HOUR OF POWER

Rowing WA

Physiology of Rowing:

The assessment and management of athlete training load and adaptation

Presented by

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Overview

- Demands of the sport and athletic profile of elite rowers
- Assessment of physiology/performance
- General training concepts
  - How to develop aerobic/anaerobic capacity
  - Periodisation principles
- Monitoring load
  - Why and How?

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Physiological Demands of Rowing

- One of the most physically demanding sports
- 5:30-8:30 minutes (*3:00-4:30 minutes for masters)
- Predominantly aerobic in nature
  - 70-90%
  - *60-80% for masters
- All body exercise
  - 50% Legs
  - 30% Trunk
  - 20% Arms

How Do Rowers Compare?

100 kg; 7.5 L/min; 75 ml/kg/min

VO_{2max}

70 kg; 6 L/min; 85 ml/kg/min

85 kg; 4.5 L/min; 55 ml/kg/min

95 ml/kg/min

Compared to the Average Joe

78 kg; 3.5 L/min; 40-45 ml/kg/min

68 kg; 2.5 L/min; 35-40 ml/kg/min

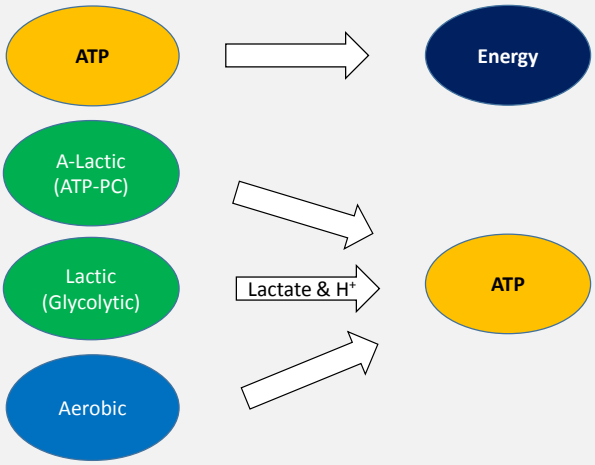
How Much Can You Shift It?

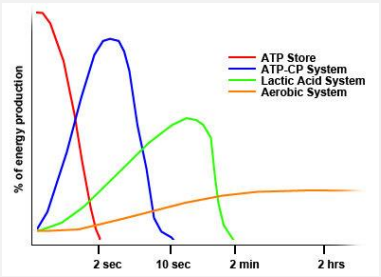
2009

2016

- 30-50% Genetics
- Training +5-25%

Understanding Energy Systems





Assessing Physiology

- Identify strengths and weaknesses
  - Some athletes more anaerobic
- Track Training Progression
- Aerobic Tests
  - 30 min Open Rate or R20 (FTP = 6-26”)
  - 5 km Ergo or TT
  - Submaximal (2 x 6 km @ 95%, 6 x 6 min etc)
- Anaerobic Tests
  - 100-250 m Ergo
  - Blood lactate production

7 x 4 min Step Test

Previous Years Selection Ergometer Time	<5:50.0	5:50.0 - 6:00.0	6:00.0 - 6:10.0	6:10.0 - 6:20.0	6:20.0 - 6:30.0	6:30.0 - 6:40.0	6:40.0 - 6:50.0	6:50.0 - 7:00.0	7:00.0 - 7:10.0	7:10.0 - 7:20.0	7:20.0 - 7:30.0	7:30.0 - 7:40.0	7:40.0 - 7:50.0
Work Load Increments (W)	45	45	40	35	35	30	25	25	25	20	20	15	15
Work Load 1 (W)	200	170	170	160	140	140	150	130	115	125	110	120	110
Work Load 2 (W)	245	215	210	195	175	170	175	155	140	145	130	135	125
Work Load 3 (W)	290	260	250	230	210	200	200	180	165	165	150	150	140
Work Load 4 (W)	335	305	290	265	245	230	225	205	190	185	170	165	155
Work Load 5 (W)	380	350	330	300	280	260	250	230	215	205	190	180	170
Work Load 6 (W)	425	395	370	335	315	290	275	255	240	225	210	195	185
Work Load 7 (W)	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
Work Load 1 (mm:ss.s)	02:00.7	02:07.4	02:07.4	02:10.0	02:15.9	02:15.9	02:12.8	02:19.3	02:25.2	02:21.2	02:27.3	02:23.1	02:27.3
Work Load 2 (mm:ss.s)	01:52.7	01:57.8	01:58.7	02:01.7	02:06.2	02:07.4	02:06.2	02:11.4	02:15.9	02:14.3	02:19.3	02:17.6	02:21.2
Work Load 3 (mm:ss.s)	01:46.6	01:50.5	01:52.0	01:55.2	01:58.7	02:00.7	02:00.7	02:05.0	02:08.7	02:08.7	02:12.8	02:12.8	02:15.9
Work Load 4 (mm:ss.s)	01:41.6	01:44.8	01:46.6	01:49.8	01:52.7	01:55.2	01:56.0	01:59.7	02:02.7	02:03.8	02:07.4	02:08.7	02:11.4
Work Load 5 (mm:ss.s)	01:37.4	01:40.1	01:42.1	01:45.4	01:47.8	01:50.5	01:52.0	01:55.2	01:57.8	01:59.7	02:02.7	02:05.0	02:07.4
Work Load 6 (mm:ss.s)	01:33.8	01:36.1	01:38.2	01:41.6	01:43.7	01:46.6	01:48.5	01:51.3	01:53.5	01:56.0	01:58.7	02:01.7	02:03.8
Work Load 7 (mm:ss.s)	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX

- Blood Lactate vs. Power Relationship
- Lactate Thresholds
  - Aerobic Threshold (LT1)
  - Anaerobic Threshold (LT2)
  - $VO_{2peak/max}$

Other Uses

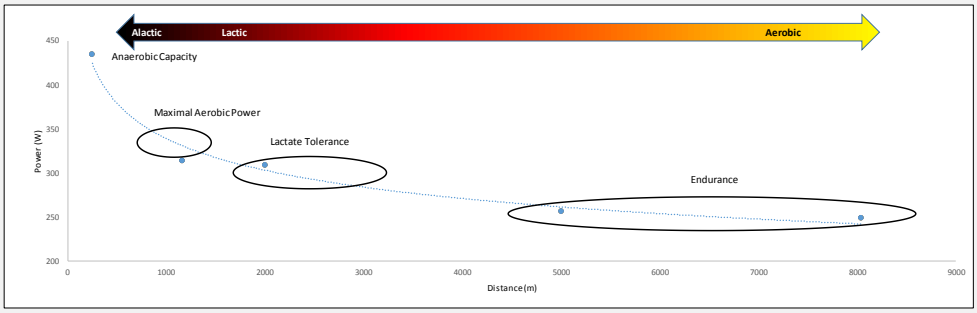
LT1 – first elevation of blood lactate above resting levels – when the anaerobic energy system starts to become active

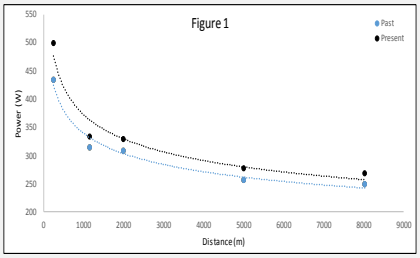
LT2 - The intensity at which lactate starts to accumulate in the blood stream faster than it can be removed – limited over this capacity

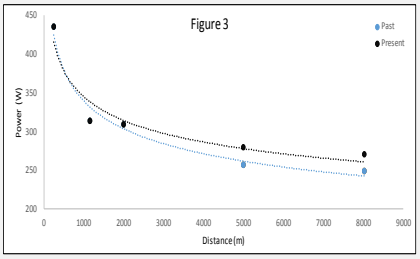
- Often considered to be just as critical as VO2max as it determines the relative % of maximum you can sustain through aerobic sources

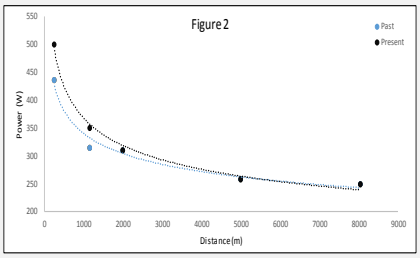
Power Profile

- Great way to profile aerobic and anaerobic capacity
- 4 Tests within a week (100 m to 30 min)
- Power vs. Distance in excel (fit **Power** trendline)









- Compare tests over time
- Compare athlete to benchmarks

Figure 1 – Shift in aerobic and anaerobic (beginning to end of season)
Figure 2 – Shift in anaerobic only (speed block as comp approaches)
Figure 3 – Shift in aerobic only, early season.

Testing Benchmarks

Rowing Australia Benchmarks

			Heavyweight Men				Lightweight Men			Heavyweight Women				Lightweight Women		
			Junior	Under 21	Under 23	Senior A	Under 21	Under 23	Senior A	Junior	Under 21	Under 23	Senior A	Under 21	Under 23	Senior A
Laboratory/Targets	Sum of 7 skinfold (mm) Body composition is not a rowing performance measure. Numbers represent normative ranges for each category	Healthy performance range (min)	N/A	50	50	35	38	38	30	N/A	60	60	55	47	47	43
		Healthy performance range (max)	N/A		55	45		42	40	N/A		100	75		55	60
	4 min Max (m)	Primary	1300	1330	1363	1390	1240	1273	1307	1112	1139	1168	1210	1089	1114	1140
		Secondary	1259	1300	1338	1363	1209	1240	1273	1087	1112	1139	1166	1065	1089	1114
	4 min Max (W)	Primary	445	483	512	544	386	417	452	279	299	321	359	282	280	300
		Secondary	404	445	483	512	358	386	417	260	279	299	321	245	262	280
	2mmol/L Power (W)	Primary				330			300				255			215
	4mmol/L Power (W)	Primary				390			370				275			255
	$VO2_{peak}$ (L/min)	Aspirational	N/A	6.20	6.50	6.80	5.65	6.00	6.20	N/A	4.30	4.50	4.80	3.80	4.00	4.20
		Lower Expectation	N/A	5.90	6.20	6.50	5.30	5.65	6.00	N/A	4.10	4.30	4.50	3.50	3.80	4.00
Ergometer Targets (mm:ss.s, watts)	Drag Factor	Mandatory	130				125			110				100		
	2000m (mm.ss.s)	Aspirational	06:08.0	06:00.0	05:58.0	05:48.0	06:25.0	06:20.0	06:10.0	07:05.0	07:00.0	06:55.0	06:40.0	07:25.0	07:20.0	07:05.0
		Lower Expectation	06:20.0	06:10.0	06:05.0	05:55.0	06:35.0	06:30.0	06:20.0	07:15.0	07:10.0	07:05.0	06:55.0	07:35.0	07:30.0	07:15.0
	2000m (W)	Aspirational	449	480	488	532	393	408	442	292	302	313	350	254	263	292
		Lower Expectation	408	442	461	501	363	378	408	272	282	292	313	238	246	272
	5000m (mm:ss.s)	Aspirational	16:24.0	16:13.0	15:57.0	15:30.0	17:20.5	17:07.0	16:25.0	18:40.0	18:25.3	18:12.0	17:41.0	19:31.1	19:18.0	18:40.0
		Lower Expectation	16:56.0	16:40.0	16:15.7	15:48.7	17:47.6	17:34.1	16:51.6	19:06.3	18:51.6	18:38.3	18:20.8	19:57.4	19:44.3	19:06.4
	5000m (W)	Aspirational	367	380	399	435	311	323	366	249	259	269	283	218	225	249
		Lower Expectation	334	350	377	410	288	299	338	232	242	250	262	204	211	232
	30 min R_{spm} (m)	Aspirational	8950	9140	9300	9525	8550	8880	9045	7950	8050	8150	8400	7595	7767	7950
		Lower Expectation	8667	8893	9122	9337	8334	8457	8807	7767	7863	7958	8096	7428	7595	7767
	30 min R_{spm} (W)	Aspirational	344	367	386	415	300	314	355	241	250	260	285	210	225	241
		Lower Expectation	313	338	364	391	278	290	328	225	233	242	255	197	210	225
	30 min R_{ps} (m)	Aspirational	8500	8700	8900	9200	8200	8400	8550	7800	8000	8100	8200	7400	7600	7800
		Lower Expectation														
	30 min R_{ps} (W)	Aspirational	295	316	338	374	265	285	300	228	246	255	265	195	211	228
		Lower Expectation														

5 km vs. 30 min
+6-8%

2 km vs. 30 min
+30%

School =>80% Jnr Targets Club = 60-80% Senior A Masters = 40-60% Senior A

Important Testing Considerations

Minimise variability

- Time of Day
- Prior Training
- Diet (Food and Fluid)
- Test experience is valuable

Training for Optimal Performance

Key principles of training

- Periodisation
- Specificity
- Variety
- Recovery/Adaptation
- Individualisation

Key training concepts

Periodisation of training – how to breakdown year/month/week into goals
Specificity – X-training is good but rowing is the best
Variety – Maximise variation in session type, intensity, conditions to avoid plateau
Recovery – Time for adaptation, particularly after heavier sessions
Individualisation – no athlete is the same.

Date 16/09/2013 **Team** AUS **Sport** Rowing

Regatta NTC TT National Ergometer Test Training Camp

Month	September			October				November				December					January				February				March					April				May				June					July				August				Sep	
Monday	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	3	10	17	24	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	1	8
Tuesday	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11	18	25	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9
Wednesday	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	5	12	19	26	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	3	10
Thursday	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	6	13	20	27	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	4	11
Friday	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	5	12
Saturday	21	28	5	12	19	26	2	9	16	23	30	7	14	21	28	4	11	18	25	1	8	15	22	1	8	15	22	29	5	12	19	26	3	10	17	24	31	7	14	21	28	5	12	19	26	2	9	16	23	30	6	13
Sunday	22	29	6	13	20	27	3	10	17	24	1	8	15	22	29	5	12	19	26	2	9	16	23	2	9	16	23	30	6	13	20	27	4	11	18	25	1	8	15	22	29	6	13	20	27	3	10	17	24	31	7	14
Weeks	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Weeks Remain	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	0	3	2	1	0	0	9	8	7	6	5	4	3	2	1	0	5	4	3	2	1	0	0		
OS (option 1)																																																				
OS (option 2)																																																				
OS (option 3)																																																				
Peaking Index													3									2					2	2				1								2			1						1	1		
Competitions													X									X					X	X				X								X			X						X	X		
Events	National Team Cl											National 5km Erg	NTC Time Trial, N				National Camps	National Camps	National Camps			NSW Rowing Cha			WCup1 Training C		AUS National Cha	WCUP1 - Penrith				National Selection								WCUP 2 - Aiguebe			WCUP 3 - Lucern		U23 WCH - Vares		Jnr WCH - Hambu		WCH - Amsterda	WCH - Amsterda		
Macrocycle	Macrocycle 1														Macrocycle 2																			Macrocycle 3																		
Training Phase	Base aerobic + build threshold														Base & heavy aerobic endurance							Intense Aerobic							Intense Aerobic + Hold Threshold					Intense Aerobic + Build Threshold + Minimal Comp Prep										Intense Aerobic + Hold Threshold + Comp								
L; M; H; Rec	M	M	M	M	M/H	Red	H	H	M/H	M/H	H	H	Red	M/H	L/M	M	M/H	H	H	VH	M	Red	M	VH	H	M/H	Red	M	M/H	H	H																					
Specific Training Notes																																					Add starts and winds to training pieces								Add starts and winds to training pieces							
National Camps																																																				
Review of Plans																																																				
National Ergo Testing																																																				
Test: 30 min OR																																																				
Test: 10+4																																																				
Monitor: 6km@95%																																																				
Monitor: 6x6																																																				
SnrA km's (on-water)	80 - 140 km									120 - 180 km																						160 - 220 km												180 - 240 km								
U23 km's	70 - 125 km									110 - 160 km																						145 - 200 km												160 - 215 km								
Jnr km's	65 - 110 km									95 - 145 km																						130 - 175 km												145 - 190 km								
Actual min (T2)	400-600 min T2 / week									400-700 min T2 / week					400-700 min T2 /							400-700 min T2 / week					300-500 min T2		400-700 min T2 / week			400-700 min T2 / week												400-700 min T2 /								
Actual min (T4)	60-80 min T4 / week									60-120 min T4 /					70-100 min T4 / week							85-115 min T4 /					20-30 min T4		90-120 min T4 / week			90-180 min T4 / week												180-250 min T4 /								

Yearly Periodisation Summary

1) Work back from target competition

2) Identify 3 main phases – Preparation, Competition and Transition

3) Specific breakdown of each macro – specific prep etc.

4) Monthly (Meso) Cycles – 3 up 1 down etc.

5) Plan for testing/monitoring around key training goals

6)Taper (7-28 days; volume ↓50%; intensity ↔)

Yearly Periodisation Summary

Remember that you only have to be good when it counts

Be prepared to have a long term view towards peak competition

If you are performing well all the time and feeling good you aren't training hard enough!

You will sometimes need to train and race fatigued in order to peak at the right time

Prepare for this psychologically as well as physically is your yearly plan.

Weekly Periodisation

1) Identify where you want quality and where you want fatigue/freshness

2) Allow for Recovery/Adaptation from threshold and heavy strength (Neural/Sympathetic Fatigue)

3) Vary sessions where possible (↓Monotony)

4) Front-end or book-end week

Training for Optimal Performance

General Adaptation Syndrome (GAS)
Training is a stressor/stimulus and the body's response is to adapt in order to improve your ability to tolerate that stress

Training variables
- Frequency
- Intensity
- Volume (km)
- Duration
- Mode

Training Zones

Training Zone	Description	Blood Lactate Relationship	%HR_{max}	% of FTP_W	RPE	Critical Duration
T1	Light Aerobic (Recovery)	<LT1	60-75	50-69	Very Light	>3 h
T2	Moderate Aerobic	Lower half between LT1 and LT2	75-84	70-81	Light	1-3 h
T3	Heavy Aerobic	Upper half between LT1 and LT2	82-89	82-90	Somewhat Hard	20-60 min
T4	Threshold	Around LT2	88-93	91-104	Hard	12-30 min
T5	Maximal Aerobic	>LT2	92-100	105-115	Very Hard	5-8 min

RPE (CR-20 Scale)	
Rating	Descriptor
6	No exertion at all
7	Extremely Light
8	
9	Very Light
10	
11	Light
12	
13	Somewhat Hard
14	
15	Hard (Heavy)
16	
17	Very Hard
18	
19	Extremely Hard
20	Maximal Exertion

Aerobic Sessions

Aerobic energy system can be trained in a number of ways

- High Volume Low Intensity (HVLI) (T1-T2)
- High Intensity Intervals (HII) (95-105% VO_{2max})
  - 1:1 Work:Rest
  - 30-180 sec

- Polarized model
  - 70-80% of HVLI (T1 and T2 < LT1)
  - 10-20% of HII (T4 and T5 > LT2)
  - 0-10% in between LT1 and LT2

- Jnrs and Masters should prioritise HVLI

Anaerobic Sessions

Anaerobic Quality Sessions

- >>VO_{2max}
- 15-120 sec
- 1:3+ Work:Rest
- Close to competition
- Well rested

Anaerobic Tolerance Sessions

- 95-105% LT2
- 45+ sec
- Minimise Rest
- i.e. 2 x 6 km w/5-8 min rest
- i.e. 4 x 10 min w/3 min rest
- 16-18 RPE

Training Priorities

School and Juniors
Basic strength/flexibility/competence
Rowing Volume>>Intensity

Club-Elite
Strength in key lifts
Volume with targeted intensity

Masters
Basic strength/flexibility/movement
Rowing Volume>>Intensity
Efficiency is most powerful weapon

How Else Do We Impact Physiology?

Environmental variation as another way to stress the body

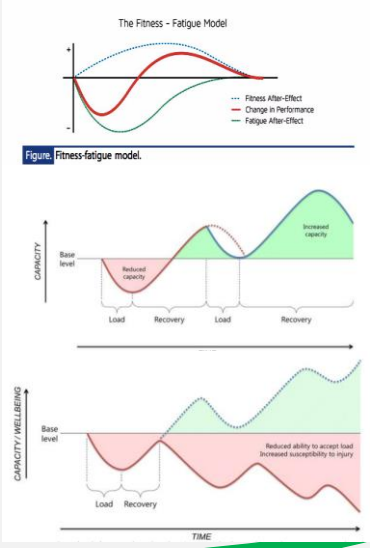
Altitude – low oxygen – encourage body to make more haemoglobin (considered doping in some places)
Altitude – Sleep high training low, 1% per 100 hours
Can also training high to maximise Vo2max adaptation during HII

Heat – Stress ability of body to lose heat through sweat
- Become more efficient at cooling (critical limiting factor in exercises is core temp rising)
- increase plasma volume, oxygen delivery more efficient, increase VO2max
- to prepare for heat, or to enhance cool weather performance

Both can also be used for one of sessions to increase internal load (Hr) while limiting external load (power)

Monitoring/Managing Load

- Training Dose-Response
- What is Load?
  - External load (Distance, Velocity etc.)
  - Internal load (Heart Rate, RPE etc.)
- Why is it important?
  - Current athlete status
  - Response to applied training
  - Minimise injury and maximise performance



Load: "The sport and non-sport burden (be that physiological, psychological or mechanical stressors) as a stimulus that is applied to a human biological system.

External Load: "Any external stimulus applied to the athlete that is measured independently of the response of the athlete.

Any external load will result in an individual internal load being realised.

Internal Load: "The physiological and psychological responses in each athlete, following interaction with, and variation in several other biological and environmental factors".

Quantifying External Load

Quantify what the athletes do, NOT ONLY what the coach wants them to do

1) The training the coach plans at the beginning of the season/training block
2) The training the coach plans on the day (modified for weather, time etc.)
3) **<u>The training the athlete actually performs on the day!</u>**

It is not possible to identify the effects of training without a precise quantification of the workload applied.

Quantifying Internal Load

Heart Rate
- TRIMP
- TSS (Training Peaks)

Limitations

T2 Minutes Tran et al. (2014)
- Standardise Intensity to 1 common zone (T2)
- Intensity, Duration and Mode Specific
- Threshold (T4) min worth 2.1 x T2 min
- Ergo-min worth 1.3 x on-water min

Limitations

HR good for the majority of work (endurance)
Not good for high intensity and gym, is not sensitive to pick up intervals or heavy work
Also sensitive to heat, diet, fluid intake etc.

T2 minutes cannot distinguish the individual response of an athlete. Only prescription. Is it harder than it was yesterday, we want to know that.

Quantifying Internal Load

Simple is still just as good!

Recent research is supporting Session-RPE (sRPE) Saw et al., (2016)

sRPE = Training Duration x RPE

Robust across all modes of training (endurance, intervals and gym)

Excel and/or Google Docs Forms
- Simple and easy to implement

RPE (CR-10 Scale)	
Rating	**Descriptor**
1	Very Light
2	Light
3	Moderate
4	Somewhat Hard
5	Hard
6	
7	Very Hard
8	
9	Very, Very Hard
10	Maximal

sRPE Method Example

DAY	TRAINING TYPE	DURATION (min)	sRPE	LOAD
Monday	Row	90	4	360
Tuesday	Weights	60	5	300
Wednesday	Row Ergo	90 60	4 6	360 360
Thursday	Weights	60	5	300
Friday	Row Cycle	120 80	3 4	360 320
Saturday	Row	90	4	360
				2720

*sRPE should be given 30 min post-session and represent the overall RPE for the whole session.

sRPE Limitations

30 min x RPE 10 = 300

150 min x RPE 2 = 300

Must be aware of interplay between internal and external load
- Track minutes/load associated with higher RPE separately?

No perfect system
- Plan and Report
- Internal *AND* External

Training Plan Detail

Session	Volume (min)	Volume (km)	Coach RPE	Approx. Session Load
20 km Row	120	20	5	600
GYM	60	0	6	360
Interval Ergo	40	7	8	**320**
Row w/ rope	60	7	7	420

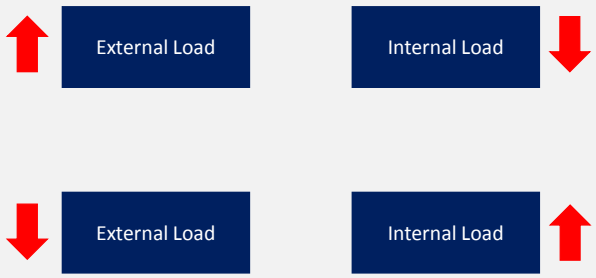
External Load

Internal Load

What Can It Tell Us?

Coach vs. Athlete RPE

- Is the athlete responding as planned?
- Are they training harder/lighter than intended?



Minimising Injury/Training Lost

Significant burden to athlete success rate

Time lost to training through injury/illness
- Recurring injury chances

Athlete Management a Priority
- ↓minimise risk

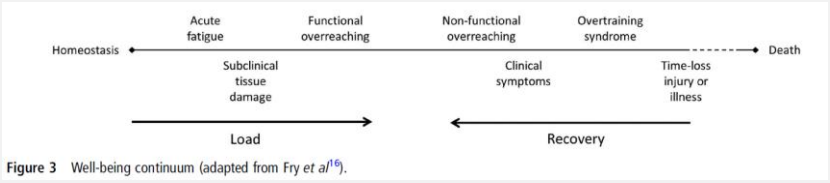


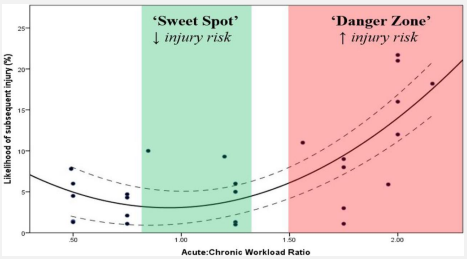
Figure 3 Well-being continuum (adapted from Fry *et al*[16]).

Minimising Injury/Training Lost

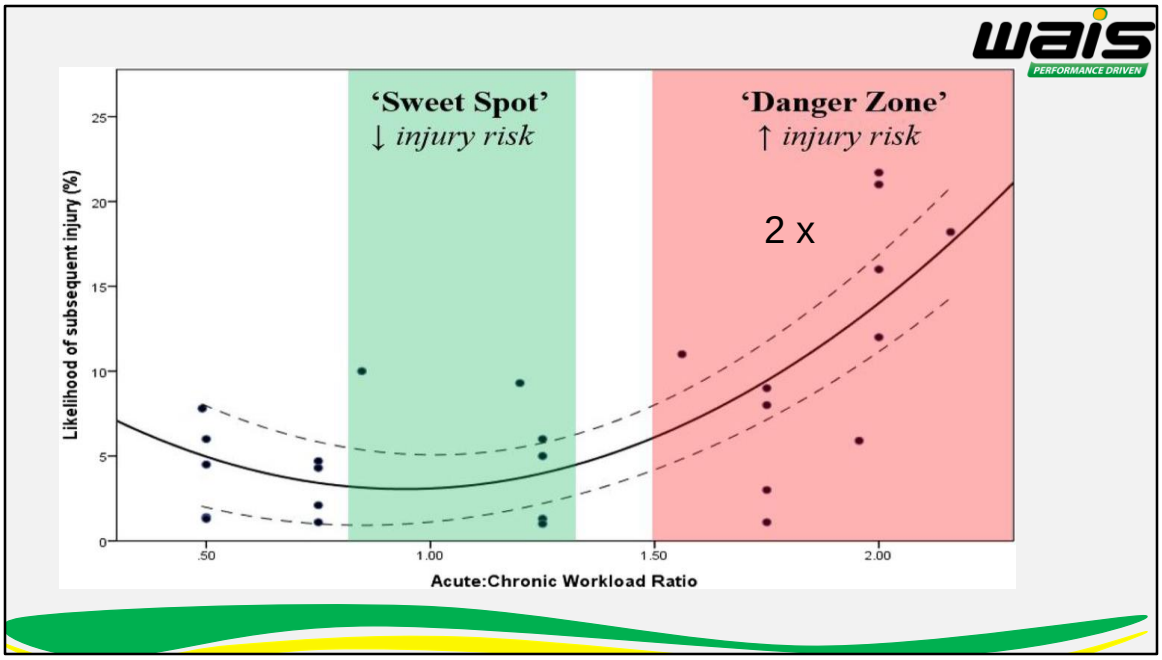
Load is protective against injury

However;
- We must build up to it safely
- Minimise spikes and drops in key load variables (<10% per week)
- Injury Latency (<4 weeks)

Definitions
Acute Workload
Chronic Workload
ACWR (0.8 – 1.3)



- Fitness and experience is protective - tolerance
- Athletes respond significantly better to relatively small increases (and decreases), rather than larger fluctuations in loading
- "A high chronic external workload is protective of injury".
- "Injury risk increases significantly in the week following sharp increases in acute workload and can last for up to 4-weeks with a delayed remodelling in the bone, tendons, ligaments etc.



- Acute – 7 days and chronic = 28 days
- ACWR – Acute relative to Chronic
- 0.8-1.3 acute workload should be 80 – 130 % of prior 4 weeks.

Minimising Rowing Injury

What load is important to measure?
- Common injuries in rowing

Establishing limits for each athlete

Tolerance increases with training age

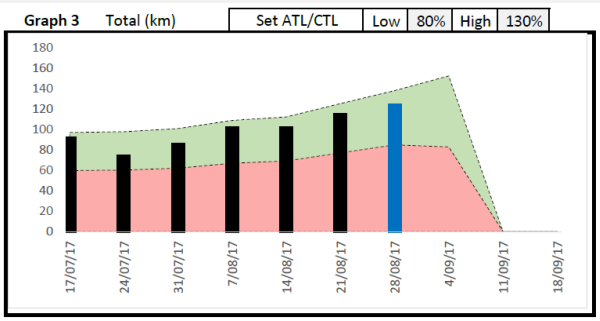
Other protective tactics
- Strength and Body Weight

HW men – 13-17% BF and 50-70 mm
HW women – 18-25% BF ad 70-90 mm

Lightweights – 73-75 kg and 59-61 kg

Management Example

Total Volume (km)					
Week #	ATL	CTL	ATL: CTL	Guide Only	
				Low	High
-5	87	75	1.17		
-4	70	75	0.92		
-3	81	78	1.05		
-2	98	84	1.16		
-1	98	86	1.13		
0	110	97	1.14		
1	120	106	1.13	77	142
2				83	153
3					
4					

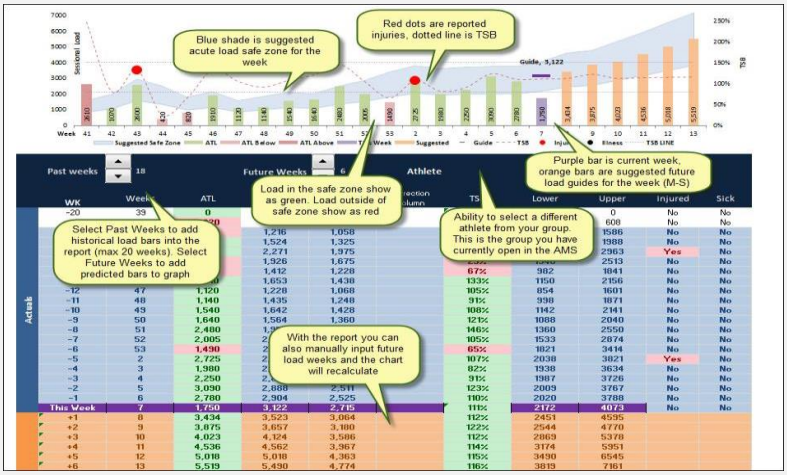


Weekly review of 'Safe' progression as a guide

Still establishing important metrics and limits for rowing

WAIS example of external load tracking

Athlete Management System (AMS)



AIS example

What About Illness?

Upper Respiratory Tract (URT) Infections
- 50% of reported illness
- 33% of missed training
- 2-4 Days out

Similar Relationship with Load

Elite athlete more tolerant

Management of Juniors through camps etc.

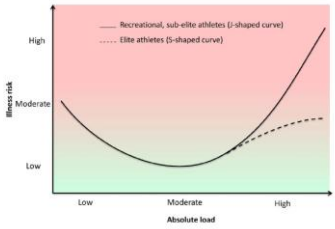


Figure 2 The relationship between load and risk of illness in recreational and subelite athletes (J-shaped curve) versus elite athletes (S-shaped curve).[63 75]

Key Factors at Play

IOC Position Statement on Load and Injury/Illness

1) Behaviour, lifestyle and medical
2) Training and competition load management
3) Psychological load management
4) Measure and monitor early signs of illness, over reaching or over training

Load is complex and multifaceted

Not just physical

Minimise risk

1) **diet, early identification, staying warm, sleeping enough**
2) **Minimise big spikes**
3) **Manage stress as much as possible**
4) **Identify and manage asap.**

Athlete Status?

Subjective and Objective Feedback

Subjective
- Wellness questionnaires (sleep, mood etc.)
- POMS

Objective
- Resting Metabolic Rate (RMR)
- Heart Rate Variability

Resting Metabolic Rate

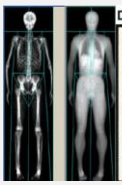
Amount of energy required to support basic functions

Relative to Fat Free Mass (FFM) from DXA

Supressed RMR (<126 KJ/Kg.FFM)
- Increased risk of injury/illness
- Impair Adaptation

RMR can drop during heavy training or periods of stress

Energy balance crucial



DXA Results Summary:

Region	Fat (g)	Lean+BMC (g)	% Fat
L Arm	696.9	5043.8	12.1
R Arm	1043.4	5286.6	16.5
Trunk	8450.6	33309.2	20.2
L Leg	4049.2	11731.4	25.7
R Leg	3870.5	12674.3	23.4
Subtotal	18110.5	68045.3	21.0
Head	1082.9	5034.9	17.7
Total	**19193.5**	**73080.2**	**20.8**

RMR < 126 KJ/KgFFM can indicate that there is insufficient energy available for basic metabolic functions.

Low energy availability can be problematic as it can lead to reduced hormone production (i.e. oestrogen and testosterone), decreased bone density, reduced immune function, and an impaired ability to lose body fat amongst other things.

RMR can drop during periods of energy restriction (i.e. energy in ≠ energy out from daily activity)

Can be used to guide training/diet for athlete and identify if they are coping

Heart Rate Variability

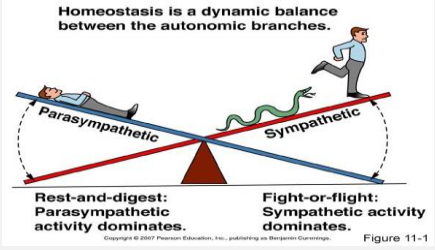
Insight into Autonomic Nervous System

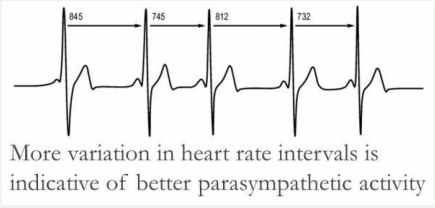
Complex area looking at PS and S responses to training

Can help to guide functional OR and taper

Training Progression ↓ RHR and ↑HRV
Tapering 'readiness' ↑ RHR and ↓HRV

iPhone – HRV4Training
Android – Elite HRV





Sympathetic – blood pressure, heart rate, blood flow, sweating
Parasympathetic – rest, recover, adapt

HRV is high when parasympathetic is active and low when it is suppressed.

Measuring Load – Key Advice

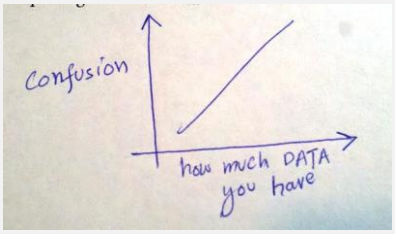
Keep it Simple

'measure what counts, not just what you can'

External
Rowing volume is key (ie. km on ergo and on-water)

Internal
HR is good for detail, sRPE is good for consistency (every session)

Training Peaks, Today's Plan and Google Docs all good resources



Even if you just do it for key sessions on the water and on the ergo to get a feel of how they are tracking