



**TSAC AUSTRALIA**  
Evidence Based | Tactically Tested | Operationally Proven

**TACTICAL STRENGTH & CONDITIONING AUSTRALIA  
RAPID FIRE MINI CONFERENCE**



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**Load Carriage: Impacts and Conditioning**  
A/Prof Rob Orr (Bond University)



## TACTICAL STRENGTH & CONDITIONING AUSTRALIA RAPID FIRE MINI CONFERENCE

### BLUF:

- A well-structured and periodised load carriage conditioning program can reduce the negative impacts of carrying load and optimise operational performance

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### Introduction:

- Tactical operators are required to carry load as part of their occupation
- Carrying these loads can place the operators at risk through reducing occupational task performance and causing injury



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### Risks Associated with Load Carriage

**When you get shot at, you move as fast as you can...but it wasn't very fast. You are just tired. So tired.**

Justin Kalentis, US Army, wounded in Afghanistan,  
discussing the loads they were carrying  
quoted in *The Seattle Times* (14 Feb 11)



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### Risks Associated with Load Carriage

- Injuries: Associated with a variety of injuries (from skin blistering to muscle, ligament, tendon, bone and nervous system injuries)



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### RISKS ASSOCIATED WITH LOAD CARRIAGE

- Decrements in performance:
  - ↓ Mobility



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### RISKS ASSOCIATED WITH LOAD CARRIAGE

- Decrements in performance:
  - ↓ Lethality (Marksmanship / Grenade throw ability)



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### Risks Associated with Load Carriage

- Decrements in performance:
  - ↓ Mobility + ↓ Lethality



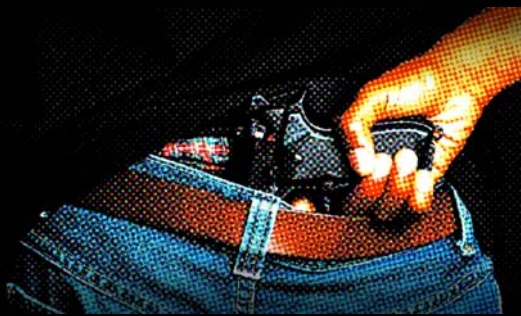
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### Risks Associated with Load Carriage

- Decrements in performance:
  - ↓ Attention to task



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### Load Carriage Conditioning

- Concept is not new and can be traced back to the Roman Legionnaires



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### Load Carriage Conditioning

Database	Search terms
MEDLINE (Ovid)	load AND carr*; load AND march*; pack AND march*; endurance AND march*
PUBMED	load AND carriage; load AND carry; load AND marching; load AND march; pack AND march; pack AND marching; endurance AND march; endurance AND marching.
PROQUEST	load AND carriage; load AND carry; load AND marching; load AND march; pack AND march; pack AND marching; endurance AND march; endurance AND marching.
CINAHL	load AND carriage OR carry; endurance AND march OR marching; pack AND march OR marching; load AND march OR marching.
DEFWEB	load AND carriage; load AND carry; load AND marching; load AND march; pack AND march; pack AND marching; endurance AND march; endurance AND marching.

Exclusion Criteria	Example:
Participant ages outside typical military service age range of 16 to 65 years	Adolescents
Study included a form of mobility aid	Walking poles
Study included medical supplementation	Ergogenic aids
Study included medically unfit subjects	Idiopathic scoliosis
Study included components in an altered environment	Microgravity; high altitude
Study not published in English	
Study did not include a load carriage variable (dependent or independent); was not specifically related to a load carriage activity; or involved no physical loads being carried	General military conditioning programs
Study had a commercial interest	Commercial backpacks
Defence documents which were rated above "unclassified".	

Orr, R. M., Pope, R., Johnston, V. & Coyle, J. (2010). Load carriage: Minimising soldier injuries through physical conditioning - A narrative review. *Journal of Military and Veterans' Health*, 18(3), 31-38.

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### Load Carriage Conditioning

- Initial literature search identified 8,053 papers.
- Further 36 papers gathered from colleagues.
- 8089 papers reduced to 214 papers following implementation of exclusion criteria
- Secondary literature search reduced papers to seven original research papers, one conference paper and four secondary source papers (military reports, journal articles).

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### F.I.T.T Formula (Frequency, Intensity, Time & Type)

- F. 10-14 days per load carriage session
- I. To loads required (Last decade 40-50kg) at the speeds and over the terrains required
- T. Duration of load carriage operations
- T. Load carriage preferable, but combined resistance and cardio may be of some benefit

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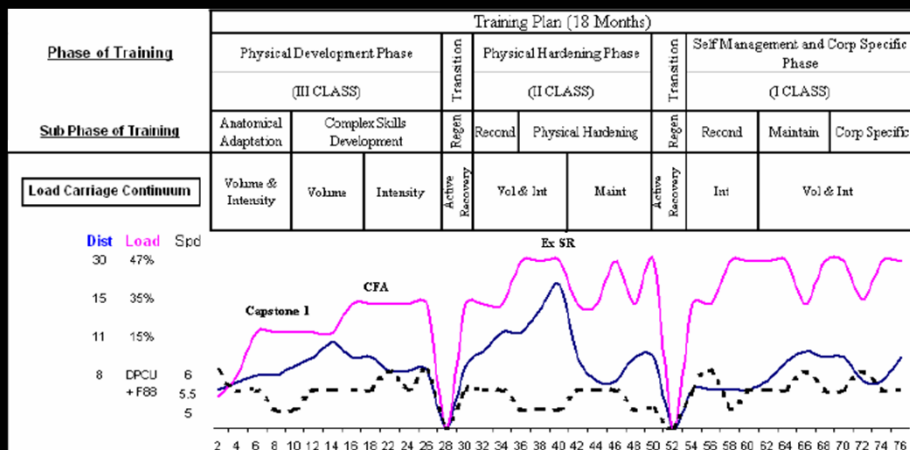
Phase of Training	Training Plan (18 Months)									
	Physical Development Phase (III CLASS)			Transition	Physical Hardening Phase (II CLASS)			Transition	Self Management and Corp Specific Phase (I CLASS)	
	Anatomical Adaptation	Complex Skills Development	Regen	Recond	Physical Hardening	Regen	Recond	Maintain	Corp Specific	
Macrocycle	[Color-coded bars representing training cycles]									
Microcycle	[Color-coded bars representing daily training cycles]									
Individual Fitness and Healthy Lifestyle	Metabolic Fitness Neuromuscular Skills and Fitness Injury Prevention Healthy Lifestyle Education Personal Training and Fitness									
Military Specific Fitness	Load Carriage Complex Warfighting Skills and Fitness									
Sports Specific Fitness	[Color-coded bar]									
Remedial Training and Rehabilitation	[Color-coded bar]									

Orr, R. (2010). The Royal Military College - Duntroon. Physical conditioning continuum model. Dept of Defence, Australia.

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### Load Carriage Conditioning

Knapik et al., (2012)

- Method: Review of several literature databases
- Results: 11 Publications from 10 original studies
- Discussion:
  - Substantial trg effect with Progressive RT combined with Aerobic trg (3x4/52)
  - Effects greater when LC added specifically
  - Field based training (inc LC) also very effective
  - RT or Aerobic trg alone had varying effects

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### Take Home:

To improve load carriage performance and reduce the risks associated with load carriage (including injury and reduced tactical performance) a well designed and progressive LC program is needed.

This program would include specific LC events, preferably ever 7-14 days



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- Drain, J., Orr, R., Billing, D., & Rudzki, S. (2010). *Human Dimensions of Heavy Load Carriage*. Paper presented at the Land Warfare Conference 2010 in Brisbane, Australia 15 – 19 November 2010.
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- Knapik, J. J., Harman, E., Steelman, R.A. & Graham, B.S. (2012). A Systematic Review of the Effects of Physical Training on Load Carriage Performance, 26(2), 585-597.
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- Orr, R., Pope, R., Johnston, V., & Coyle, J. (2010). Load carriage: Minimising soldier injuries through physical conditioning – a narrative review, *Journal of Military and Veterans' Health*, 18(3), 31-38
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