Finnish Defence Research Agency

EFFECT OF MILITARY FIELD TRAINING ON WARFIGHTERS PHYSIOLOGICAL RESPONSES

Researcher

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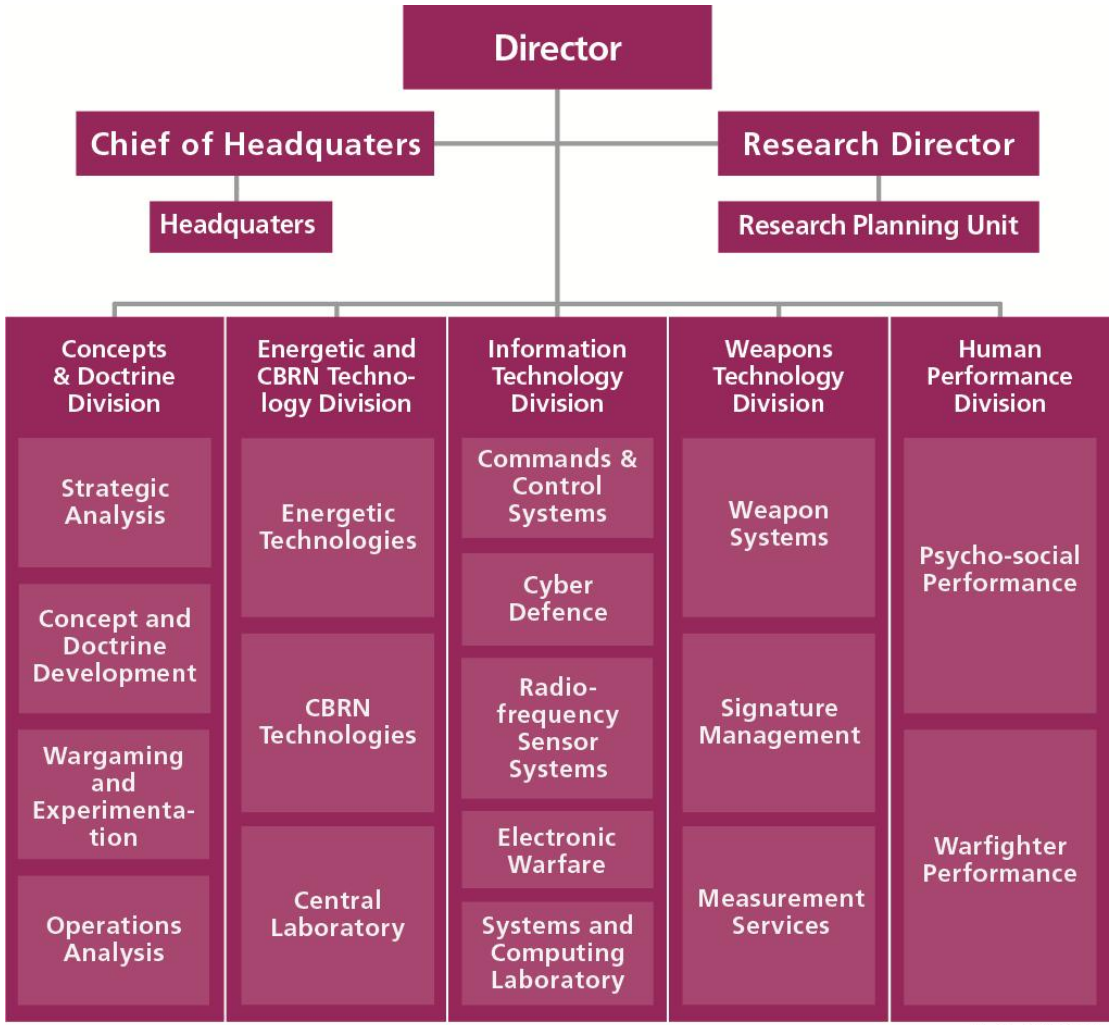
FINNISH DEFENCE RESEARCH AGENCY



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INTRODUCTION

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SHORT MILITARY FIELD TRAINING (≤ 5 DAYS)

Study	N, Country	Design	Results	Methods
Jacobs et al. 1989	29, Canada	5 day Field Training with average 4 - 5 hours of sleep per day and with high energy deficit	Anaerobic endurance ↓ Aerobic endurance ↓ Maximal isometric strength ↓	Wingate-test Cycle ergometer Isometric strength
Hackey et al. 1991	30, USA	Marines 4 day Field Training in cold environment with 25 kg load	Anaerobic endurance ↓	Wingate-test
Opstad et al. 1992	Norway	5 day Field Training	Testosterone ↓ 47 %	
Guezennec et al. 1994	27, France	5 day Field Training with average of 4 hours of sleep per day and with high energy deficit	Anaerobic endurance ↓ Aerobic endurance ↓	Cycle ergometer
Friedl et al. 1995	Review – article	Several researches	Body weight ↓ 5 – 10 % causes lower body stregth ↓	
Nindl et al. 2002	10, USA	3 day Field Training with average 2 hours of sleep per day and 1600 kcal/day energy deficit	Fat free mass↓ 2,3 % Fat mass ↓7,3 % Lower body explosive strength ↓ Obstackle course ↓ Difficulty in cognitive tasks	DEXA Squat jump Obstackle course
Gomez-Merino et al. 2002 ja 2003	26, France	5 day Field Training in mountain environmet with average of 3 – 4 hours of sleep per day and with energy deficit	Leptin ↓ 73% IL-6 ↑ 39% Testosterone ↓ 35%	
Nindl et al. 2003	12, USA	3 day Field Training with average 2 hours of sleep per day and with energy deficit	Total IGF-1 ↓ 24 % Free IGF-1 ↓ 42 % SHBG ↑	
Nindl et al. 2006	10, USA	84 hour physically demannig Field Training with sleep and energy deficit	IGF-1 ↓ 27 % Testosterone ↓ 24 % Leptin ↓ 47 %	
Rintamäki et al. 2012	20, Finland	Impact of heat on warfighters physical performance	Body weight ↓ 3,6 % Sit-ups ↑ 10,9 % Leg extension ↑ 7,7,%	InBody Muscle Endurance Isometric strength Cooper

LONG MILITARY FIELD TRAINING (≤ 3 WEEKS)

Study	N, Country	Design	Results	Methods
Spiegel et al. 1999	11, USA	11 men, 9 days, first 3 nights with 8 hours of sleep. following 3 noghts with 4 hours of sleep and the final 3 nights with 12 hours of sléep	Cortisol ↑ after 4 hours of sleep	
Rintamäki et al. 2005	23, Finland	12 day field training in winter conditions	Lower body explosive strength Aerobic endurance ↔ Upper body maximal strength↓	CMJ Cycle ergometer Isometric strength
Alemany et al. 2008	34, USA	8 day physically demanding field training with energy deficit and lack of sleep	IGF-1 ↓ 50 % Testosterone ↓ 49 % SHBG ↑ 66 %	
Kyröläinen et al. 2008	7, Finland	20 day reconnaissance field training	Testosterone ↓ 27 % after first stage Cortisol ↑ 32 % after first stage	
Kyröläinen et al. 2008	7, Finland	20 day reconnaissance field training	Larger energy deficit in the beginning (4000kcla/day), in the end smaller (1000kcal/day) => hormone levels normalized	
Tyyskä et al. 2010	9, Finland	15 day Field Training, Finnish Defence Forces officers	Testosterone – SHBG ratio ↓ 28 %, subjects with low aerobic endurance	
Chester et al. 2013	14, Australia	14 day survival training with energy deficit and lack of sleep	Body weight ↓ 8% Lower body explosive strength↓ 10%	CMJ
Chester et al. 2013	14, Australia	14 day survival training with energy deficit and lack of sleep	CK ↑ 128% IL-6 ↔	
McLung et al. 2013	21, USA	7 day field training, including 54 km skimarch	IL-6 ↑ 37% CK ↑ 356%	
Margolis et al. 2014	21, Norway	7 day field training in winter conditions, with 4 day combat phase and 3 day skimarch	Energy expenditure higher during skimarch than in combat phase (6851 vs 5480 kcal)	

LONG TRAINING COURSES (6 – 9 WEEKS)

Study	N, Country	Design	Results	Methods
Nindl et al. 1997	10, USA	8 weeks	13 – 16 % deficit in body weigth, also seen in ability to produce power in strength measurements	
Friedl et al. 2000	97, USA	8 weeks / US Army Ranger - course	Testosterone ↓ 86 % IGF-1 ↓ 50 % Cortisol ↑	
Nindl et al. 2007	50, USA	8 weeks / US Army Ranger - course	Maximal power ↓ 21 % Maximal strength ↓ 20 % Body weight ↓ 12,6 % Fat free mass ↓ 6 %	Isometric strength DEXA
Nindl et al. 2007	50, USA	8 weeks / US Army Ranger - course	Testosterone ↓ IGF-1 ↓ Cortisol ↑	
Santtila et al. 2009	72, Finland	Conscripts 8 week basic training	Testosterone ↑ 16,3–26,6% Cortisol ↑ 11,1 % (strength group)	
Crawford et al. 2011	99, USA	Impact of body fat mass on soldiers physical performance	Less body fat => Aerobic and Anaerobic endurance ↑ Muscle strength ↑	VO_2 Max running Isokinetic strength Muscle endurance
Mikkola et al. 2012	945. Finland	Changes in aerobic endurance ja body composition among finnish conscripts	Running distance ↑ 6,8 %	Coopers test Body conposition
Rintamäki et al. 2012	20, Finland	Impact of warm climate on soldiers physical performance	Body weigth ↓ 3,6 % Sit ups ↑ 10,9 % Leg extension ↑ 7,7,%	Body conposition Muscle endurance Isometric strength Coopers test
Sporis et al. 2012	25, Croatia	9 week special force training in Croatia Army	Body weigth and fat% ↓ Upper body strength and power ↓ Aerobic and anaerobic endurance ↓	Body composition Muscle endurance Speed test 3,2 km running
Richmond et al. 2014	40, USA	8 week physically demanding training	Due to energy deficit, there was an average of 5,1 kg decline in body weigth	

INTERNATIONAL OPERATIONS (6 – 13 MONTHS)

Study	N, Country	Design	Results	Methods
Sharp et al. 2008	110, USA	9 month operation, effects to soldiers physical perfomance	VO_2 Max ↓ 4,5 % Medicine ball throw↓ 4,9 % Body weight ↓ 1,9 % Fat free mass ↓ 3,5 % Fat%i ↑	VO_2 Max running Strength tests Medicine ball throw DEXA
Lester et al. 2010	73, USA	13 month operation, effects to soldiers physical perfomance	Upper and lower body strenght↑ (7/8%) Upper body power ↑ 9 % Fat free mass ↑ 3 % Aerobic endurance ↓ 13 % Fat mass ↑ 9%	Strength tests 2 mile run DEXA
Pihlainen et al. 2016	98, Finland	6 month UN-operation. Effect of different training programs to soldiers physical performance	Muscle mass ↑ Fat%i ↓ ↑ Muscle endurance ↑ Lower body maximal strength↑ Aerobic endurance ↔ Combat course ↑	Body composition Muscle endurancet Isometric strength 3 km run Combat course

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MEASUREMENTS






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SHORT MILITARY FIELD TRAINING (≤ 5 DAYS)

Endurance / Strength

- Aerobic endurance ↓
- Anaerobic endurance ↓
- Maximal strength↓ ↑
- Lower body explosive strength↓
- Obstacle course↓
- Body mass ↓
- Fat mass ↓
- Fat free mass↓

Hormones

- Testosterone ↓ (24 – 47 %)
- Cortisol ↑
- IGF-1 ↓ (24 – 27 %)
- SHBG ↑
- Leptin ↓ (47 – 73 %)
- IL-6 ↑ (39 %)

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LONG MILITARY FIELD TRAINING (≤ 3 VKO)

Endurance / Strength

- Aerobic endurance ↔
- Maximal strength ↓
- Lower body explosive strength ↑ ↓
- Body mass ↓
- Fat mass ↓
- Fat free mass ↓

Hormones

- Testosterone ↓ (27 - 49 %)
- Cortisol ↑ (32 %)
- IGF-1 ↓ (50 %)
- SHBG ↑ (66 %)
- CK ↑ (128 – 356 %)
- IL-6 ↔ ↑ (0 - 37 %)

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CONCLUSION

Military Field Training

- Energy deficit
- Sleep deficit
- Continous physical activity
- Aerobic performance
  - ↓ after intensive MFT
  - ↔ after long MFT
- Muscle power seems to decline
  - Especially in lower body
- Muscle strength does not seem to change
- Recovery quite fast
  - 2-3 days after MFT

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CONCLUSION

STRENGTH TRAINING • One platoon • Strength training • 0-3 times per week • 6 + 6 week at the end of conscript time	**ENDURANCE TRAINING** • One platoon • Endurance training • 0-3 times per week • 6 + 6 week at the end of conscript time
WARFIGHTER TRAINING • One platoon • Warfighter training • 0-3 times per week • 6 + 6 week at the end of conscript time	**CONTROL GROUP** • One platoon • Normal physical training • 0-3 times per week • 6 + 6 week at the end of conscript time

Training study

- How to train to meet the requirements?
- Study was made earlier this year
- Results are analysed at the moment…

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