Presentation Outline

- Training Philosophy and guiding principles
- Needs Analysis
- Strength and power training
- Aerobic training and Repeat sprint ability
- Injury prevention
- Programming and Periodisation

Training Philosophy

- ❑ Defines your beliefs, values and training principles, which drive your actions.
- ❑ Helps you maintain focus and direction and describes why and how you coach.

Abbott et al., (2019). A season long investigation into the effects of injury, match selection and training load on mental wellbeing in professional under 23 soccer players: A team case study. *EJSS*

Carling *et al.*, (2015). Squad management, injury and match performance in a professional soccer team over a championship-winning season. *EJSS*

Ready and Robust

Blagrove et al.,(2017). Strength and conditioning habits of competitive distance runners. *JSCR*

Priorities:

- Training ready, Ops ready
- Career longevity and life after service
- Life outside of work
- Physical capacity

Health, well-being, and coach compassion

Targets injury reduction

Training specificity is overrated. With good training, all roads lead to Rome

Deliver and sustain Technical and Tactical KPI's

My Advice before you start…

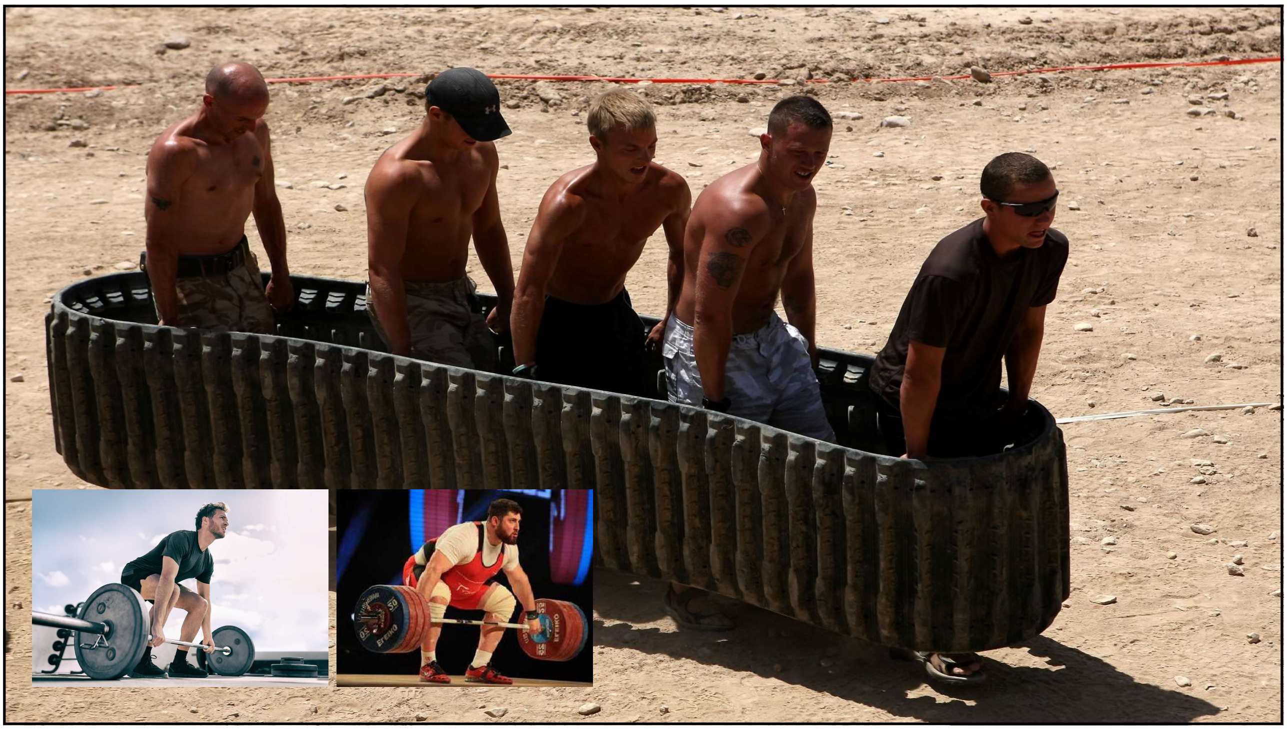
- If you have been in the military (or collected the data) and understand their demands, then feel free to use various stats to describe their role.
- If not, *collectively* make links to typical demands and exercises
  - Ask questions, you are a civilian, they know you need help connecting the dots.
  - The Military has only recently started to employ civilian SMEs, so training is still largely based on tradition, emphasising aerobic training over strength training – your job is to justify change and create buy-in
- Be good at training large groups with minimal equipment (this need also explains the previous point)
- Some do not like to be referred to athletes. And never again use the term "in the trenches" when referring to coaches or athletes!

Needs Analysis

Start by asking what they believe are the fundamental physical characteristics of a good soldier

- ✓ Strength
- ✓ Speed
- ✓ Power
- ✓ Agility
- ✓ Repeat Sprint Ability (Anaerobic endurance)
- ✓ Aerobic Capacity
- ✓ Mobility
- ✓ Robustness


Snap Downs

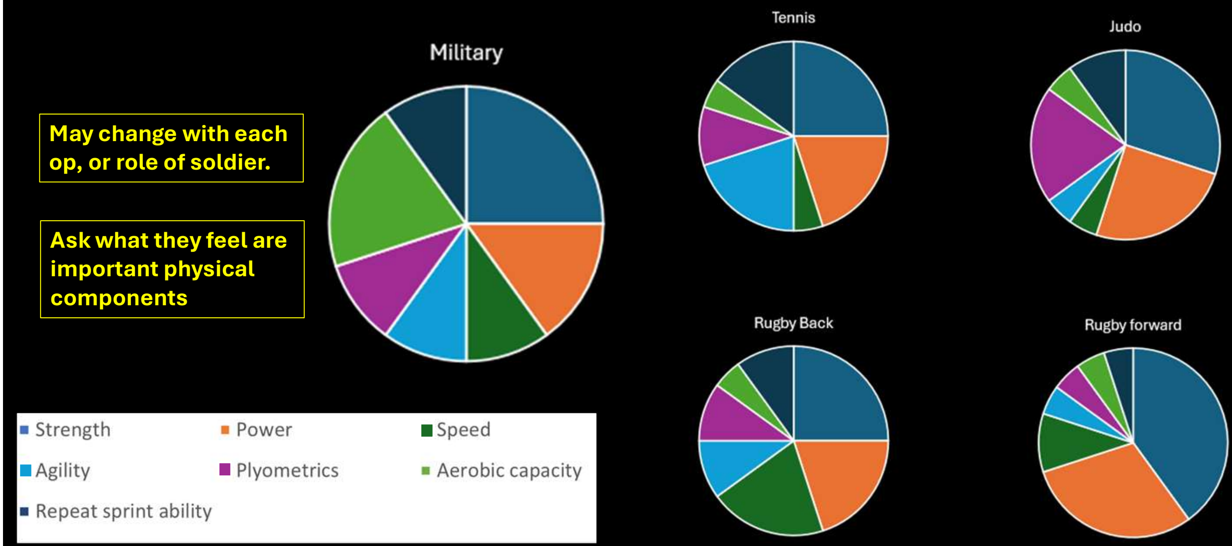


% of each type of training delivered by the S&C coach

(Hypothetical/totally made-up!)

May change with each op, or role of soldier.

Ask what they feel are important physical components

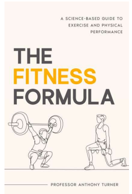


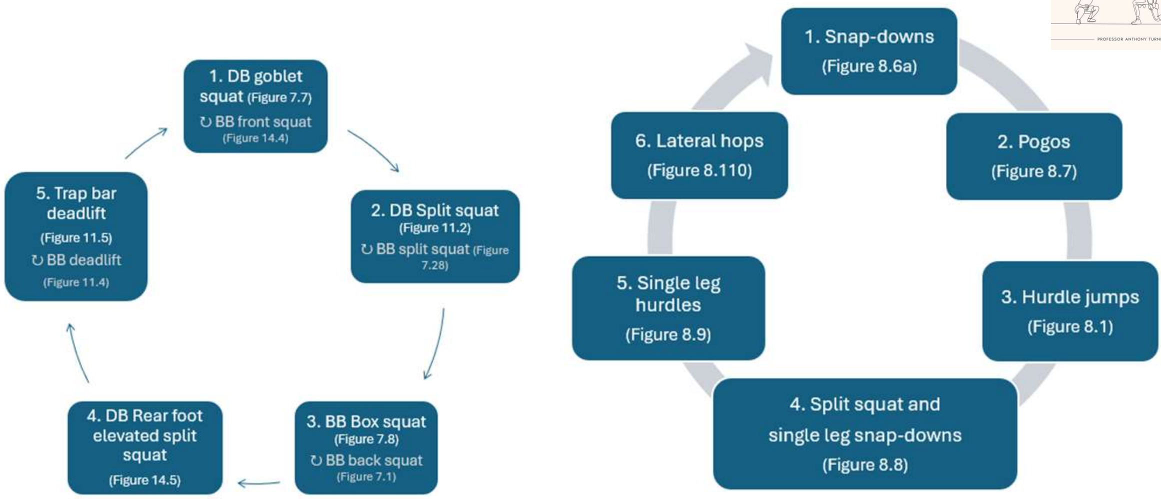
Can you be too sport/demand specific!?

Focus on the stimulus not the movement

(kinetics and physiological adaptations are key)

Irrespective of demand, I have a preferred coaching progression (a best guess plan to get going with)





But of course, you adapt to the individual and no plan survives first contact!

Question…

- Is running 1.5miles the same as tabbing 1.5miles?
- Can some people complete the tab but not the run?
- Which is a better predictor of on-ops performance?

Who would you pick?

- Run 1.5miles?
- DL 60kg?
- Tab 1.5miles… with 60kg?
- *A high aerobic capacity is important, but need to consider how it is developed considering modern-day warfare*

The military has an absolute Demand.

How heavy is a Bergen to you?

Strength and Conditioning Journal

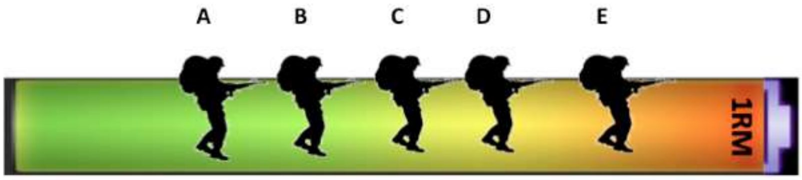
Strength and Conditioning for British Soldiers

Anthony Turner, PhD, MSc, PGCE, ASCC, CSCS*D
Department of Science and Technology, London Sport Institute, Middlesex University, London, England

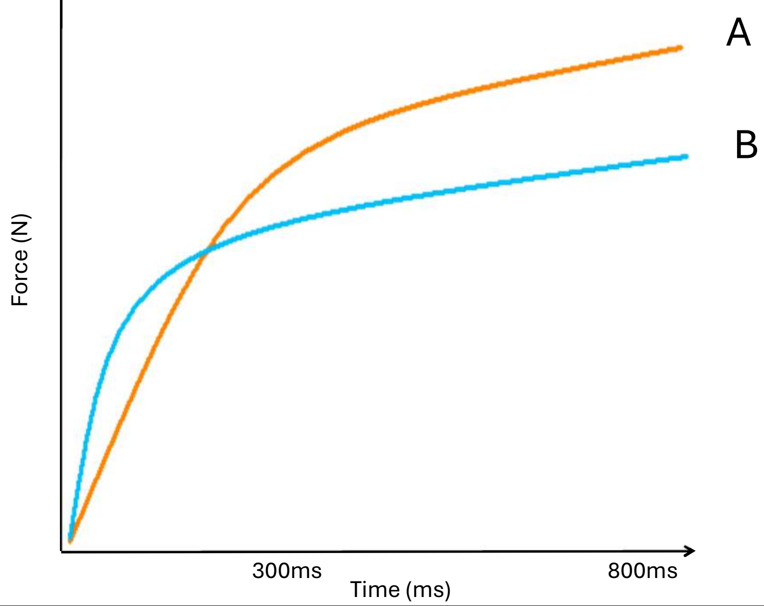
1 - 10 Borg Rating of Perceived Exertion Scale	
0	Rest
1	Really Easy
2	Easy
3	Moderate
4	Sort of Hard
5	Hard
6	
7	Really Hard
8	
9	Really, Really, Hard
10	Maximal: Just like my hardest race

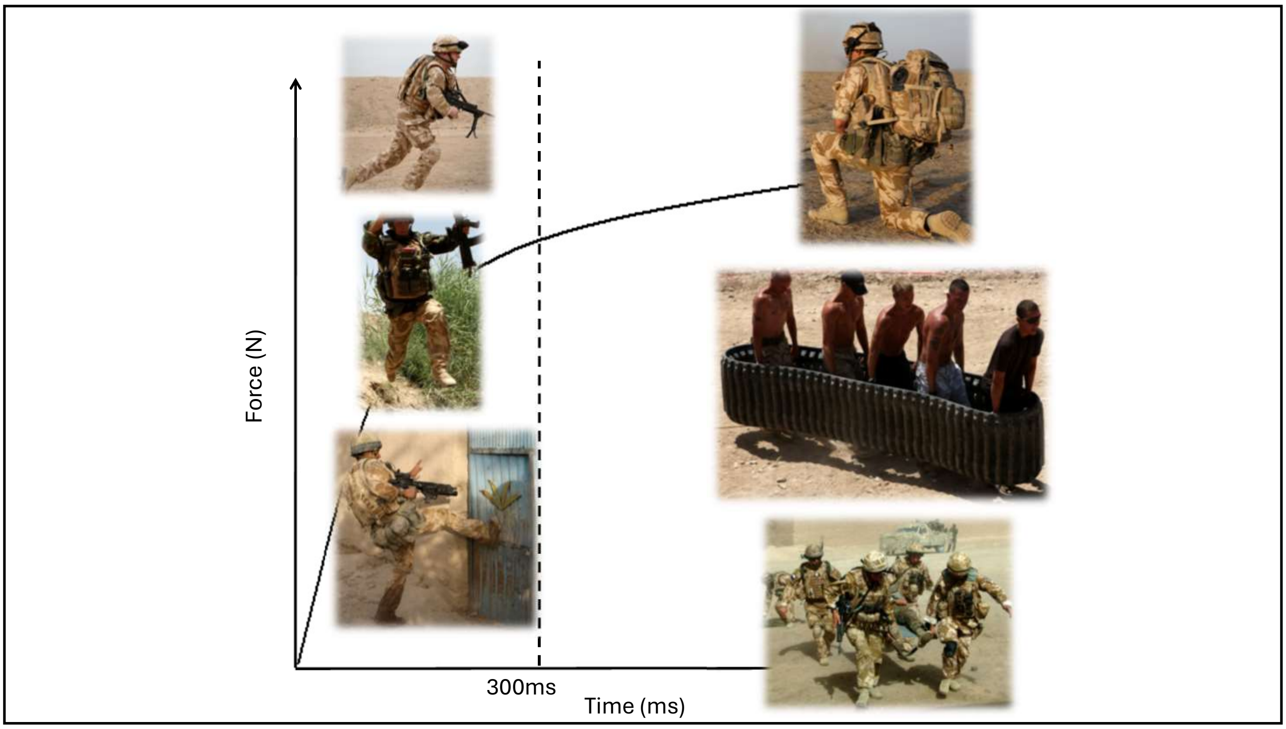
Based on a load carriage of 50kg, the data below represents this load as percentage of a soldier's 1RM in the back squat; the data is also represented graphically. One would assume that the less this load taxes your 1RM, the greater muscle mass and energy reserves you have for subsequent tasks.

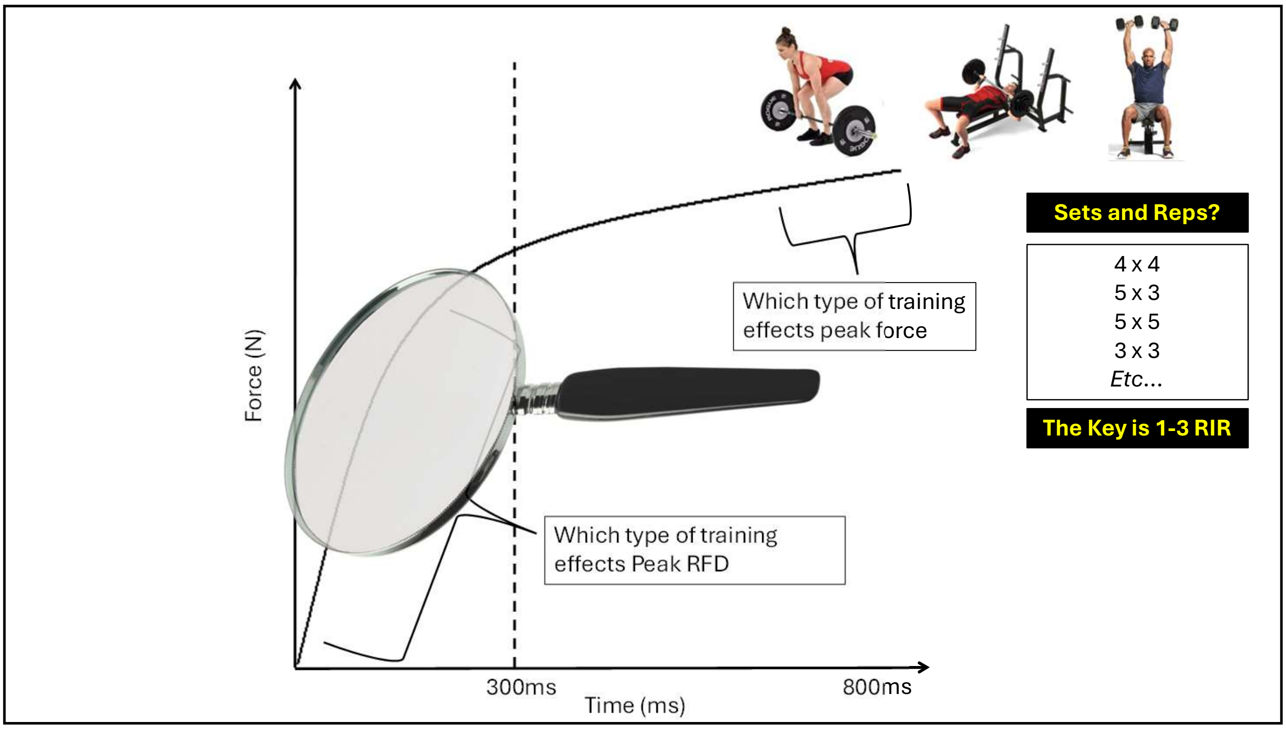
Soldier	A	B	C	D	E
1RM squat	140kg	120kg	100kg	80kg	60kg
Load/RM %	36%	42%	50%	62%	83%



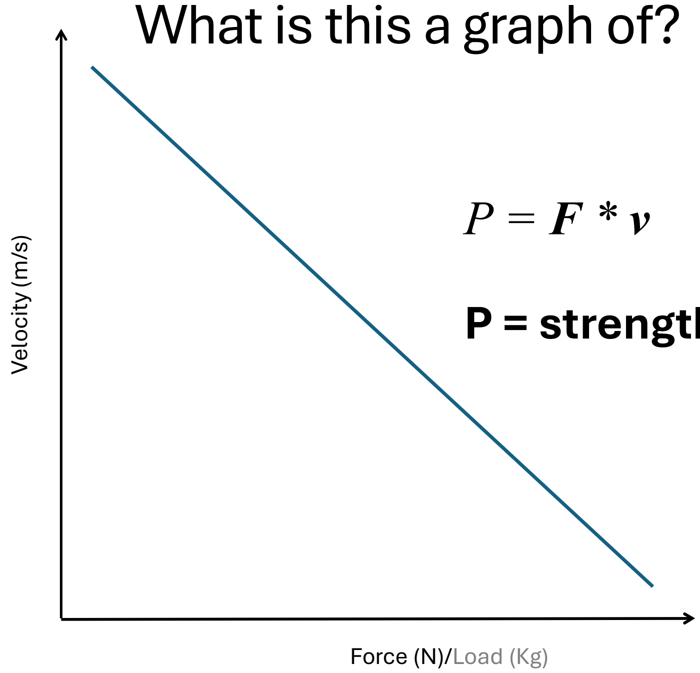
Which Soldier would you rather be?




Force (N)
300ms
Time (ms)


Force (N)
Which type of training effects peak force
Which type of training effects Peak RFD
Sets and Reps?
4 x 4
5 x 3
5 x 5
3 x 3
Etc…
The Key is 1-3 RIR
300ms
800ms
Time (ms)

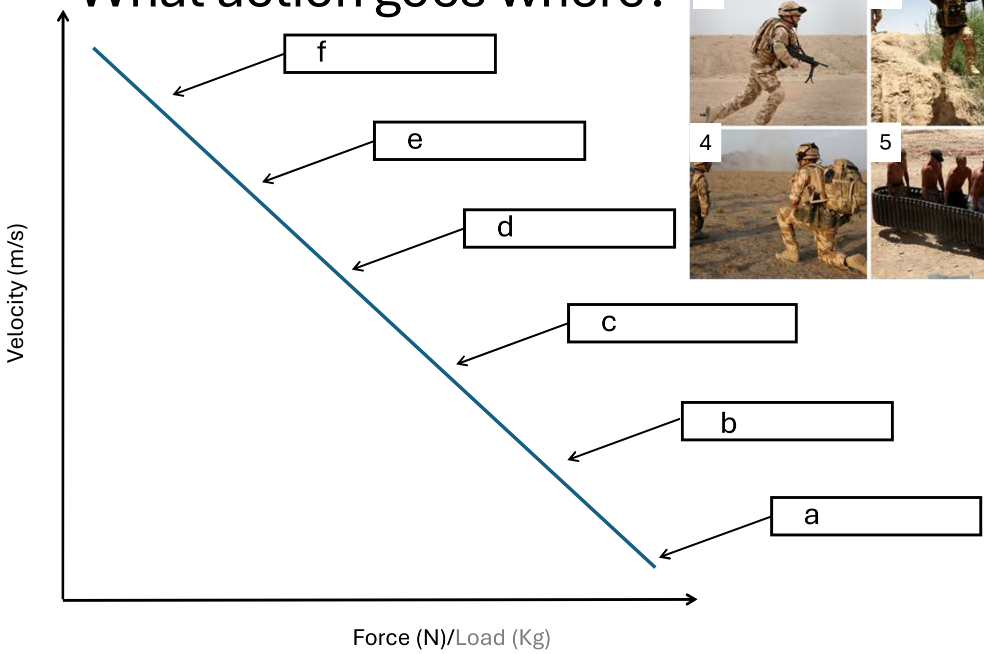
What is this a graph of?

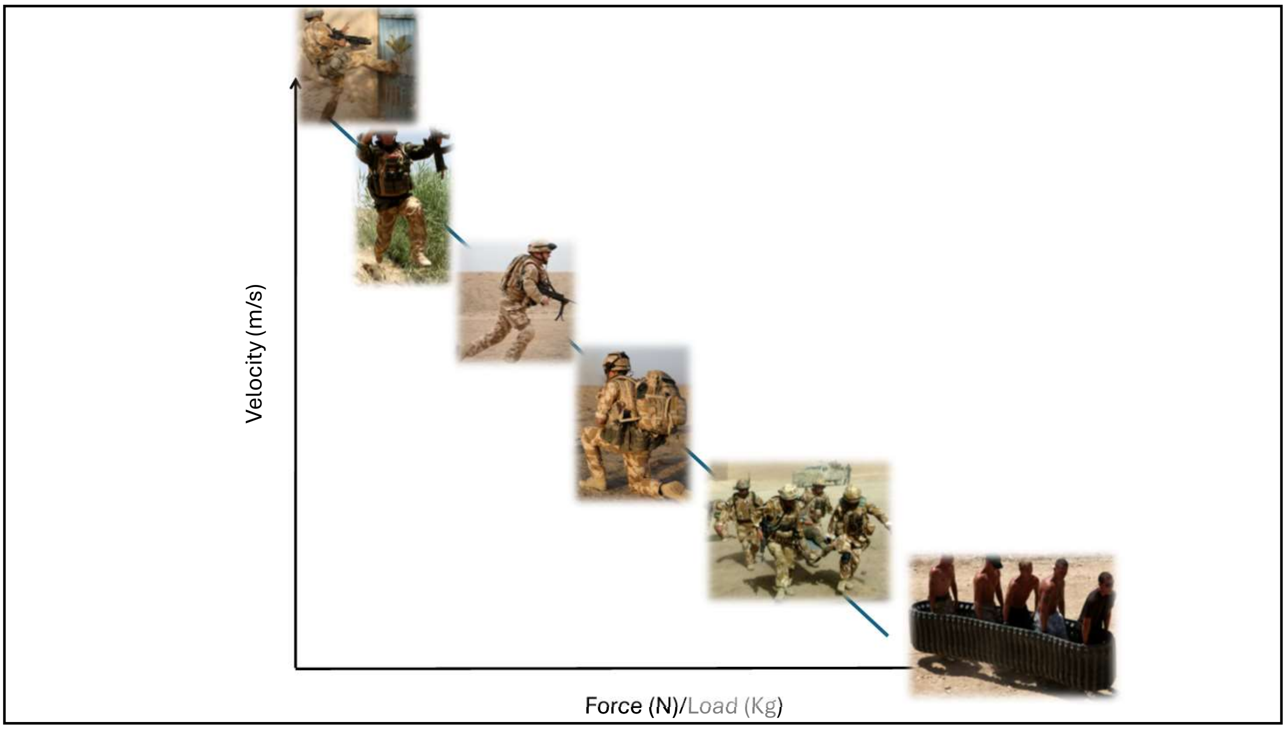


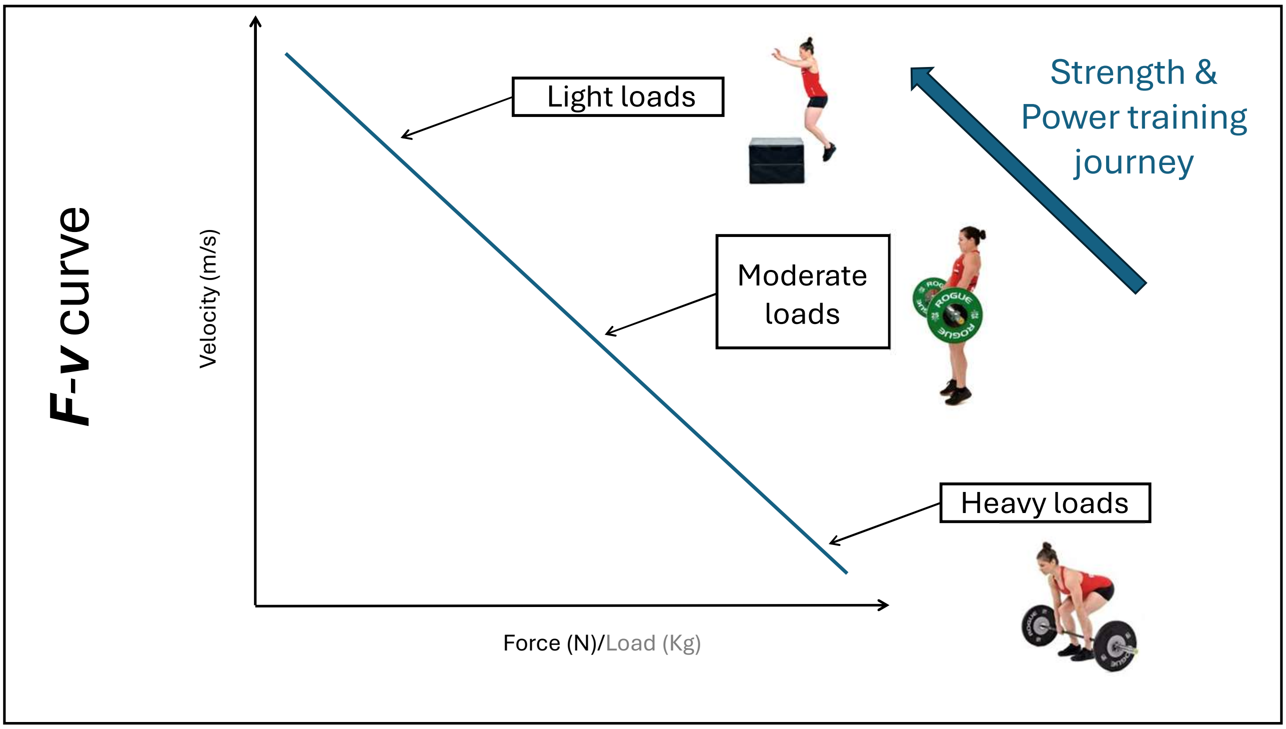
$P = \boldsymbol{F} * \boldsymbol{v}$

P = strength x speed

What action goes where?

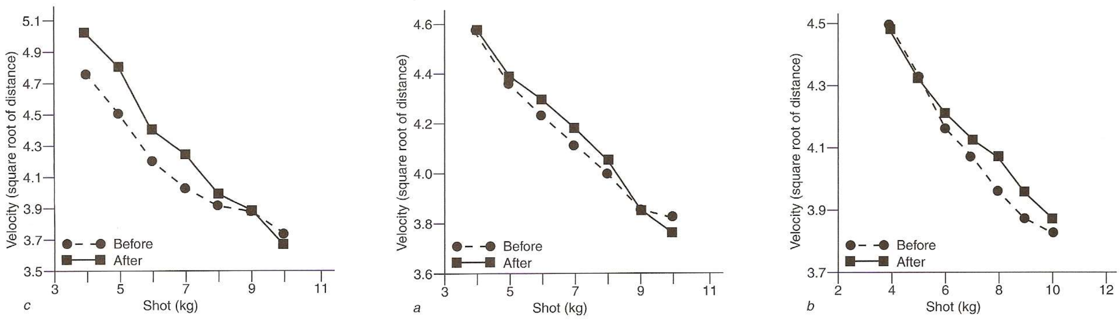



Velocity (m/s)
Force (N)/Load (Kg)

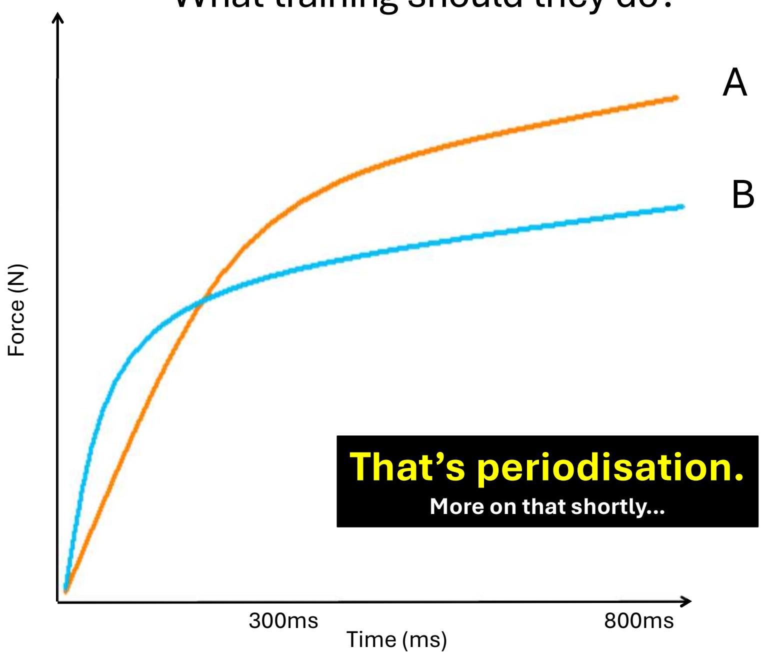

F-v curve
Velocity (m/s)
Light loads
Moderate loads
Heavy loads
Strength & Power training journey
Force (N)/Load (Kg)

Shot Put

Which graph is which: heavy, light or standard?



What training should they do?



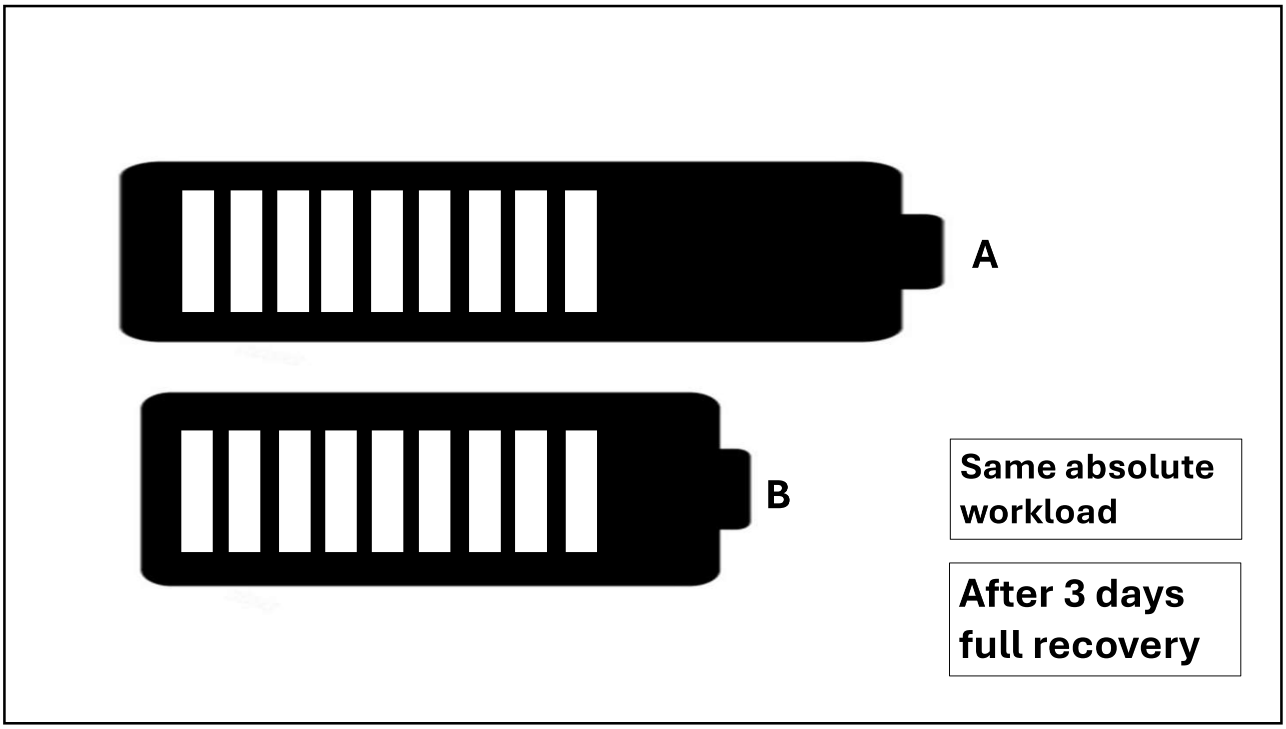
That's periodisation.
More on that shortly…

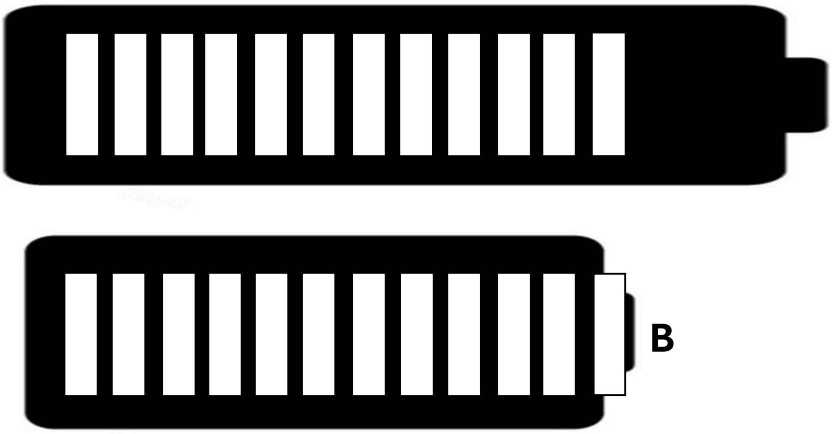
Strength sets the upper limit

Train strength
↓
Train Power
↓
Train strength
↓
Train Power

Forever!


Fitter, Stronger, Faster:
Athleticism and Injury Risk
Malone, S., Hughes, B., Doran, D.A., Collins, K. and Gabbett, T.J., 2018. Can the workload–injury relationship be moderated by improved strength, speed and repeated-sprint qualities?. Journal of Science and Medicine in Sport.
@shakebotapp
40 amateur male hurling players had their training loads, injuries, and physical capabilities monitored over 2 consecutive seasons
Fitness
Fitter athletes had lower injury risk, compared with less-fit athletes.
Repeated Sprint Ability (RSA) Times
30.0s
30.5 - 34.0s
1.5x risk
34.5 - 36.0s
3.2x risk
36.5 0 - 40.0s
5.1x risk
Strength
Stronger athletes (relative to bodyweight) had lower injury risk, compared with weaker athletes.
Trapbar Deadlift 3RM, relative to body mass
3x BW
2.5-2.9x BW
1.8x risk
1.7-2.4x BW
2.6x risk
1.0-1.7x BW
6.1x risk
Speed
Faster athletes had lower injury risk, compared with slower athletes.
20-meter Sprint Times
2.85s
2.85-2.89s
2.1x risk
2.89-3.01s
3.1x risk
>3.01s
4.6x risk


A
B
Same absolute workload
After 3 days full recovery



After only 1 day's recovery

Then they go again…

And again…

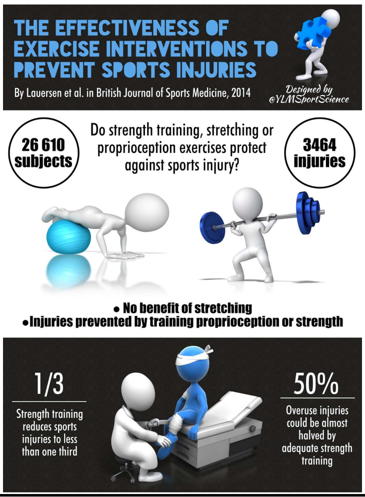
And again…

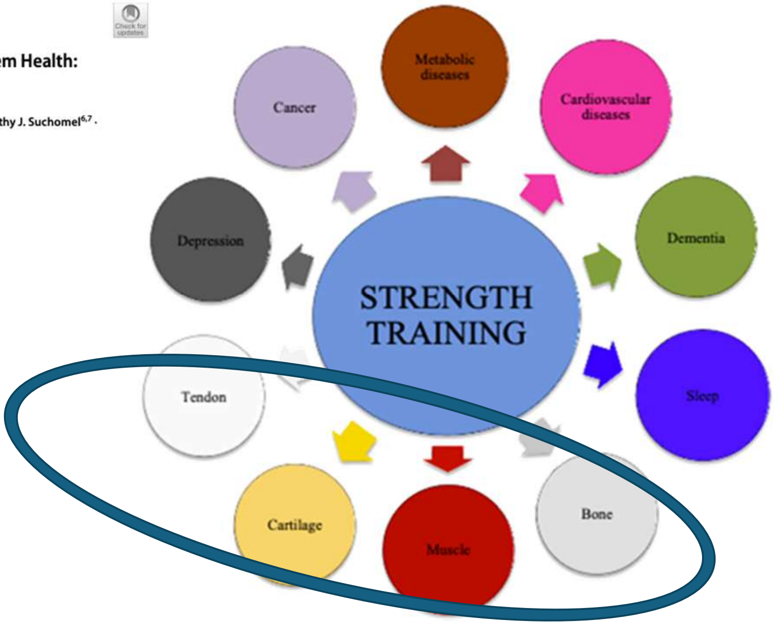
Sports Medicine (2020) 50:1431–1450
https://doi.org/10.1007/s40279-020-01309-5

REVIEW ARTICLE

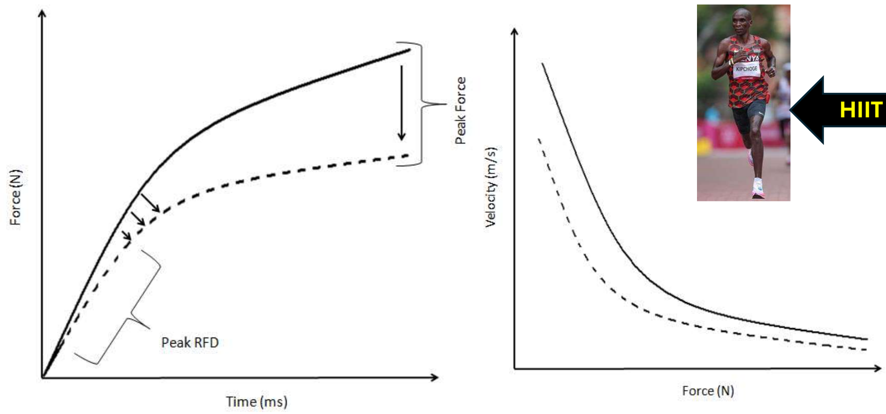
The Benefits of Strength Training on Musculoskeletal System Health: Practical Applications for Interdisciplinary Care

Luca Maestroni[1,2,3] · Paul Read[4,5] · Chris Bishop[3] · Konstantinos Papadopoulos[3] · Timothy J. Suchomel[6,7] · Paul Comfort[7,8,9] · Anthony Turner[3]





What type of training causes the dash?

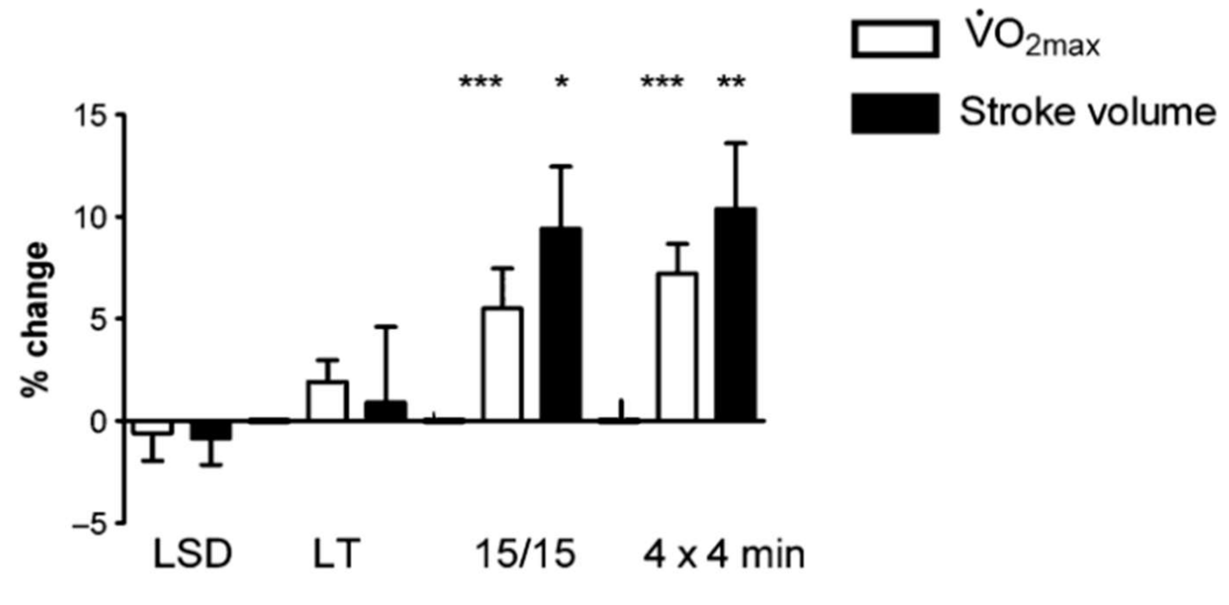


How do we meet in the middle

Aerobic High-Intensity Intervals Improve $\dot{V}O_{2max}$ More Than Moderate Training

JAN HELGERUD[1,2], KJETILL HØYDAL[1], EIVIND WANG[1], TRINE KARLSEN[1], PÅLR BERG[1], MARIUS BJERKAAS[1], THOMAS SIMONSEN[1], CECILIES HELGESEN[1], NINAL HJORTH[1], RAGNHILD BACH[1], and JAN HOFF[1,3]

Training Group	Protocol	Training Intensity	Pre-training VO_2max	Post-Training VO_2max
Long slow distance running (LSD)	continuous run at 70% HRmax for 45 min.	Low	55.8 ± 6.6 (ml/kg/min)	56.8 ± 6.3 (ml/kg/min)
Lactate threshold running (LT)	continuous run at lactate threshold (85% HRmax) for 24.25 min.	Moderate	59.6 ± 7.6 (ml/kg/min)	60.8 ± 7.1 (ml/kg/min)
15/15 interval running (15/15)	47 repetitions of 15-s intervals at 90–95% HRmax with 15-s of active resting periods at warm-up velocity, corresponding to 70% HRmax between.	High	60.5 ± 5.4 (ml/kg/min)	64.4 ± 4.4 (ml/kg/min) 5.5% increase*
4 x 4-min interval running (4 x 4 min)	4 x 4-min interval training at 90–95% HRmax with 3 min of active resting periods at 70% HRmax between each interval.	High	55.5 ± 7.4 (ml/kg/min)	60.4 ± 7.3 (ml/kg/min) 7.3% increase*

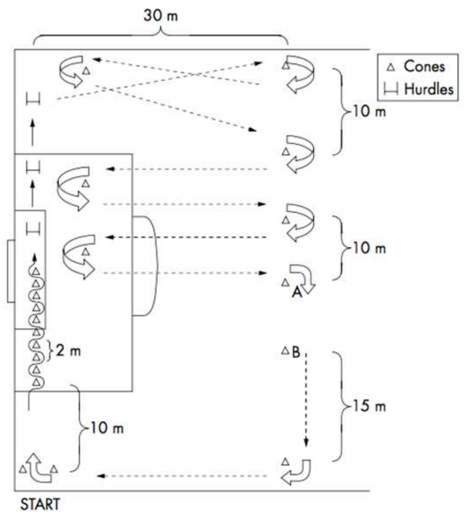


ORIGINAL ARTICLE

Soccer specific aerobic endurance training

J Hoff, U Wisløff, L C Engen, O J Kemi, J Helgerud

Br J Sports Med 2002;36:218–221



J Physiol 575.3 (2006) pp 901–911

Short-term sprint interval *versus* traditional endurance training: similar initial adaptations in human skeletal muscle and exercise performance

Martin J. Gibala[1], Jonathan P. Little[1], Martin van Essen[1], Geoffrey P. Wilkin[1], Kirsten A. Burgomaster[1], Adeel Safdar[2], Sandeep Raha[2] and Mark A. Tarnopolsky[2]

6 training sessions over 14 days

Table 2. Training protocols

Parameter	SIT group	ET group
Work intensity	'All out' supramaximal (~700 w)	65% $\dot{V}_{O_2 peak}$ (~175 w)
Exercise protocol (per session)	30 s × 4–6 repeats, 4 min recovery	90–120 min of continuous exercise
Total exercise/training time commitment per session	2–3 min (intervals only) 18–27 min (incl. recovery)	90–120 min
Total exercise/training time commitment over 2 weeks	15 min (intervals only) 135 min (incl. recovery)	630 min
Total exercise volume[1] over 2 weeks	~630 kJ (intervals only) ~950 kJ (incl. recovery)[2]	~6500 kJ

SIT, sprint interval training; ET, endurance training; $\dot{V}_{O_2 peak}$, peak oxygen uptake. [1]Based on average workloads sustained during training and [2]assuming subjects cycled at the highest workload permitted during recovery (30 W) for the maximum duration (4 min) after every interval performed during training (total of 30 intervals over 2 weeks).

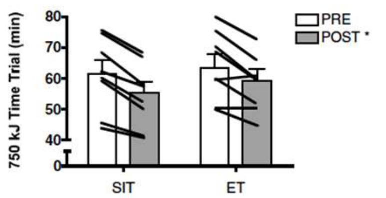


Figure 1. 750 kJ cycling time trial performance before (PRE) and after (POST) 6 sessions of sprint interval training (SIT) or endurance training (ET) over 2 weeks
*$P \leq 0.05$ *versus* pre-training (main effect for time). Lines denote individual data for 8 subjects in each group.

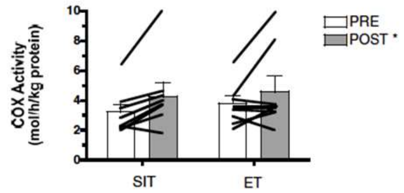


Figure 2. Maximal activity of COX measured in resting muscle biopsy samples obtained before (PRE) and after (POST) 6 sessions of sprint interval training (SIT) or endurance training (ET) over 2 weeks
*$P \leq 0.05$ *versus* pre-training (main effect for time). Lines denote individual data for 8 subjects in each group.

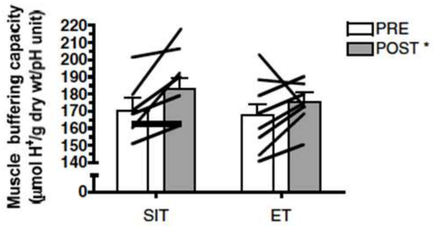


Figure 4. Skeletal muscle buffering capacity measured in resting muscle biopsy samples before (PRE) and after (POST) 6 sessions of sprint interval training (SIT) or endurance training (ET) over 2 weeks
*$P \leq 0.05$ *versus* pre-training (main effect for time). Lines denote individual data for 8 subjects in each group.

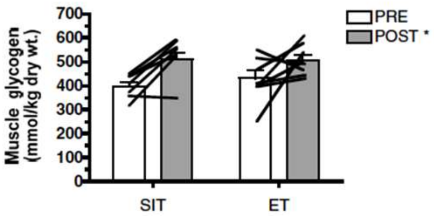


Figure 5. Resting muscle glycogen content before (PRE) and after (POST) 6 sessions of sprint interval training (SIT) or endurance training (ET) over 2 weeks
*$P \leq 0.05$ *versus* pre-training (main effect for time). Lines denote individual data for 7 subjects in SIT group and 8 subjects in ET group.

J Physiol 586.1 (2008) pp 151–160

Similar metabolic adaptations during exercise after low volume sprint interval and traditional endurance training in humans

Kirsten A. Burgomaster[1], Krista R. Howarth[1], Stuart M. Phillips[1], Mark Rakobowchuk[1], Maureen J. MacDonald[1], Sean L. McGee[2] and Martin J. Gibala[1]

Over 6 weeks

Table 2. Summary of sprint interval training (SIT) and endurance training (ET) protocols

Variable	SIT Group ($n = 10$)	ET Group ($n = 10$)
Protocol	30 s × 4–6 repeats, 4.5 min rest (3 × per week)	40–60 min cycling (5 × per week)
Training intensity (workload)	'All out' maximal effort (~500 W)	65% of $\dot{V}_{O_2peak}$ (~150 W)
Weekly training time commitment	~10 min (~1.5 h including rest)	~4.5 h
Weekly training volume	~225 kJ	~2250 kJ

$\dot{V}_{O_2peak}$, peak oxygen uptake.

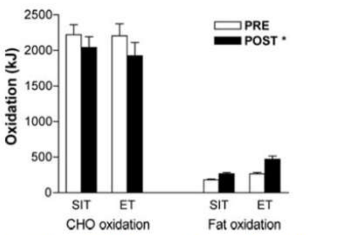
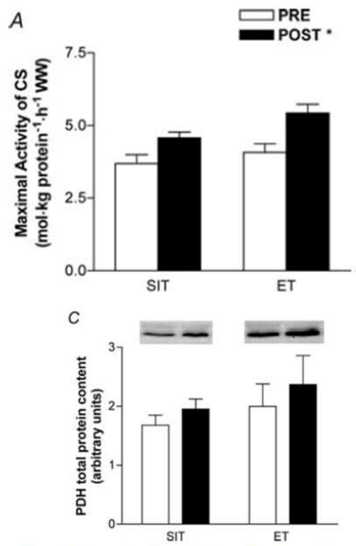


Figure 1. Whole-body carbohydrate and fat oxidation during exercise that consisted of 60 min at 65% $\dot{V}_{O_2peak}$ before (PRE) and after (POST) 6 weeks of sprint interval training (SIT) or 6 weeks of endurance training (ET)
Values are means ± S.E.M. ($n = 10$ per group). *Main effect for condition ($P < 0.05$), such that carbohydrate and fat oxidation PRE and POST are different.



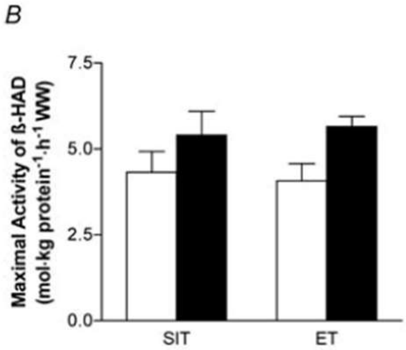


Figure 2. Maximal activity or total protein content of mitochondrial enzymes citrate synthase (CS; *A*), 3-hydroxyacyl CoA dehydrogenase (β-HAD; *B*) and pyruvate dehydrogenase (PDH; *C*) measured in biopsy samples obtained before (PRE) and after (POST) 6 weeks of sprint interval training (SIT) or 6 weeks of endurance training (ET)
Values are means ± S.E.M. ($n = 10$ per group); WW, wet weight. *Main effect for condition ($P < 0.05$), such that post-training (POST) > pretraining (PRE).

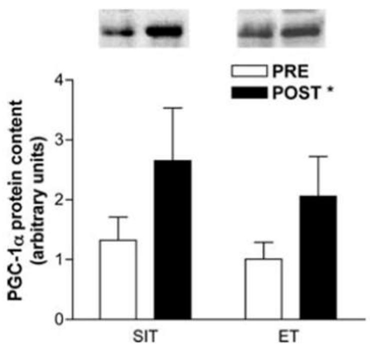


Figure 3. Total protein content of PGC-1α measured in biopsy samples obtained before (PRE) and after (POST) 6 weeks of sprint interval training (SIT) or 6 weeks of endurance training (ET)

Values are means ± S.E.M. ($n = 10$ per group); WW, wet weight. *Main effect for condition ($P < 0.05$), such that post-training (POST) > pretraining (PRE).

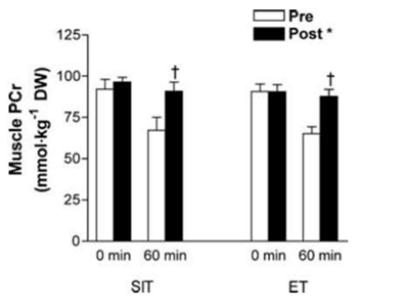
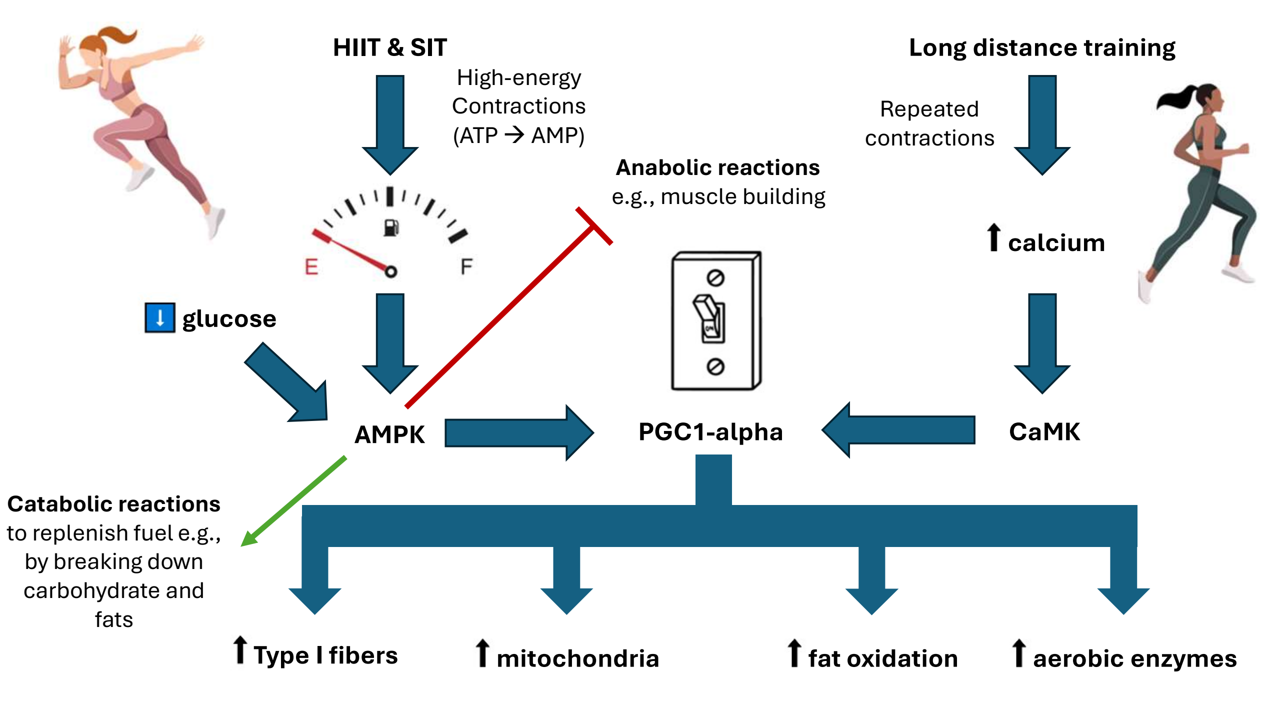
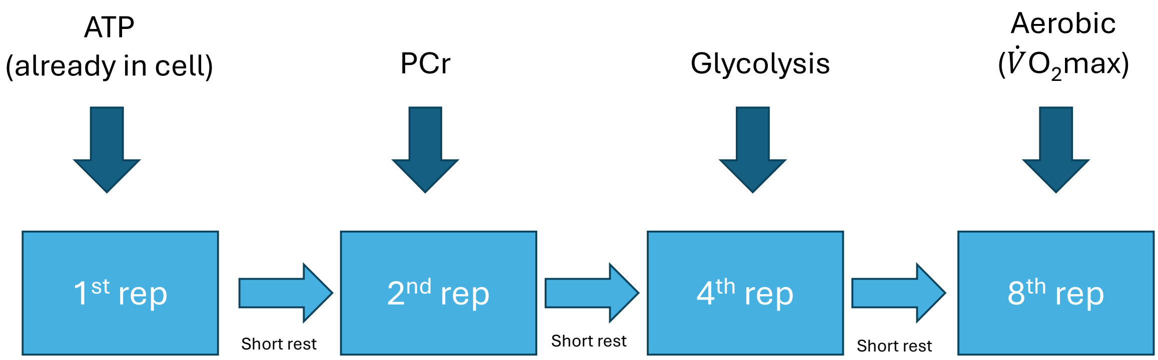


Figure 5. Muscle phosphocreatine (PCr) concentration measured at rest and during cycling exercise that consisted of 60 min at 65% $\dot{V}_{O_2peak}$ before (Pre) and after (Post) 6 weeks of sprint interval training (SIT) or 6 weeks of endurance training (ET)

Values are means ± S.E.M. ($n = 10$ per group); DW, dry weight. *Main effect for condition ($P < 0.05$), such that post-training (Post) > pretraining (Pre). †Condition (Pre and Post) × time (0 and 60 min) interaction ($P < 0.05$), such that Post 60 min > Pre 60 min in both groups.

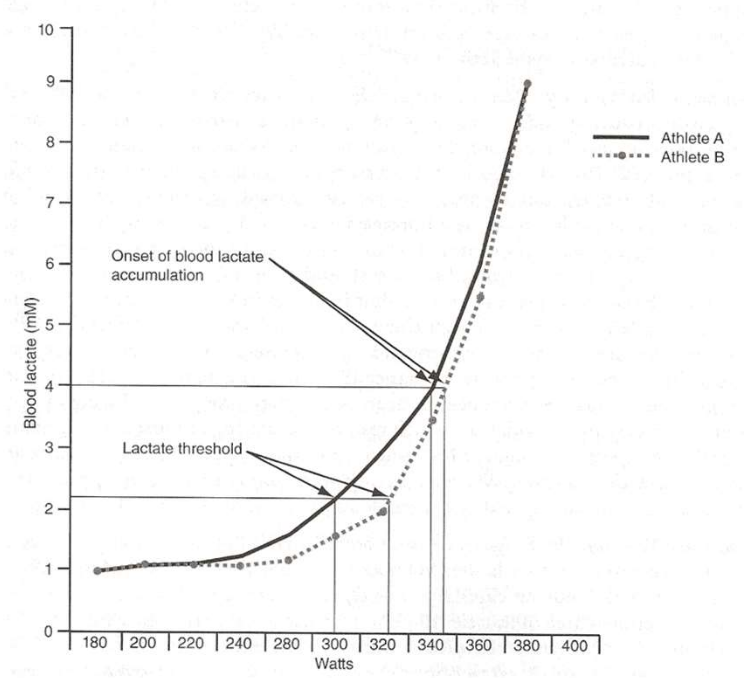


Really Crude Continuum



Training Focus	Training plan	Rationale
Phosphocreatine System	Gym based strength and power Track based max speed and acceleration Repeated bouts (6 – 12) of ~ 4-s, with ~ 30-s rest ≥ 2-min intervals, separated by relatively shorter rest periods e.g., 1 min, and ≥ 4 reps 4 x 4, MAS training and SIT	Increase initial sprint speed May increase PCr stores by virtue of increased type II fiber concentration Reduced effort through increases in strength, power (including RFD and SSC mechanics) and technical proficiency Increases in aerobic capacity and thus creatine shuttle efficiency
Anaerobic Glycolysis	Maximal intensity 30-s intervals, separated by > 4 min to ensure subsequent intervals are again maximally utilizing anaerobic glycolytic enzymes	Maximally activate and thus adapt key enzymes, e.g., PFK and phosphorylase
Muscle buffer capacity	Repeated bouts (~ 6) of 30 – 60-s intervals, with work to rest ratio of 1:1. Utilise a passive recovery	Increase and accumulation of H^+ and thus buffer capacity. Increases PDH and vOBLA
Aerobic system	Longer duration (≥ 2-min) intervals (at ~ VO2max), separated by relatively shorter rest periods, and ≥ 4-reps 4 x 4, MAS and SIT	Improve PCr resynthesis via the creatine shuttle, mitochondrial biogenesis, and enhanced blood flow (SV).

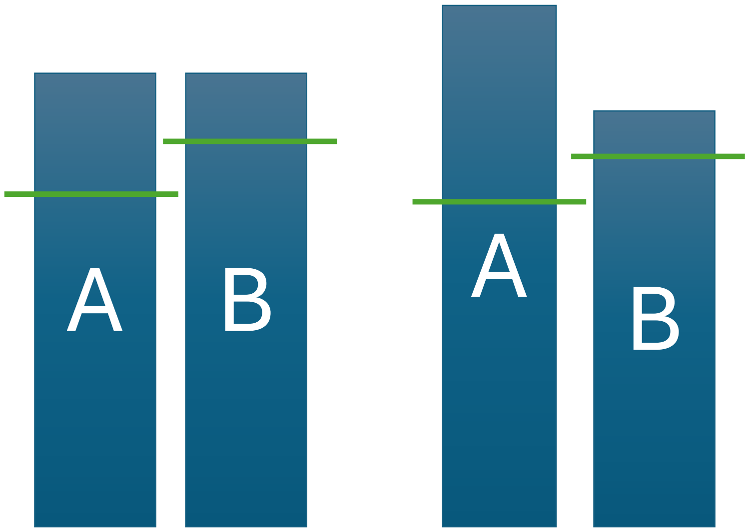
Lactate Threshold

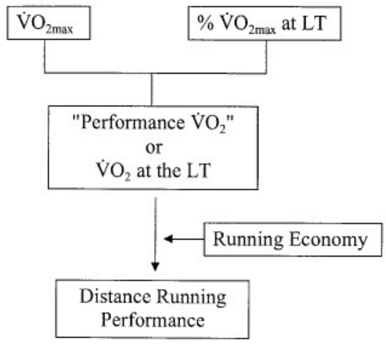


LT

- Narrow range of $\dot{V}O_2$max within elite athletes
- Therefore, unlikely to differentiate performance
- ↓ $\dot{V}O_2$max may be compensated by ability to work at a ↑ %
- Therefore '*performance* $\dot{V}O_2$'

Who Will Win the Race?

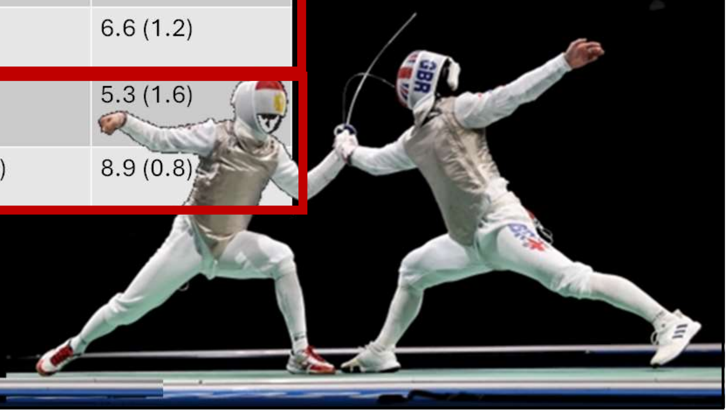




(Basset and Howley, 2000)

Off-feet or speed and agility-based conditioning

Mode	%Time > 80% HRmax	Blood Lactate (mmol/L)	sRPE (10 pt)
Pool (5 hits)	68	3.1 (1.3)	5.7 (1.3)
Elimination (15 hits)	74	3.6 (1.0)	8.5 (1.3)
Sparring (5 hits)	34	2.2 (1.8)	6.0 (0.9)
Sparring 15 hits	40	2.8 (1.6)	6.6 (1.2)
Sport Specific drill	32	2.1 (1.1)	5.3 (1.6)
30-30-6	83	12.6 (2.2)	8.9 (0.8)



12 weeks, 3/wk
SIT: 3 x 20 @ max
MICT: 45 min @ 70% HRmax

RESEARCH ARTICLE

Twelve Weeks of Sprint Interval Training Improves Indices of Cardiometabolic Health Similar to Traditional Endurance Training despite a Five-Fold Lower Exercise Volume and Time Commitment

Jenna B. Gillen[1], Brian J. Martin[1], Martin J. MacInnis[1], Lauren E. Skelly[1], Mark A. Tarnopolsky[1,2], Martin J. Gibala[1]*

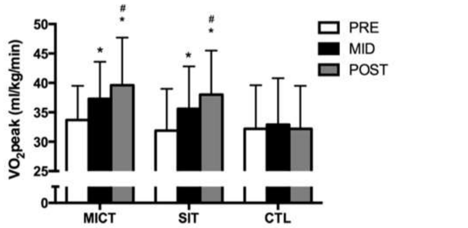


Fig 1. Effect of SIT and MICT on VO_2peak. Measured at baseline (PRE), 6 weeks (MID), and 12 weeks (POST) in MICT, SIT and CTL. Values are means ± S.D. * p<0.05, vs. same group at PRE; # p<0.05, vs. same group at MID.

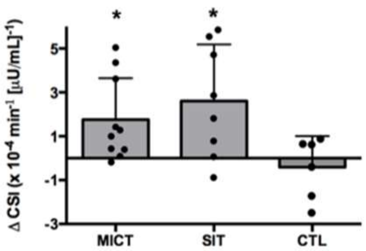
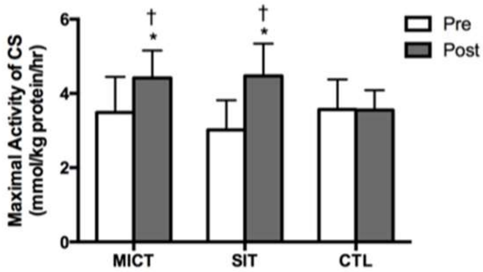
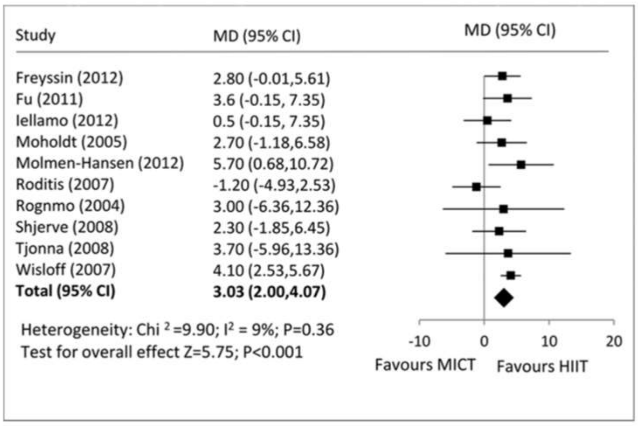


Fig 2. Effect of SIT and MICT on insulin sensitivity. The change in insulin sensitivity (CS_I) over the 12-week intervention, measured from a 50-minute IVGTT in MICT, SIT and CTL. Closed circles denote individual responses. Values are means ± S.D. * p<0.05, PRE vs. POST.



High-intensity interval training in patients with lifestyle-induced cardiometabolic disease: a systematic review and meta-analysis

Kassia S Weston,[1] Ulrik Wisløff,[2] Jeff S Coombes[1]



Box 1 Adaptations occurring significantly more with HIIT compared to MICT

- ↑VO_2peak
- ↓Systolic and diastolic blood pressure
- ↑High density lipoproteins
- ↓Triglycerides and fasting glucose
- ↓Oxidative stress and inflammation
- ↓FATP-1 and FAS
- ↑Adiponectin, insulin sensitivity and β-cell function
- ↑PGC-1α
- ↑Maximal rate of Ca^{2+} reuptake
- ↑Availability of nitric oxide
- ↑Cardiac function
- ↑Enjoyment of exercise
- ↑Quality of life

FATP-1, fatty acid transport protein 1; FAS, fatty acid synthase; HIIT, high-intensity interval training; MICT, moderate-intensity continuous training

Table 2 Protocol recommendations for HIIT

Frequency	3×/Week
Duration	40 min
Modality	Treadmill/hill, cycle ergometer. Increasing speed or incline
Intensity	Interval=85–95% PHR Rest=passive–70% PHR
Interval times	4×4 min intervals 3×3 min recovery
Warm-up	10 min at 60% PHR
Cool-down	5 min at 50% PHR

HIIT, homeostasis model assessment-insulin resistance; PHR, peak heart rate.

Exercise Physiology

Cardiovascular Risk of High- Versus Moderate-Intensity Aerobic Exercise in Coronary Heart Disease Patients

Øivind Rognmo, PhD; Trine Moholdt, PhD; Hilde Bakken, BSc; Torstein Hole, MD, PhD; Per Mølstad, MD, PhD; Nils Erling Myhr, BSc; Jostein Grimsmo, MD, PhD; Ulrik Wisløff, PhD

Table 1. The Number of Patients, Exercise-Hours, and the Corresponding Number of Cardiovascular Events Associated With Moderate- and High-Intensity Exercise, Respectively

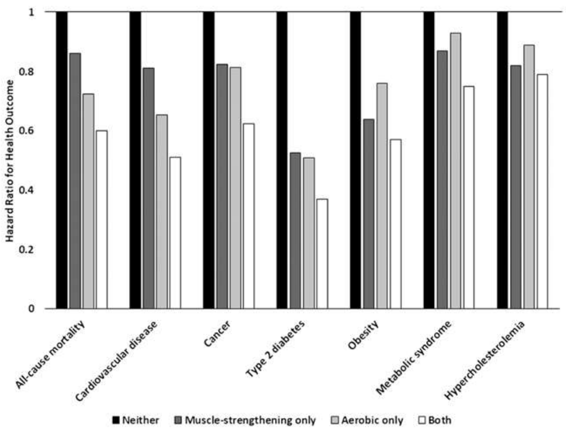
Center	Patients, n	Total Training, h	Moderate Intensity, h	High Intensity, h
Ålesund	775	25 720 (1)	15 232	10 488 (1)
Feiring	2629	85 208 (2)	63 032 (1)	22 176 (1)
Røros	1442	64 892	51 192	13 700
Total	4846	175 820	129 456	46 364
Event rates				
Cardiac arrest, fatal			1	0
Cardiac arrest, nonfatal			0	2
Myocardial infarction			0	0
Risk of events		1/58 607	1/129 456	1/23 182

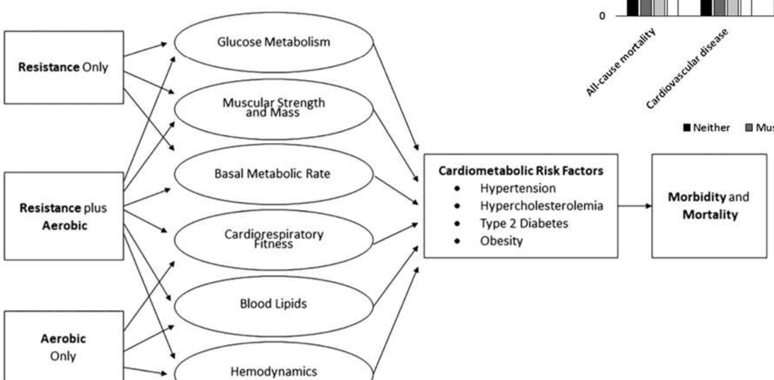
The numbers in parentheses indicate the number of events in each center according to intensity.

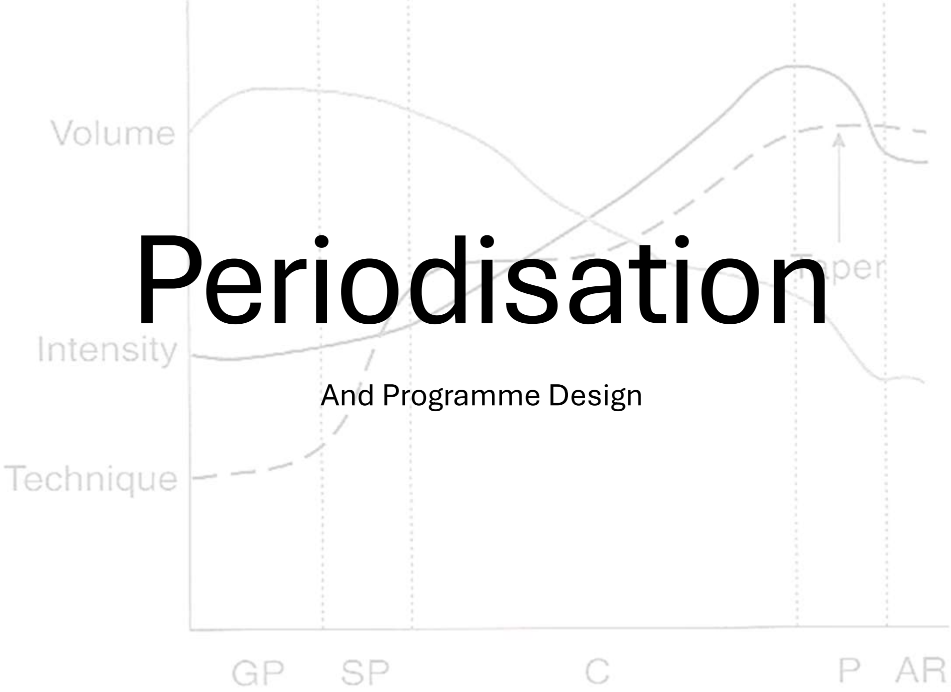
Exercise is Medicine

Aerobic or Muscle-Strengthening Physical Activity: Which Is Better for Health?

Angelique G. Brellenthin, PhD;[1] Jason A. Bennie, PhD;[2] and Duck-chul Lee, PhD[1]







Periodisation

And Programme Design

Example non-traditional periodisation strategy

Session	1	2	3
Volume load	Strength	Power	ASAP & HIIT

Sessionv	1	2	3
Volume load	Upper (STR & POW)	Lower (STR & POW)	ASAP & HIIT

Session	1	2	3
Volume load	Push (STR & POW)	Pull (STR & POW)	ASAP & HIIT

Session	1	2	3
Volume load	Upper (STR & POW, + SIT)	Lower (STR & POW, + SIT)	Sport/hobby-based practice

The Programme

Lower Body	Upper Body
Strength	Chest
Power	Back
Plyo	Overhead push
Hamstrings	Overhead pull
Lower Prehab	Core
Conditioning	Upper Prehab

While I have a preferred order of exercises, soldiers can simply choose form a list.

They can stick with the same exercises or change from session to session.

Conditioning	6	HIIT/SIT: choose one	On (s)	Off (s)	reps	Notes e.g., average m or W
	SIT	Cycling	5	25	6	
	HIIT	Cycling	30	30	3	
	SIT	Battle ropes	10	20	6	
	HIIT	Rowing	30	30	3	
	SIT	Sled push	10 meters	30	6	
	HIIT	Elliptical/Tredmill	30	30	3	
	SIT	Linear/CoD sprints	10 - 20 meters	30	6	
	HIIT	Ski erg	30	30	3	

If you hve the means, each session, switch between a 'HIIT' and a 'SIT' conditioning exercise. Remember, the mode does not matter, it's all about intensity!

If you decide to use linear and CoD sprints as part of your conditioning, I suggest you precede your chosen drill with one or two warm-up sets to groove the movement pattern and ensure you hit biomechanically sound shapes when you go at high intensity. Equally, consider progressing the drills as

Thank you for Listening :-)

Any Questions?

THE FITNESS FORMULA