



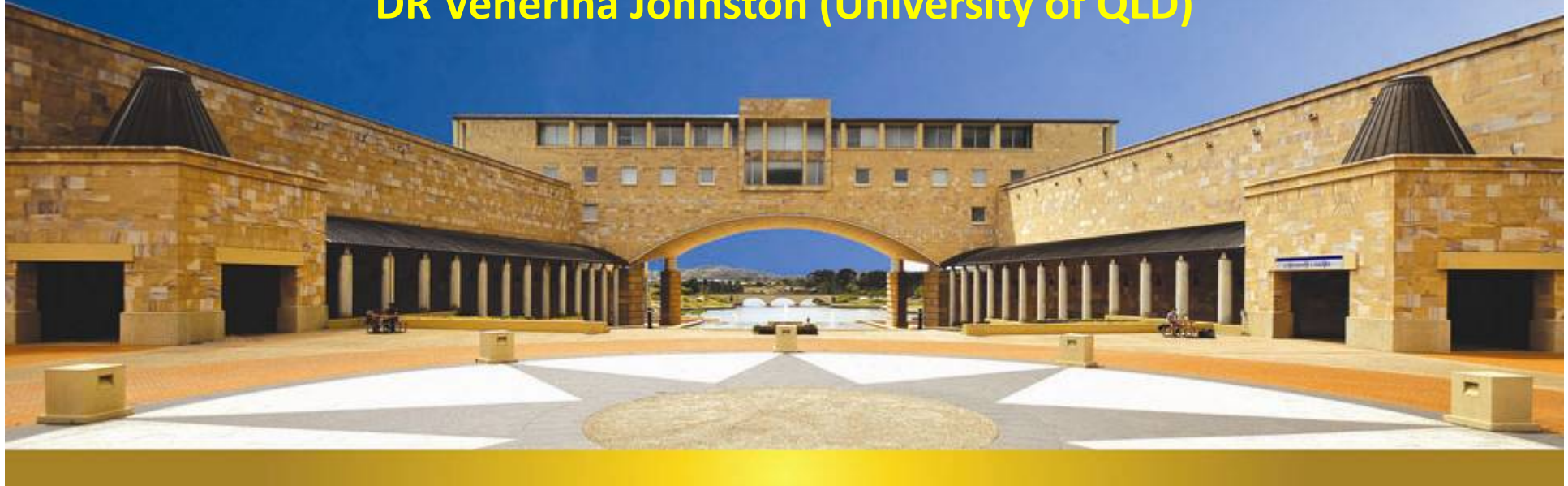
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# **Soldier Load Carriage: A investigation into the load carriage conditioning practices of the ARA**

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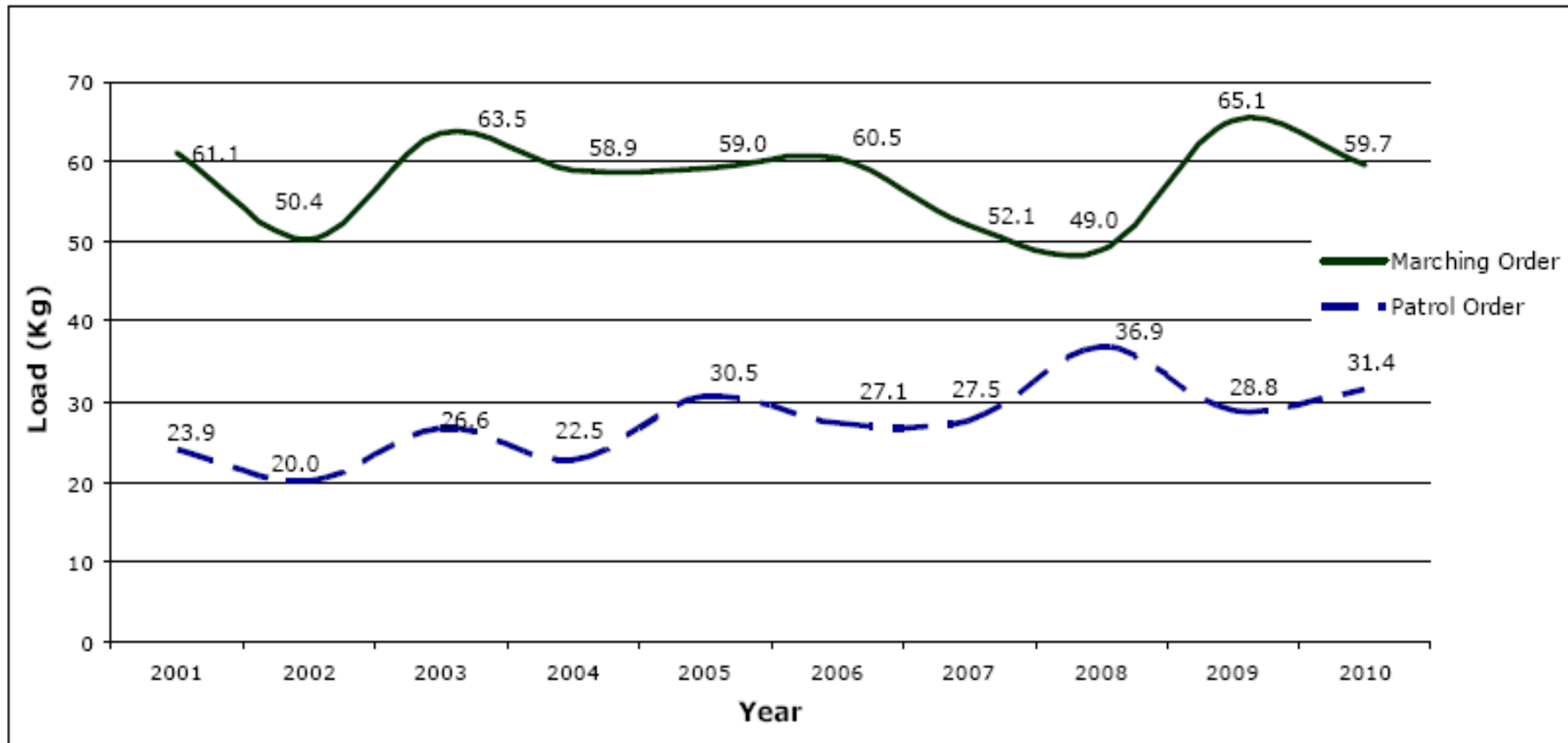
# Soldier Load Carriage: A Risk Management Approach



# The Australian Soldier Context



## Operational Load Carriage – Last Decade: Load weights



**COMBINED LOADS (PO & MO): M = 47.7 KG OR 56% BW**

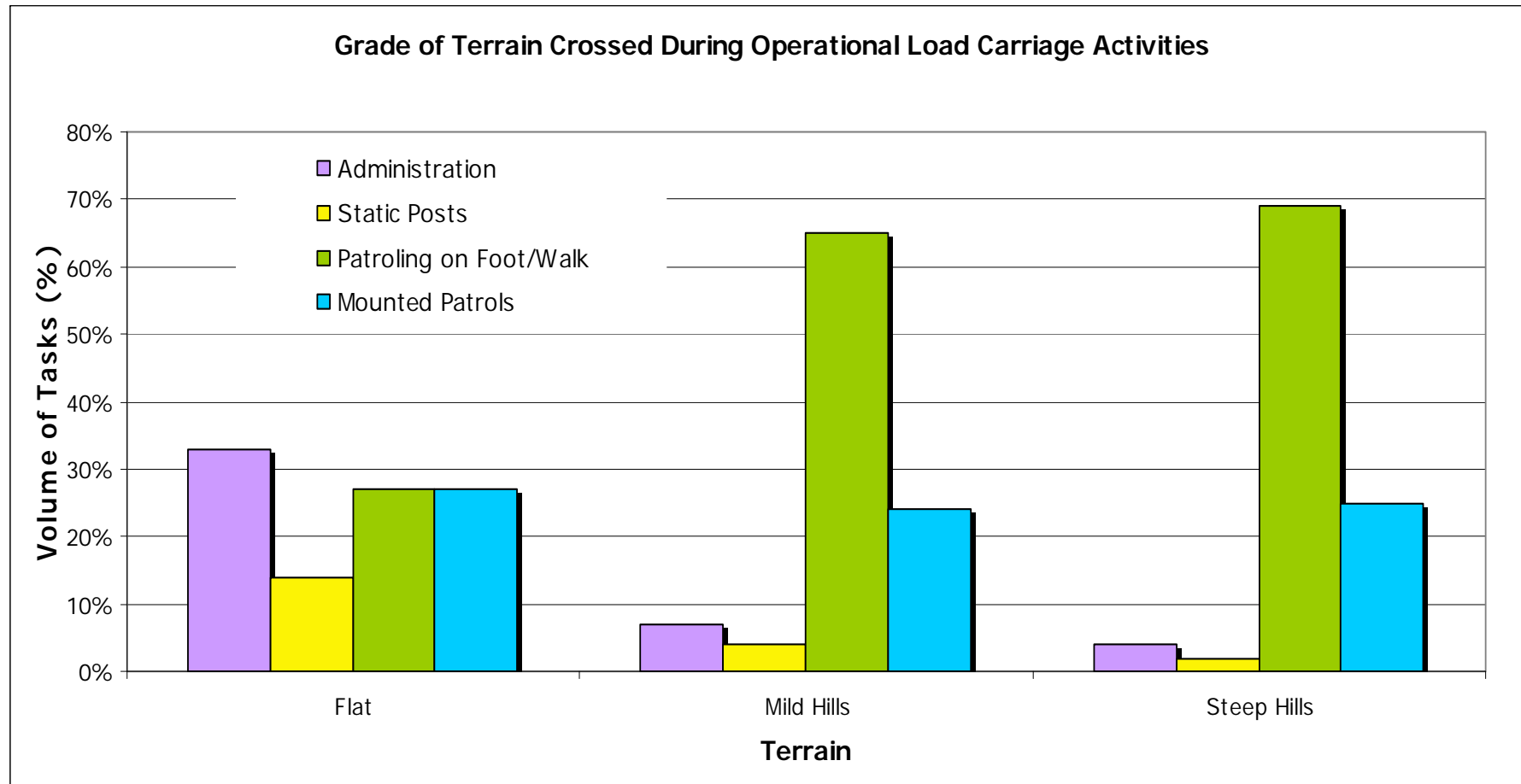
Patrol Order =  $M=28.4$  kg

Marching Order =  $M=56.7$  kg

# The Australian Soldier Context



## Operational Load Carriage – Last Decade: Tasks and Terrain Type



# Impacts of Load Carriage

## Impacts of Load Carriage – From the Literature

- **↑ in load weight = ↑ in the energy cost of standing, walking (forwards and backwards, up and down stairs) and running**



# Impacts of Load Carriage



## Impacts of Load Carriage – From the Literature

- $\uparrow$  in speed of load carriage =  $\uparrow$  in the energy cost of carrying given load (more than weight)?  $\uparrow 0.5\text{km/h} = \uparrow 10\text{kg}$



# Impacts of Load Carriage



## Impacts of Load Carriage – From the Literature

- $\uparrow$  in gradient of load carriage =  $\uparrow$  in the energy cost of carrying given load (more than weight)?  $\uparrow 1\% = \uparrow 10\text{kg}$



# 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)





# Risks Associated with Load Carriage

- **Injuries:** Associated with a variety of injuries (from skin blistering to muscle, ligament, tendon, bone and nervous system injuries)
- **Performance:** ↑ in load weight = ↓ Mobility, Marksmanship, Grenade throw ability, general task performance & attention to task.



# Risks Associated with Load Carriage

## Reduced performance

- **Decreased Lethality**
- **Decreased Mobility**

**Fire &  
Move**



# Phys Con for Load Carriage



# Phys Con for Load Carriage



## Methods: Determining Best Practice

- **Search of the Literature**

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.

# Phys Con for Load Carriage



## Results: Determining Best Practice

- 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).

# Phys Con for Load Carriage



## Results: Determining Best Practice

### **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**

# Phys Con for Load Carriage



## Methods: ARA Data Capture

- **ARA soldiers and units selected via purposive sampling**
- **Soldier self-reported participation in load carriage physical training (PT) was captured via online survey**
- **Textual PT programs were requested from training institutions and operational units.**
  - **On receipt of textual PT programs, relevant data were extracted and each PT session rated from 1 to 4 based on the session's specificity and value to load carriage conditioning**
  - **A rating for each PT session was determined by reviewing the PT session title, dress, nature of the PT activity, and any clarifying comments to describe the lesson.**
- **Ethics approval provided by ADHREC (569/09) and University of Queensland BSSERC (2009001820)**

# Phys Con for Load Carriage



## Results: Programs from Training Establishments

Table 20: Descriptive breakdown of training institution PT programs

Program <sup>81</sup>	Length of Program (Sessions)	Type of Training <sup>82</sup>				Load Carriage (Type 1)		
		1	2	3	4	Freq (per week)	Intensity (minimum to maximum load)	Time (min to max)
A~	11 weeks (38 sessions)	8	7	13	10	Approx 1x week	9.5 kg- 27.5 kg	22 – 77 mins
B~	69 weeks (105 sessions)	18	24	43	20	Inconsistent (e.g. 2 in one week, nil for 2 months)	Up to 47% Body weight	60-165 mins
C	8 weeks (17 sessions)	0	2	10	5	No load carriage PT sessions		
D	12 weeks (20 sessions)	0	1	9	11	No load carriage PT sessions		
E	12 weeks (34 sessions)	3	2	21	8	Inconsistent (weeks 2, 6,8)	PO (?load)	60 – 100 mins
F~	14 weeks (50 sessions)	11	16	11	12	Approximately 1x week for the first 11 weeks	25kg – 32kg	60-165 mins

~ During these programs trainees spent time conducting field training exercises dressed in load carriage equipment



# Phys Con for Load Carriage



## Results: Programs from Operational Units

Table 21: Descriptive breakdown of Unit PT programs

Program 84	Length of Program (Sessions)	Type of Training				Load Carriage (Type 1)		
		1	2	3	4	Freq (per week)	Intensity (minimum to maximum load)	Time (min to max)
A*	6 weeks (12 sessions)	12	0	0	0	2x/1week	7kg to 31kg	40-120 mins
B	6 Weeks (18 sessions)	3	1	13	1	1x/2 weeks	15kg to 20 kg	60 mins
C**	15 weeks (75 sessions)	13	3	43	16	1 per week first 12 weeks	No Information	up to 60 mins
D*~	11 weeks (33 sessions)	8	9	10	6	1 per week first 8 weeks	Patrol Order+	up to 60 mins
E	10 weeks (49 sessions)	0	10	28	11	No load carriage PT sessions		
F	10 weeks (42 sessions)	0	9	19	14	No load carriage PT sessions		
G	8 weeks (31 sessions)	0	8	18	5	No load carriage PT sessions		
H	6 weeks (18 sessions)	0	0	12	6	No load carriage PT sessions		

\*Training for Combat Fitness Assessment

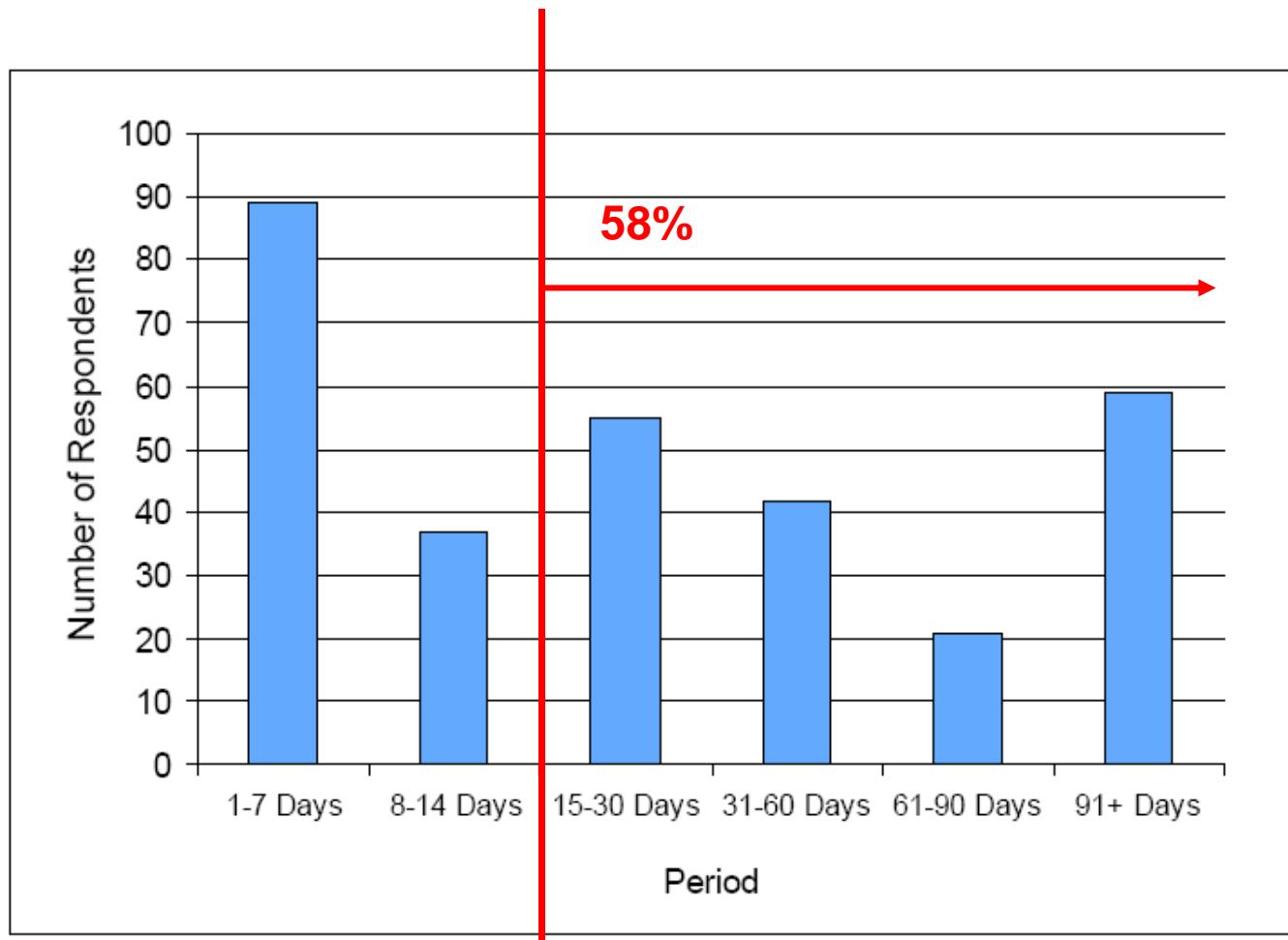
~Included carrying additional stores like Ammunition boxes

†No additional load weight provided

# Phys Con for Load Carriage



Results: Self Reported – Frequency (Last load carriage session)



# Phys Con for Load Carriage



## Results: Self Reported – Intensity (Loads carried)

### ABSOLUTE LOADS

Patrol Order:  $M = 15.5$  ~~kg~~ <sup>31.4kg</sup>

Marching Order:  $M = 36.3$  ~~kg~~ <sup>59.7kg</sup>

### RELATIVE LOADS

Patrol Order:  $M = 18\%$

Marching Order:  $M = 43\%$

# Phys Con for Load Carriage



## Results: Self Reported – Intensity (Loads and Dress)

Table 18: Distribution of loads and equipment by order of dress

Dress		TOTAL	Webbing	Pack	Body Armour*	Helmet*	Weapon*	Stores*
Patrol Order	Respondents (%)	30%	100%	N/A	11%	7%	43%	26%
	Absolute load (kg)	15.3	7.4	N/A	11	1.8	3.6	14.4
	<i>M</i> (SD)	(10.6)	(3.4)		(0)	(0)	(0.2)	(11.8)
Marching Order	Respondents (%)	70%	100%	100%	5%	13%	74%	40%
	Absolute load (kg)	36.3	8.0	23.0	11	1.8	3.7	9.6
	<i>M</i> (SD)	(12.0)	(3.0)	(7.5)	(0)	(0)	(0.5)	(8.3)

\* If worn or carried

# Phys Con for Load Carriage

Results: Self Reported – Intensity (Terrain)

Roads 42%

Dirt/Grass 39%

Light Bush 16%



Flat/Mild Hills 90+%

Steep hills 7%



# Phys Con for Load Carriage



## Results: Self Reported – Intensity (Terrain)

Period	Road	Dirt/Grass	Light bush	Heavy bush	Loose sand	Rock	Other
PT	42%	39%	16%	1%	1%	1%	0%
RECENT OPS	31%	13%	12%	15%	8%	12%	8%

Activity	Flat	Mild hills	Steep hills
PT	38%	56%	7%
RECENT OPS	45%	27%	29%

# Phys Con for Load Carriage



## Results: Self Reported - Time

**< 2h = 79% (50% of these < 1h)**

- **Most fit into 60 min PT sessions**
- **Skewed by the units preparing for CFA (3hrs)**

# Phys Con for Load Carriage



## Results: Self Reported - Type

	<u>Patrol Order (PO)</u>			<u>Marching Order (MO)</u>		
	Load (kg) M (SD)	Relative Load (% body weight) M (SD)	Dressed in PO for task (%)	Load (kg) M (SD)	Relative Load (% body weight)	Dressed in MO for task (%) M (SD)
Endurance						
March	11.5 (5.2)	14 (7)	12	35.8 (12.3)	43 (15)	88
Obstacle Course	12.5 (4.1)	15 (6)	74	38.0 (7.0)	45 (8)	26
Lift & Carry	20.8 (15.0)	24 (16)	76	37.1 (10.7)	44 (11)	24
Combinations	17.0 (11.7)	20 (12)	47	36.4 (11.1)	41 (14)	52
Other	15.0 (12.1)	17 (14)	66	48.5 (10.4)	56 (12)	33



# Phys Con for Load Carriage



## Results: Against Best Practice

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



#### **F. 10-14 days per load carriage session**

- 25% Of Corps Training
  - One of these corps training institutions with NO load carriage over its program was responsible for training a corps identified as carrying some of the heaviest loads.
- 50% of Units (although biased due to CFA prep)
- 42% of respondents



#### **I. 40-50kg at the speeds and over the terrains required**

- Max loads around 35 Kg
- Terrains are mismatched to those more arduous in operations (eg steep hills with thick terrain or rocks/gravel)

# Phys Con for Load Carriage



## Results: Against Best Practice

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



#### T. Duration of load carriage operations

- Much shorter (typically no more than 3 hours (biased to CFA))



#### T. Load carriage preferable, but combined resistance and cardio may be of some benefit



- Endurance marching most common (60%) – foot patrols constitute  $\frac{3}{4}$  of Exercise and Ops tasks
- Complex activities (Marksmanship, throwing etc)

# Phys Con for Load Carriage



## Recommendations

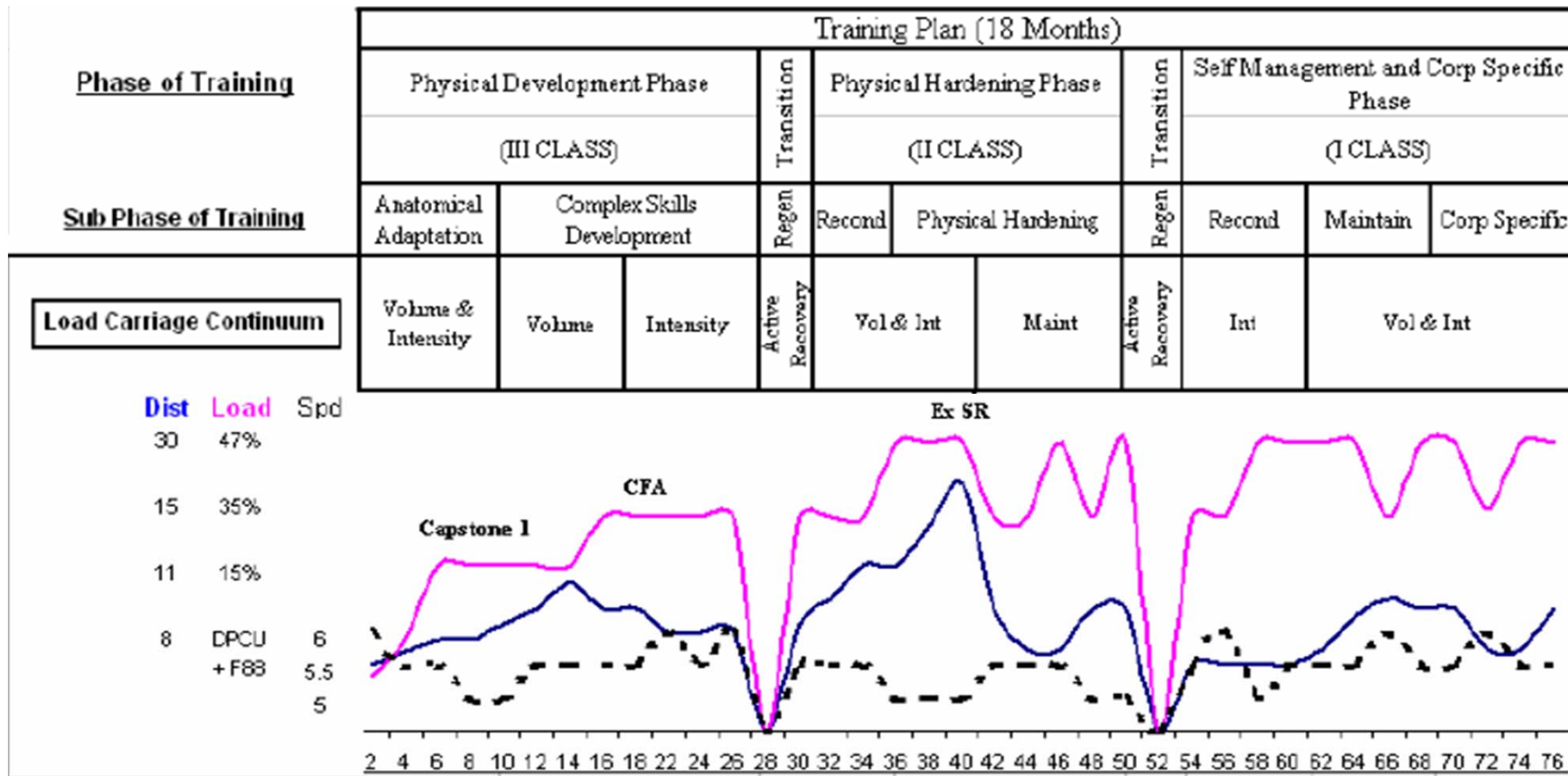
**Load carriage practices in corps training units must be developed to align with Recruit training and begin to prepare soldiers for corps requirements (ARTC → SOInf prime example)**

# EXAMPLE: The RMC PCOR – Periodised Plan

<b>Phase of Training</b>	<b>Training Plan (18 Months)</b>									
	<b>Physical Development Phase</b>		<b>Transition</b>	<b>Physical Hardening Phase</b>		<b>Transition</b>	<b>Self Management and Corp Specific Phase</b>			
	<b>(III CLASS)</b>			<b>(II CLASS)</b>			<b>(I CLASS)</b>			
<b>Sub Phase of Training</b>	Anatomical Adaptation	Complex Skills Development	Regen	Recond	Physical Hardening	Regen	Recond	Maintain	Corp Specific	
<b>Macrocycle</b>	[Orange blocks representing macrocycles]									
<b>Microcycle</b>	[Cyan vertical bars representing microcycles]									
<b>Individual Fitness and Healthy Lifestyle</b>	Metabolic Fitness									
	Neuromuscular Skills and Fitness									
	Injury Prevention									
	Healthy Lifestyle Education									
	Personal Training and Fitness									
<b>Military Specific Fitness</b>	Load Carriage									
	Complex Warfighting Skills and Fitness									
<b>Sports Specific Fitness</b>	[Yellow block]									
<b>Remedial Training and Rehabilitation</b>	[Magenta block]									

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

# EXAMPLE: The RMC PCOR – Load Carriage Continuum



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

# Phys Con for Load Carriage



## Recommendations

**Load carriage practices in units must be progressed to meet those required in training and on operations though best practice (FITT)**

**Physical conditioning for load carriage needs to follow a periodised training cycle to avoid injuries**

**Load carriage should be inculcated into unit daily lifestyle (worn during general duties and lethality training)**

# Phys Con for Load Carriage



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# Phys Con for Load Carriage



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