est. VO_{2max} in $ml \cdot kg^{-1} \cdot min^{-1}$)	Aerobic capacity	0,62**
			20 m sprints in 2 min. (n)	Anaerobic capacity	0,60**
			Sit-ups (n)	Muscular endurance	0,56**
			Body weight(kg)	Anthropometrics	0,40**
Knapik et al.[9]	Amerikanske infanterisoldater. 34 menn (22±3 år)	Kvalitativ vurdering av hver enkelt soldats prestasjon under en 5-dagers øvelse. Prestasjonsmål: rating 1-10	Wingate anaerob overkropp (peak W)	Anaerob kapasitet	0,46**
			Wingate anaerob overkropp (gj.snitt W)	Anaerob kapasitet	0,43**
			Skyte-test med rifle (antall treff)	Koordinasjon	0,41*
			1 RM isometrisk styrke bryst (N)	Styrke	0,36*
			1 RM isometrisk løft; upright pull, (N)	Styrke	0,36*
			1 RM dynamisk markløft i maskin (N)	Styrke	0,36*
			Direkte målt VO_{2maks} ($ml \cdot kg^{-1} \cdot min^{-1}$)	Aerob kapasitet	N.S
			UVV-fettprosent (%)	Antropometri	N.S
			1 RM isometrisk styrke legg/hofter (N)	Styrke	N.S
			1 RM isometrisk styrke ryggstrekk (N)	Styrke	N.S
			APFT score (sit-ups, push-ups, 3.2 km løp)	Diverse	N.S
			Thorstensson anaerob bein (peak & gj.snitt W)	Anaerob kapasitet	N.S
			Wingate anaerob bein (peak & gj.snitt W)	Anaerob kapasitet	N.S
			1 RM isokinetisk arm (N)	Styrke	N.S
			1 RM isokinetisk bein (N)	Styrke	N.S

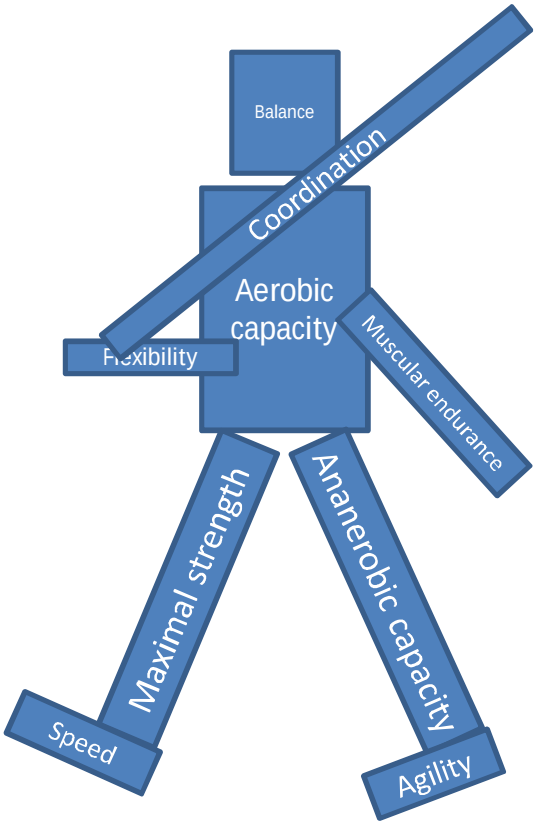
Kirknes et al. (2014)

Important physiological characteristics

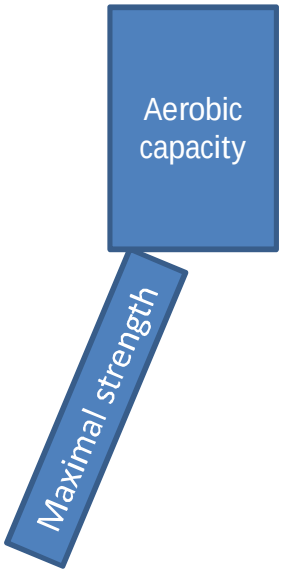
Physiological characteristics	Priority 2	Priority 1
Aerobic capacity		
Anaerobic capacity		
Muscular endurance		
Maximal strength		
Speed		
Body composition		
Agility		
Balance		
Coordination		

True world vs. test-world

True world



Ideal test-world



Feasible test-world

Physical fitness tests

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Physical tests in other (NATO) countries

Land	Gren/bransje	1-4 km løp	4-8 km løp	Cooper test	Pakningsløp/ marsj	20 m SRT	Tredemølle-test	Ergometer-sykkel test	Push-ups	Sit-ups	Pull-ups	Alternativ pull-ups	Rygg-hev	Spenst -hopp	1 RM test	Sprint/ agility	Svømme -test	Fleksi-bilitet	BMI/Bod y comp	Andre/Funk. rel. tester	Ref.
Norge	Sesjon						●								●						13
Norge	VPL, GBU, GOU	●							●	●	♂	♀									9
Norge	Årlig befalstest	○															○			○ A	9
Norge	FSK opptak	●			●				●	●	●		●				●			● B	10
Norge	MJK opptak		●						●	●	●						●				11
Sverige	Sesjon							●							●					□ C	14,15,16
Sverige	Rekrutt/befal				●				●	●	●$		●$	●							17
Sverige	Befal Hær	○			○	○		○	●	●	●$		●$	●							12
Sverige	Opptak GOU					●			●	●	●$		●$	●			●				17
Danmark	Alle			○	□*	○				●$	●		●$							○● D	17
Finland	Alle			○				○	●	●				●					●	○ E	17
Finland	Prof. soldater			●	○				●	●				●			□			●○ F	17
USA	Army basic	●							●	●									●		5
USA	Army Read. (forslag)	●							●	●				●		●					4
USA	Army Comb. (forslag)															●				●R	4
USA	Army Ranger	●	●		●				●	●	●						●		●		6
USA	Navy Seal	●							●	●	●						●		●		1
USA	Navy basic	○							●	●							○		●		2
USA	Air basic	●							●	●									●		7
USA	Marine corps		●						●	●	♂	♀							●		3
USA	Coast Guard	●							●	●							●	●	●		8
Tyskland	Spesialstyrker			●	●				●	●				●			●			● I	37
Tyskland	Gr.leg. soldatutd.	●										●				●					32
Tyskland	Gr.leg.offiserutd.			●					●	●				●		●					36
Sveits	Inntak hær basic					●M								●	●					●N	31
Australia	Inntak alle grener					●			●	●											26
Australia	Inntak GOU	●							●	●											27
Australia	Inntak spesialstyrke					●			●	●											28
New Zealand	Inntak alle grener					●			●	●											29
Canada	Alle					●			●	●				●							18
Canada	Alle (ny)																			● G	19
Canada	spesialstyrker				●	●			●	●	●				●		●			● H	20
Storbritannia	Hær GOU					●			●	●											21
Storbritannia	Hær rekrutter	●									□				●□					● J	22
Storbritannia	Sjø rekrutter	●							●	●										● K	23
Storbritannia	Sjø offiserer/vervede	○				○														○ L	25
Storbritannia	Luft GOU	○				○			●	●											24
Storbritannia	Spesialstyrker	●			●				●	●							●				20
Irland	Inntak alle grener	●							●	●									●		30
India	Opptak hærsoldater	●									●									●	35
Østerrike	Inntak yrkessoldat	○						○	●		●			●							33
Østerrike	Opptak jegerstyrke	●															●			●O	34
Østerrike	Opptak fallskjermj.	●							●		●									●P	34
Nederland	Generell basic			●					●	●											38

- Endurance: 1-4 km unloaded run
- Strength: push-ups & sit-ups

Kirknes et al. (2014)

The new tests are chosen based on...

- The test must be valid (measure what it intends to measure)
- The test must be reliable (stable test score at test and retest)
- The test must be practical
  - Time efficient
  - Easy to administer
  - Low injury risk
  - Less equipment/low-cost

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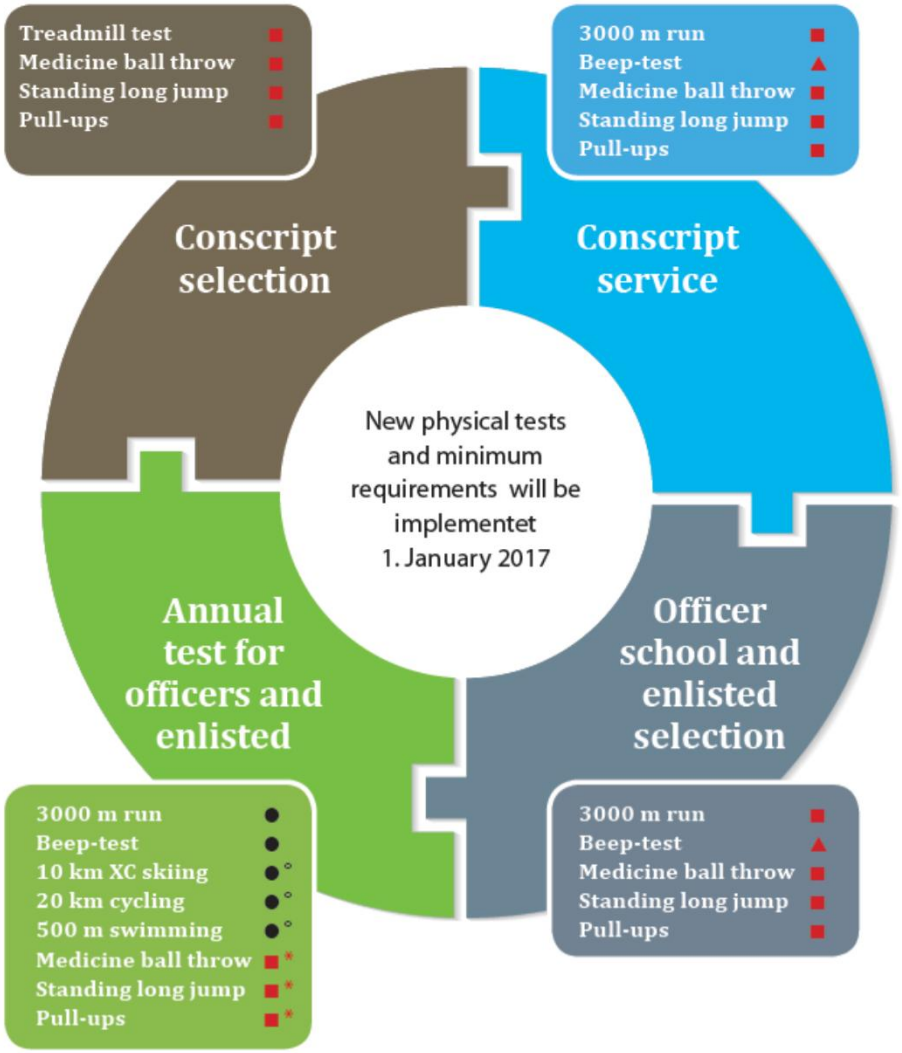
The new fitness tests in Norway








■ Obligatory test
▲ Alternative endurance test
● Endurance test of free choice

●° Not accepted test for personnel with minimum requirement endurance ≥ 4
■* Test is not obligatory for personnel with minimum requirement strength ≤ 3

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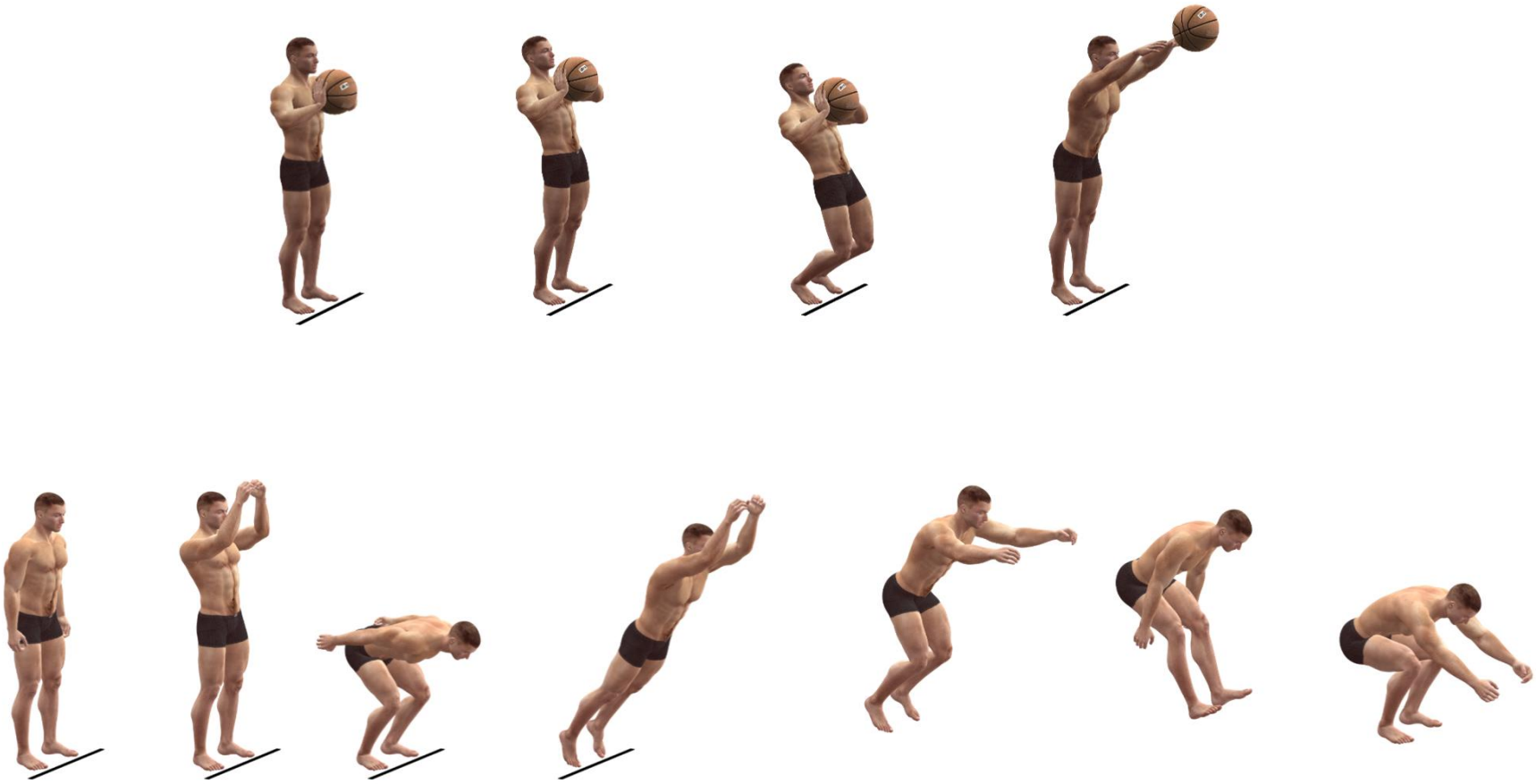
Why medicine ball throw and standing long jump?



Maximal work time and energy supply

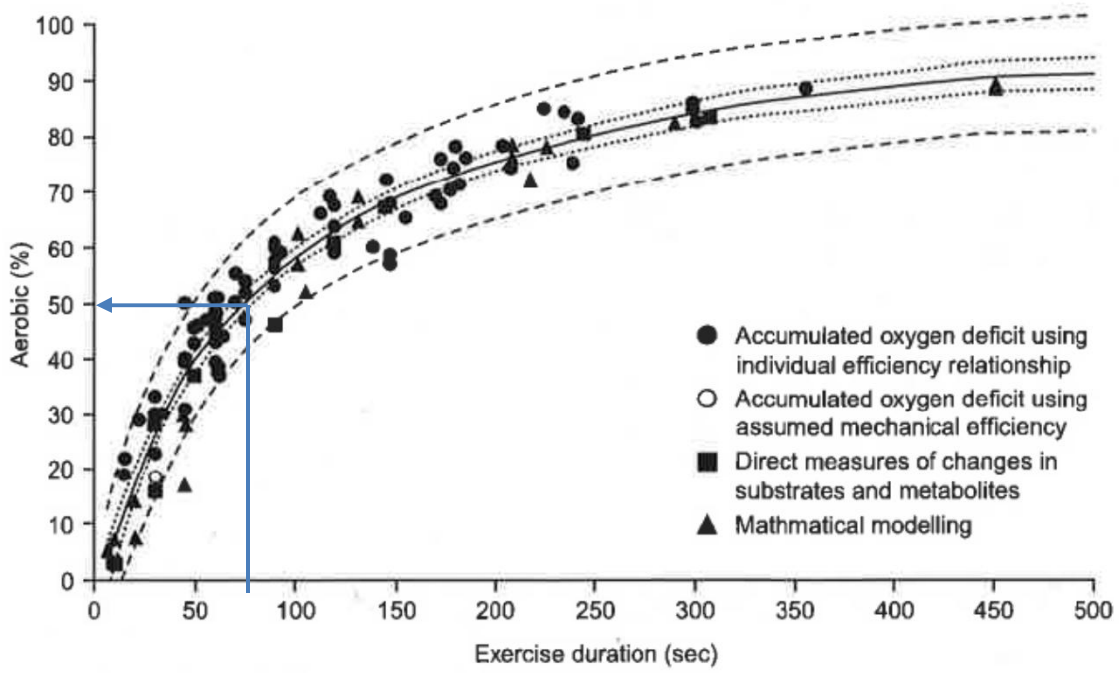


Fig. 2. Summary analysis of data in the literature of the relative aerobic contribution to the total energy supply during periods of maximal exercise. Both 95% confidence intervals (inner band) and 95% prediction intervals (outer band) are shown ($r^2 = 0.96$). Techniques used to estimate relative aerobic energy release include the accumulated oxygen deficit using an individual efficiency relationship or assumed mechanical efficiency, direct measures of changes in substrates and metabolites, and mathematical modelling. Data from table I.

Gastin (2001)

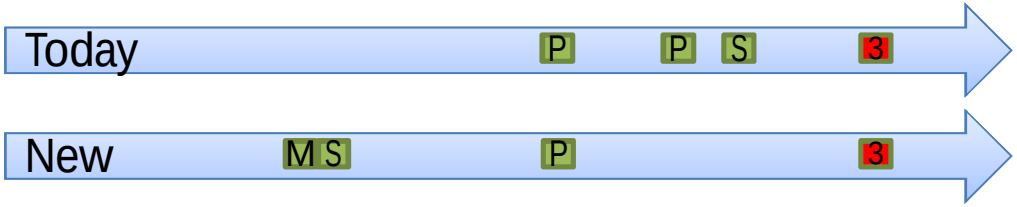
Aerobic and anaerobic energy transfer

Alactic

Lactic

Categories of Physical Fitness

PATHWAY	ANAEROBIC		AEROBIC
ENERGY SOURCE/ PATHWAY	PHOSPHOGENS/ PHOS. SPLITTING	GLYCOGEN/ GLYCOLYSIS	LIPIDS/ CITRIC ACID CYCLE
PRIMARY DETERMINANT	MUSCLE MASS	MUSCLE FIBER MAKE-UP	OXYGEN TRANSPORT
NATURE	VERY HIGH INTENSITY 1-5 SECONDS	HIGH INTENSITY 5-60 SECONDS	MODERATE-LOW INTENSITY > 1 MINUTE
EXAMPLE OF ACTIVITIES	LIFT PUSH PULL	DIGGING SPRINTING CLIMBING	RUNNING LOAD BEARING WALKING
PHYSIOLOGICAL TERMINOLOGY	MAXIMAL FORCE MAXIMAL TORQUE PEAK POWER	ANAEROBIC POWER	AEROBIC POWER
COMMON TERMINOLOGY	MUSCLE STRENGTH	MUSCULAR ENDURANCE	STAMINA CARDIOPULMONARY FITNESS



Today
3 3000 m run
S Sit-ups
P Push-ups
P Pull-ups

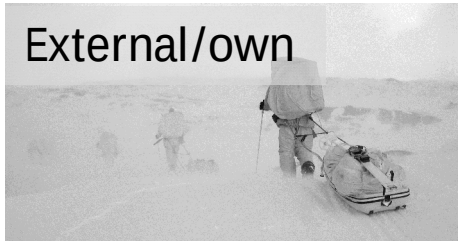
New
3 3000 m run
P Pull-ups
S Standing long j.
M Medicine ball t.

Vogel (1986), NATO (1986), Gastin (2001)

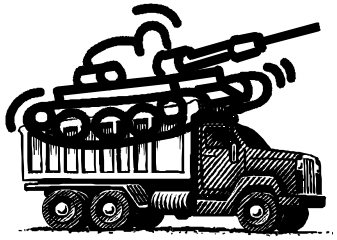
Moving external weight and/or body weight

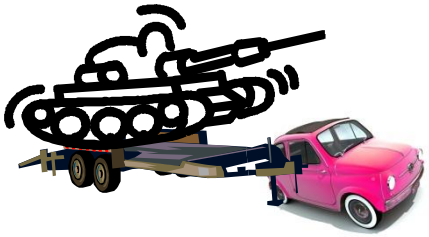
- Absolute strength and endurance: moving external weight
- Relative strength and endurance: moving own body weight

→ The military should test both absolute and relative capacities



Moving external weight and/or body weight





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Validity and reliability

Army recruits

Fitness tests:

Push-ups	Lunges with backpack
Pull-ups	Medicine ball throw
Sit-ups	Standing long jump
Bench press	Bench pull

Predicton

Medicine ball throw (1/3)+
Standing long jump (1/3)+
Pull-ups (1/3)
R^2 = 0,67

Push-ups (1/4)+
Sit-ups (1/4)+
Pull-ups (1/4)+
Lunges 22 kg (1/4)
R^2 = 0,49

Reference measure:

EVAC-test (sec.)
Lifting manuals (kg)
SMM (kg)
SMM (kg/BW)

Model	N	Predictor (test)	r	R^2
1	33	Medicine ball throw	0.86	0.74
2	33	Medicine ball throw Standing long jump	0.90	0.81
3	33	Medicine ball throw Standing long jump Bench press	0.92	0.84

Test	N	Test 1	Test 2	Mean diff (%)	LoA (%)	ICC (95 % CI)	CV
Medicine ball throw (m)	41	4.21	4.36**	+0.16 (3.8 %)	-0.33 to 0.64 (-8 to 15 %)	0.93 (0.88 to 0.96)	3.4 %
Standing long jump (m)	39	2.17	2.20*	+ 0.03 (1.4%)	-0.13 to 0.19 (-6 to 9 %)	0.96 (0.92 to 0.98)	2.3 %
Pull-ups (no.)	41	4.7	5.6**	+1.0 (21.3)	-1.2 to 3.1 (-41 to 98)	0.95 (0.90 to 0.97)	20.9 %

Recommendations from existing literature

- NATO Defence Research Group (1986):
  - "Tests such as push-ups, sit-ups, pull or chin-ups, etc. are, at best, a combination of strength and anaerobic power.."
  - "None of these tests qualify"
  - "..the capacity for the common single lift task has virtually no correlation with push-up or sit-up performance.."
  - "The only attributes are ease and rapidity of administration, universal popularity and access to a large body of reference data"
  - "Some examples of pure strength tests suitable for field measurement include a) vertical jump, b) standing broad jump and c) medicine ball throw"
- Vanderburgh (2007, 2008)
  - "In a military context, then, one could execute many push-ups but because of low body mass and, hence, total musculature, be incapable of heavy lifting absolute amounts of weight, as is typical in a military field setting"
  - "... push-ups, sit-ups, abdominal crunches, and curl-up tests not only impose an unfair body mass bias, but they may have limited occupational relevance.."
  - "... absolute strength, endurance, and power were more predictive of criterion task performance than were relative measures (...e.g. push-ups, sit-ups)
  - ..."the military appears reluctant to incorporate physical tests that require equipment"
- Hauschild et al. (2014):
  - A test of aerobic capacity is fundamental for assessing Soldiers' basic physical capacity to conduct critical tasks, while sit-ups do not appear to be an important test."
  - Muscle strength and endurance are also critical physical components.
  - Since the current AFPT does not include a measure of muscle strength or power, consideration should be given to fill this gap in future testing requirements."
- Peterson (2015):
  - The U.S. Army Research Institute of Environmental Medicine (USRIEM) and TRADOC are considering the medicine ball put and overhead powerball throw as part of the “Soldier 2020” initiative
  - Although none of the current military physical fitness tests include a jump test, these findings substantiate the validity of adding a jump test to military physical fitness tests.

PES

minimum requirements

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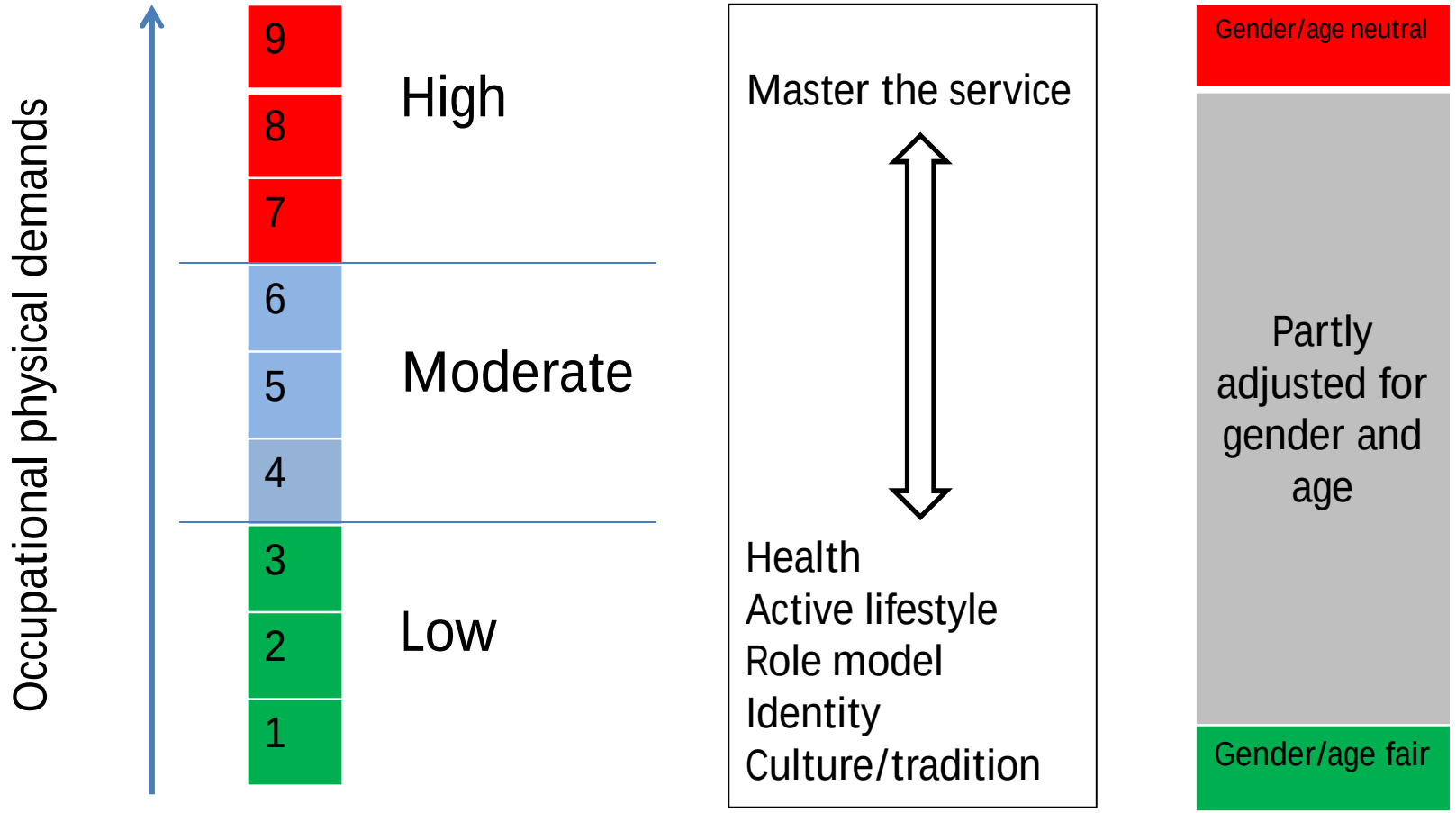
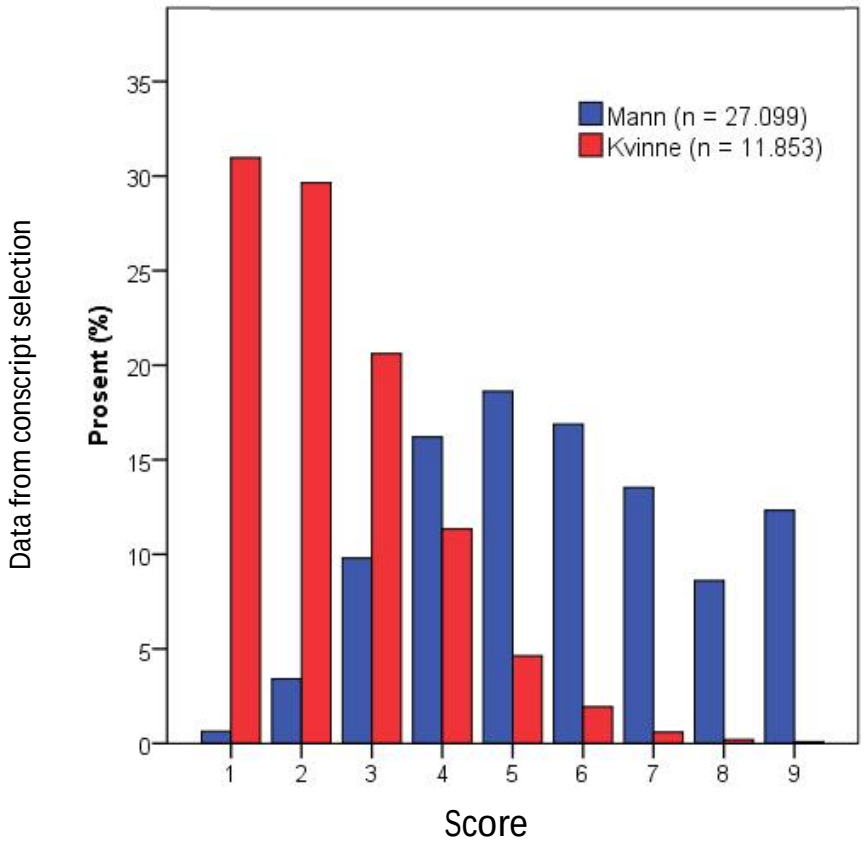
Arguments for PES



Why gender-adjusted PES?



Pros and cons, but...

If the PES are set at 5:
→ Ca. 70 % successful rate in men
→ Ca. 10 % successful rate in women

Gender neutral PES:
1) Very few women are accepted
or;
2) Nearly all men are accepted

(Partly) gender adjusted PES → the best men and the best women are accepted

Today: Gender neutral PES at conscript selection → most type of services have none or low minimum requirements (none > 5)

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PES-scales

- The chiefs of the 15 joint departments decide PES for the different type of services within their department

			Min. requirements officer school & enlisted selection - men								
	Test	Unit	1	2	3	4	5	6	7	8	9
Endurance	3000 m run	min:sec	18:00	16:30	15:00	14:30	14:00	13:30	13:00	12:30	12:00
	Beep-test	level:shuttle	6:1	7:4	8:8	9:3	9:8	10:2	10:7	11:1	11:6
Strength	Medicine ball throw	meter	3,7	3,9	4,1	4,2	4,4	4,5	4,6	4,8	5,0
	Standing long jump	meter	1,85	1,95	2,05	2,15	2,20	2,25	2,30	2,35	2,45
	Pull-ups	repetitions	3-B	6-B	1-A	3-A	4-A	5-A	7-A	8-A	10-A

			Min. requirements officer school & enlisted selection - women								
	Test	Unit	1	2	3	4	5	6	7	8	9
Endurance	3000 m run	min:sec	20:30	18:00	16:30	15:45	15:00	14:30	14:00	13:30	12:00
	Beep-test	level:shuttle	4:4	6:1	7:4	7:10	8:8	9:3	9:8	10:2	11:6
Strength	Medicine ball throw	meter	2,5	2,7	2,9	3,1	3,2	3,3	3,5	3,7	5,0
	Standing long jump	meter	1,45	1,60	1,70	1,80	1,85	1,95	2,05	2,15	2,45
	Pull-ups	repetitions	1-B	2-B	4-B	6-B	8-B	10-B	1-A	3-A	10-A

Branch-specific task simulation tests

- Each branch or joint department may include their own task-related predictive/simulation tests
  - PES may be gender neutral or gender fair

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