Kõrge intensiivsusega treeningud ning nende kasutamine treeningute planeerimisel

Jarek Mäestu

Treening kui kunst!

- Kuidas vormida tippsportlane?
- Absoluutne tõde puudub
- Treenida tuleb palju ja targalt
- Analüüsi
- Pisiasjad
- Käi oma rada

Kus me praegu seisame?

- Milline treening on efektiivsem:
  - säilitada intensiivsust 90% VO_{2max} või
  - töötada 100% VO2max intensiivsusel umbes 10 min?

Astrand & Rohdal, 1986

Teaduslik
Tunnetuslik
Pärimuslik

Aeroobne lävi

- Intensiivsus, millest alates organism hakkab lisaks rasvade ainevahetusele sõltuma rohkemal määral SV ainevahetusest
  - Laktaadi kontsentratsioon 1,8-2,5 mmol/l
  - Hingamine muutub rütmilisemaks
  - Kõige suurem hapniku omastamise osakaal

- Treeningute eesmärk – rasvade ainevahetuse parandamine
- Treeningute kestvus – 1-6 tundi
- Intensiivsus – 60-70% MHR, La 1,8-2,5 mmol/L

Anaeroobne lävi

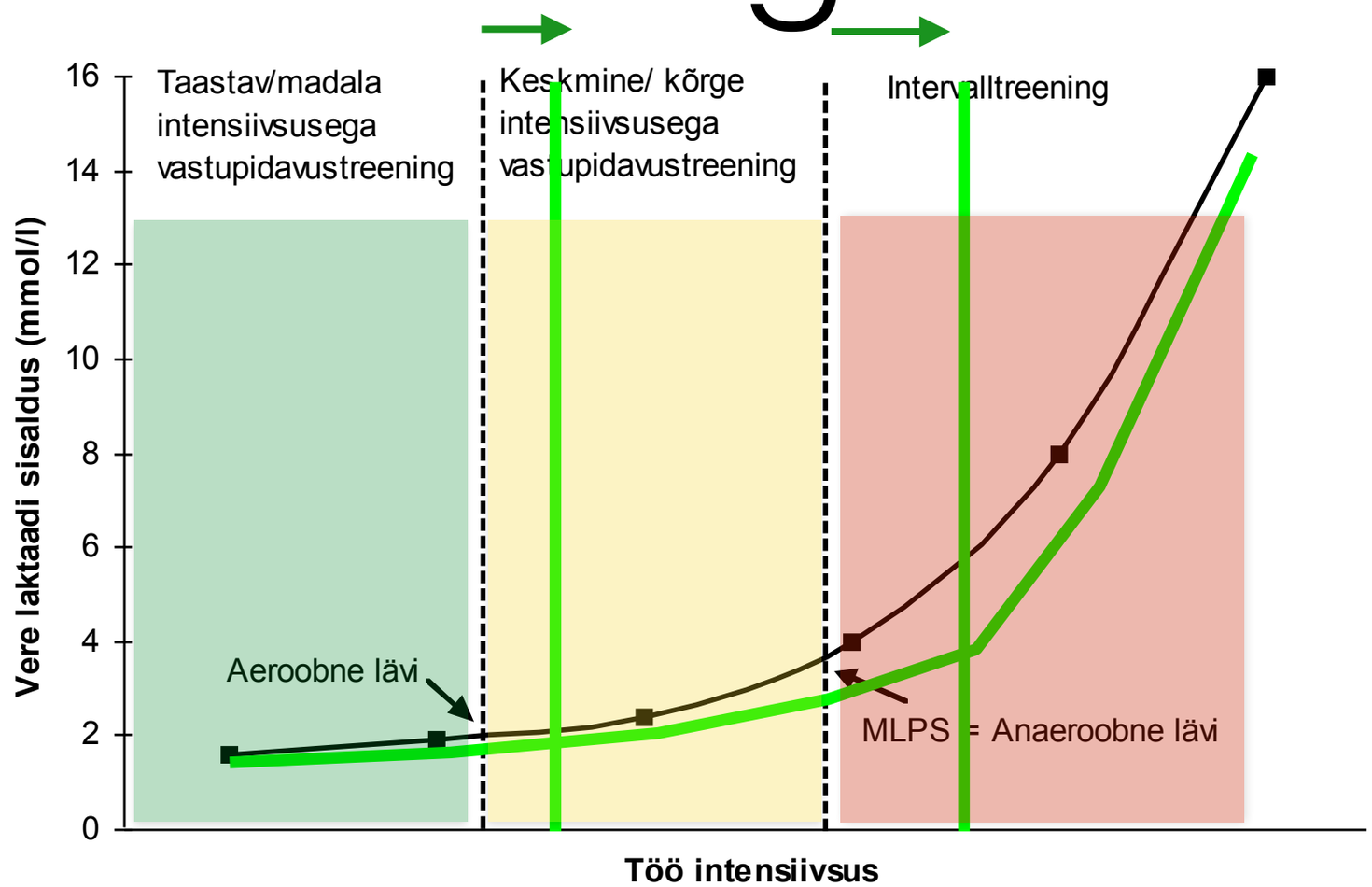
- Suurim konstantne intensiivsus (võimsus, liikumiskiirus), mille korral laktaadi produktsioon ja eliminatsioon on võrdsed ning mille korral energiat saadakse oksüdatiivsete protsesside arvelt (Bishop et al. 1998).

- Treeningute eesmärk – tempovastupidavus, laktaadi eemaldamine

- Treeningute kestvus – kuni 1 tund, reeglina kuni 45 min

- Intensiivsus – 75-85% MHR, La 3-5 mmol/L

3 tsooniga mudel



- Tsoon 1 – madal laktaadikontsentratsioon <2 mmol/l
- Tsoon 2 – laktaadiga kohanemise tsoon 2 - 4 mmol/l
- Tsoon 3 – laktaadi kuhjumise tsoon >4 mmol/l

Intervalltreeningud

Ettevalmistav periood (baastreeningud) on kõige olulisem !!!

- Korduvad, kõrge intensiivsusega treeninglõigud;
- Intensiivsus kõrgem kui 90%VO_{max} ; >An Lävi
- RPE – vähemalt “raske”
- Mittepiisav taastumine;
- Väga tugeva koormusimpulsiga.

Õigesti kombineerituna võib anda lühikese ajaga märkimisväärset töövõime paranemist

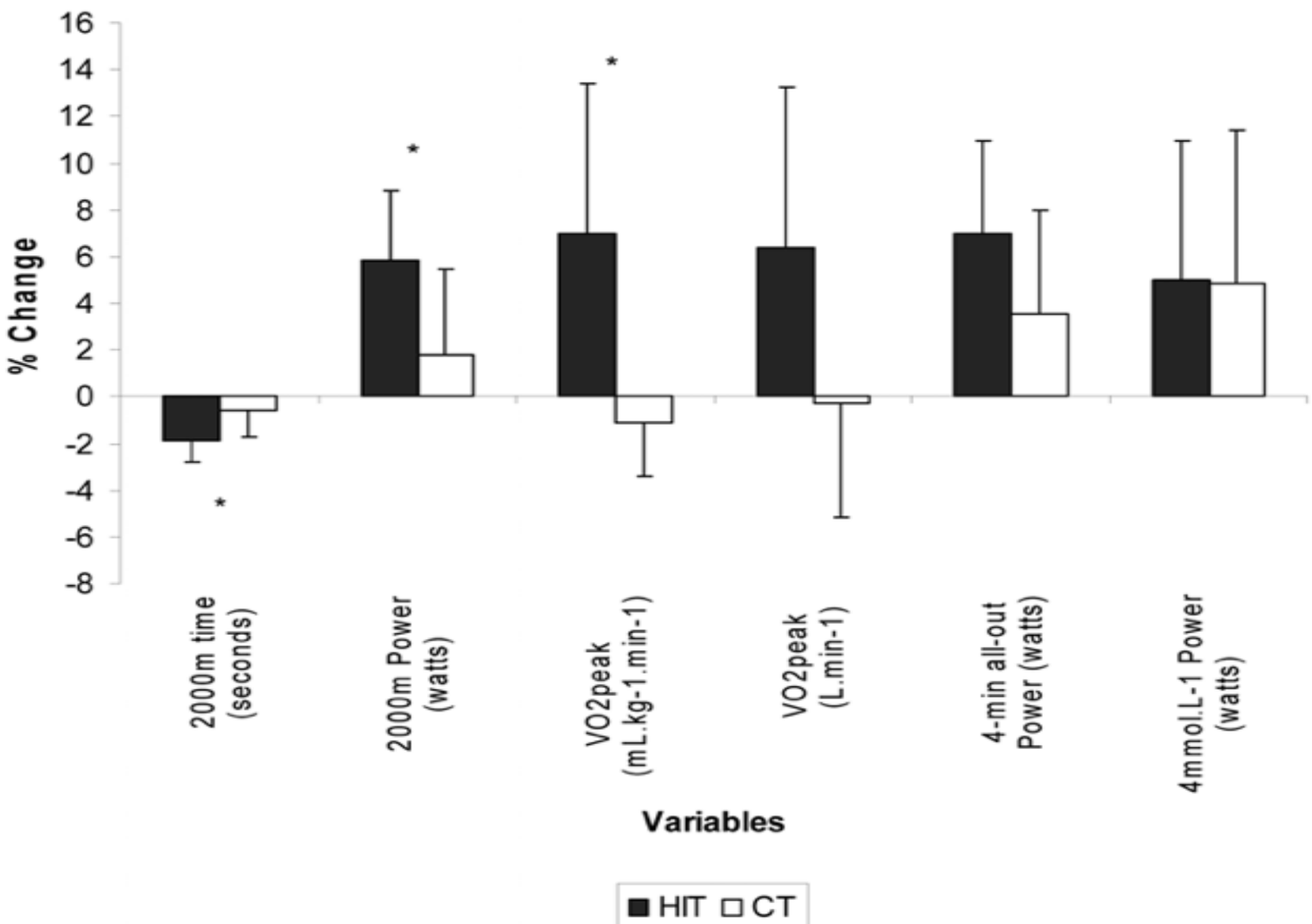
Tüüpiline intervalltreening

- Tööintervall: 30 sek – 10 min
- Puhkeintervall: mittetäielik taastumine
- Puhkeintervall: passiivne või aktiivne puhkus
- Töö intervallide arv: varieeruv
  - Treeningu eesmärk
  - Sportlase tase

4 nädalat
Kõrge tasemega sõudjad

KIT: Intervalltreening 90% max võimsus; 8x2,5 min
Taastumine: SLS< 70% maxist või 5 min

ÜT: 55 või 60 min intensiivsusel 3 ja 4 mmol/L



Driller jt. 2009

Training methods and intensity distributions in young world class rowers (Guellich jt. 2009)

- 36 Saksamaa juuniorite koondislast
  - 91.0±6.0 kg
  - 193.2±5.3 cm
  - 12.8±2.5 tundi nädalas
- Pulsitsoonid (3min koormused, 20W juurdekasv)
- 4 mmol/l võimsus (~anaeroobne lävi)
  - 373±29 W
- VO2 max ei määratud
- Ettevelmistav periood – GER J Champ (37 nädalat)
- 14 “vaatlusalust” jõudsid täiskasvanute MM ja OM

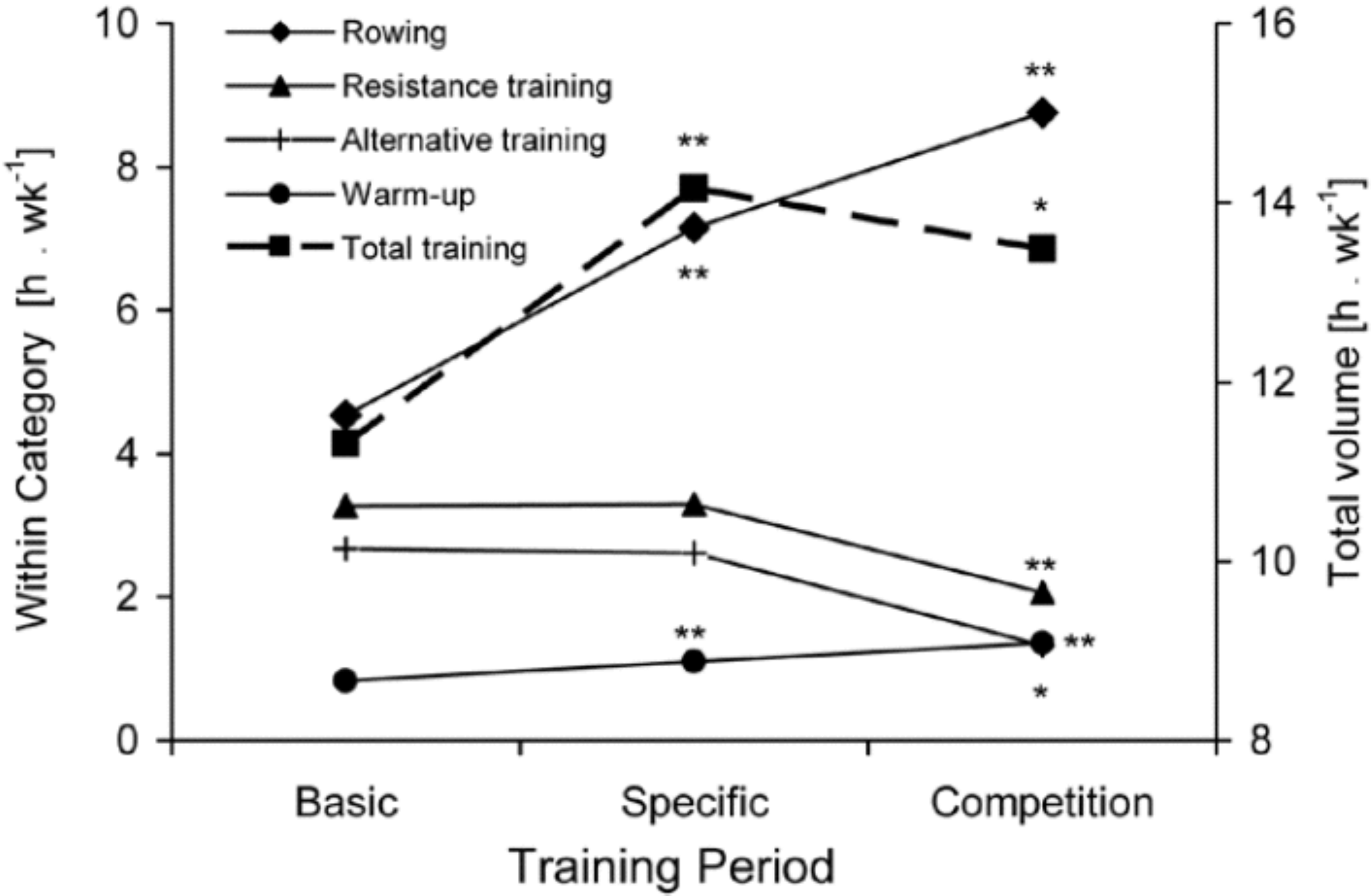
Table 1 Category definitions for specific rowing training intensity as prescribed by the German national governing body in rowing

	Definition / Description						
Category Label	Repetitions, duration (min)	Pause (min)	Total time (min)	Velocity ($\%v_{race}$)	Stroke freq. ($n \cdot min^{-1}$)	Heart rate ($b \cdot min^{-1}$)	Blood lactate ($mmol \cdot L^{-1}$)
Compensation	1, 15–60		15–60	< 70	< 20	< 140	< 2
Extensive endurance	1–3, 30–60	3–6	40–120	70–80	≤ 22	140–160	< 2
Intensive endurance	2–4, 10–60	2–6	40–100	75–85	18–24	156–168	2–4
Highly intensive endurance	2–3, 3–10	10–20	≤ 90	85–100	24–34	> 180	4–8
Race-specific velocity-end.	2–8, 0.7–2.0	5–15	≤ 70	95–110	RF ± 4	max	4–6
Velocity	6–12, 0.2–0.4	> 10		106–112	max		

Note. The first column's labels represent direct translations from the national governing body's documents (abbreviations: end. = endurance, freq. = frequency, RF = race frequency). Individual heart rates for targeted intensity ranges based on the lactate-HR relation during rowing ergometry.

Table 2 Distribution of training by type and intensity for the entire 37-wk quantification period (mid-October until the end of June)

Distribution	Mean (SD)
All Training	
Frequency (sessions·wk^{-1})	10.9 (1.6)
Time (h·wk^{-1})	12.8 (2.1)
Rowing training (%)	52.1 (5.1)
Resistance training (%)	22.6 (4.3)
Alternative training (%)	17.2 (5.2)
Warm-up and flexibility (%)	8.1 (4.3)
Rowing exercise	
Time (h·wk^{-1})	6.6 (0.8)
Distance (km·wk^{-1})	97.1 (19.5)
Compensation range (%)	8.1 (6.1)
Extensive endurance range (%)	86.8 (6.3)
Intensive endurance range (%)	2.0 (1.1)
Highly intensive endurance range (%)	1.0 (0.4)
Race-specific velocity-endurance range (%)	1.7 (0.6)
Velocity range (%)	0.4 (0.5)


Rowing
Resistance training
Alternative training
Warm-up
Total training
Within Category [h . wk-1]
Total volume [h . wk-1]
Training Period
Basic
Specific
Competition
0
2
4
6
8
10
8
10
12
14
16
**
*

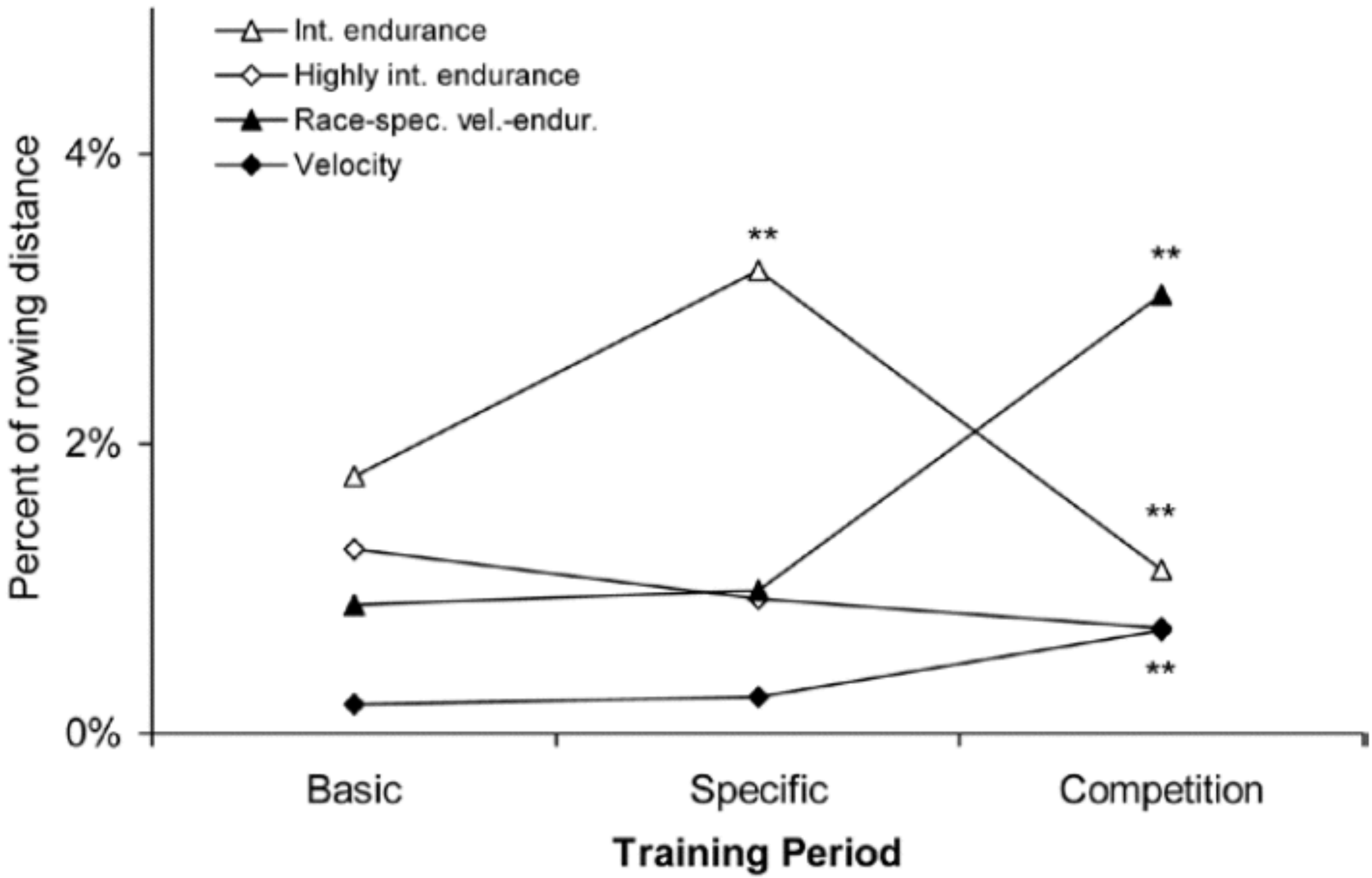

Int. endurance
Highly int. endurance
Race-spec. vel.-endur.
Velocity
Percent of rowing distance
4%
2%
0%
**
**
**
**
Basic
Specific
Competition
Training Period

Table 3 Comparison of total training distribution among junior elite rowers with international (n = 14) and national success (n = 22) 3 y after the reporting period

		International Success Mean (SD)	National Success Only Mean (SD)
Total Training (37 wk)	Sessions (n):	401 (65)	406 (61)
	Time (min):	27,534 (3,119)	28,966 (5,321)
Rowing Exercise			
Time (min)		14,654 (1,726)	14,697 (1,999)
Compensation range (km)		422 (256)	232 (177)*
Extensive endurance (km)		2,912 (446)	3,236 (743)
Intensive endurance (km)		73 (43)	74 (35)
Highly intensive endurance (km)		29 (12)	40 (18)
Race-specific velocity-endurance (km)		67 (20)	54 (17)*
Velocity range (km)		13 (11)	15 (23)
Resistance Exercise			
Time (min)		6,226 (988)	6,518 (1,751)
Alternative Training			
Time (min)		5,021 (2,593)	4,873 (1,454)
Warm-up and Flexibility			
Time (min)		2,194 (1,519)	2,520 (1,467)

Taani kergekaalu neljapaadi treeningnädal (märts 2 kuud enne võistlusperioodi)

(E.Ebbensen)

- Esmaspäev
  - 2 x 30min 70% VO2max (5 min paus)
- Teisipäev
  - 3x12min 75%VO2max (5 min paus)
  - 32 min kasvav tempo 65%-90% max
- Kolmapäev
  - 5 x 6 min 80% VO2max (5 min paus)
  - 3 x 15 min 75% VO2max (5 min paus)
- Neljapäev
  - 3 x 1000m 125% VO2max (15 min paus)
- Reede
  - 3 x 10 min 80% VO2max (5 min paus)
  - 5 x 4 min 90% VO2max (5 min paus)
- Laupäev
  - 3x15 min 75% VO2max (5 min paus)
  - 20 min 75% VO2max
- Pühapäev
  - 40 min 90% VO2max
  - 70 min 65% VO2max

Kokku 15 tundi, 200 km

T1	T2	T3	Paus
260	**108**	**70**	**115**

Kokku ca 553 min

Taani kergekaalu neljapaadi treeningnädal (august - 3 nädalat enne maailmameistrivõistlusi) (E.Ebbensen)

- Esmaspäev
  - 3 x 8 min 90% VO2max (5 min paus)
- Teisipäev
  - 3 x 1000m 125% VO2max (15 min paus)
  - 2 x 10 min 80% VO2max (5 min paus)
- Kolmapäev
  - 3 x 8 min 90% VO2max (5 min paus)
  - 2 x 10 min (45/15s) 130% VO2max
- Neljapäev
  - 3 x 2min 125% VO2max (15 min paus)
- Reede
  - 2 x 7 min 80% VO2max (5 min paus)
  - 60 min 65% VO2max
- Laupäev
  - 2 x 2 min 135% VO2max (15 min paus)
  - 3 x 7 min 85% VO2max
- Pühapäev
  - Stardid (max)
  - 40 min 65% VO2max

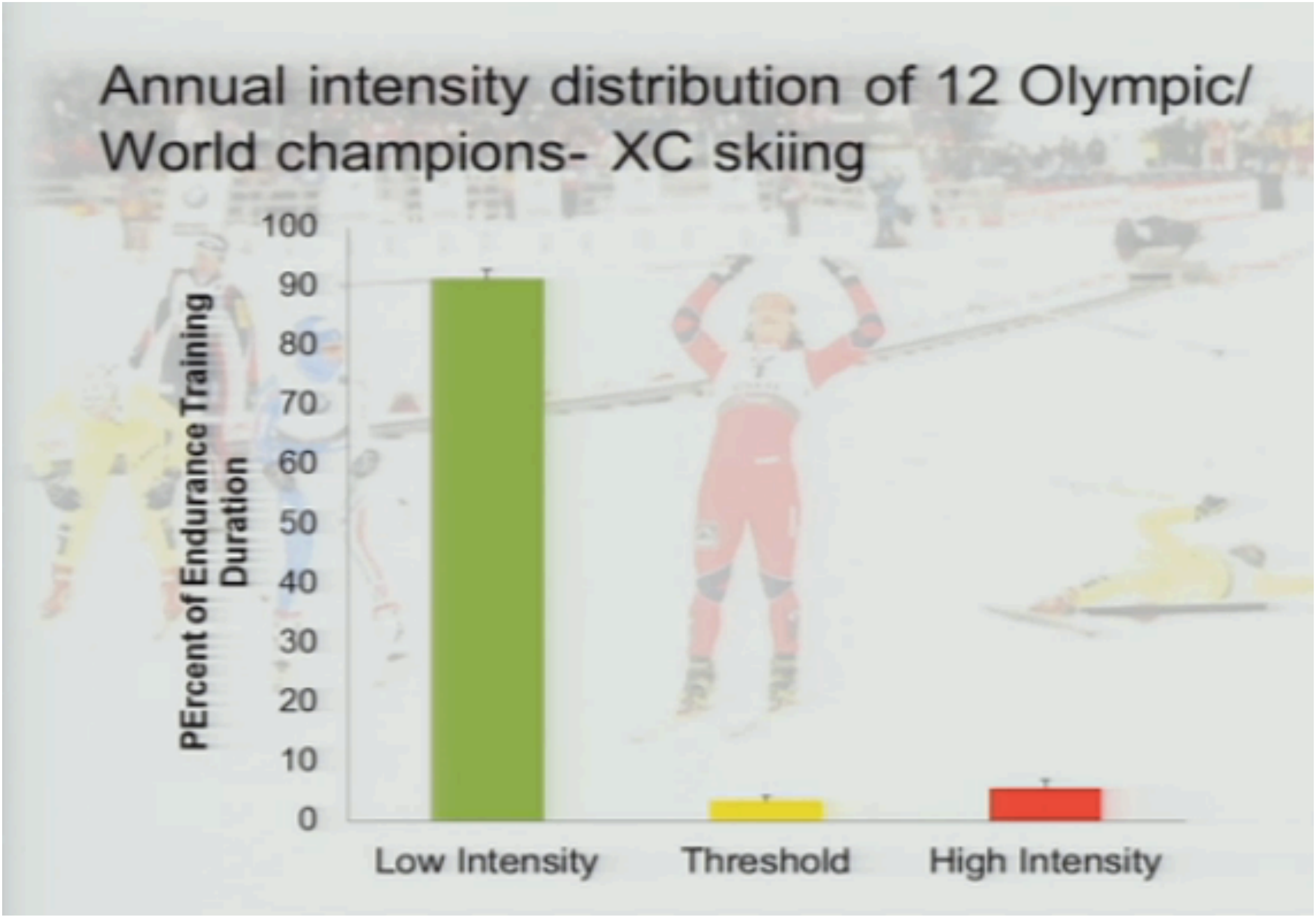
Kokku 12 tundi, 150 km

T1	T2	T3	Paus
141	55	52	80

Kokku ca 330 min

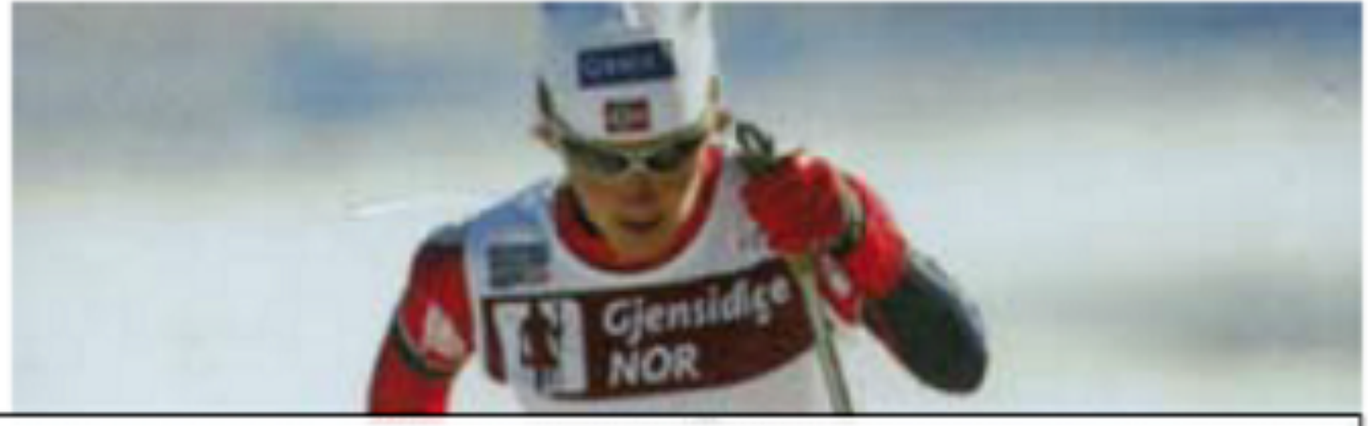
Olympiatoppen Norra

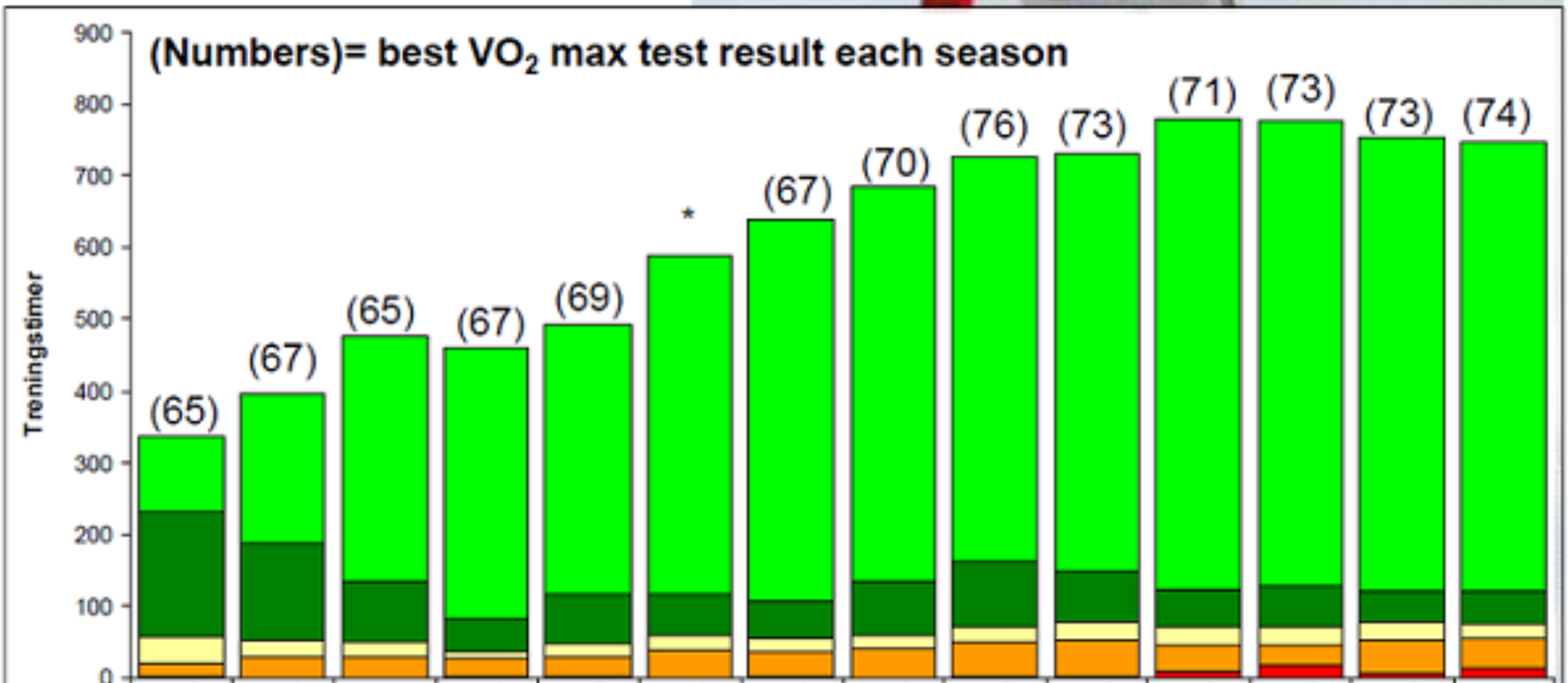
Intensity Zone	% of VO2max	% of HRmax	Total length per workout
I-zone 5	94-100	94-100	15-30 min
I-zone 4	87-94	87-92	30-50 min
I-zone 3	80-87	82-87	50-90 min
I-zone 2	65-80	72-82	1-3 hours
I-zone 1	45-65	60-72	1-6 hours



Tonnessen, 2013

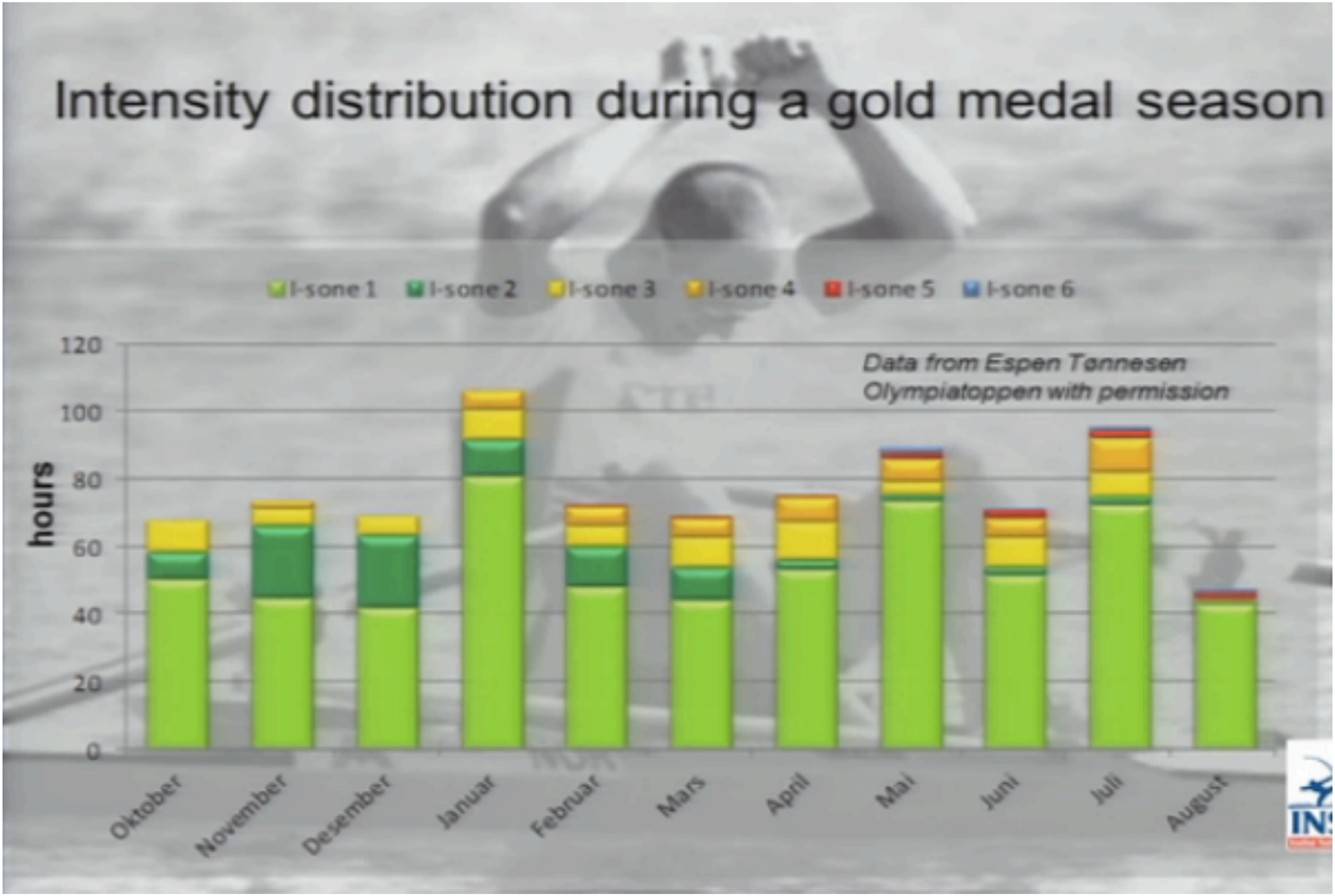
Bente Skari
5 time World Champion, O-gold, 46 WC victories





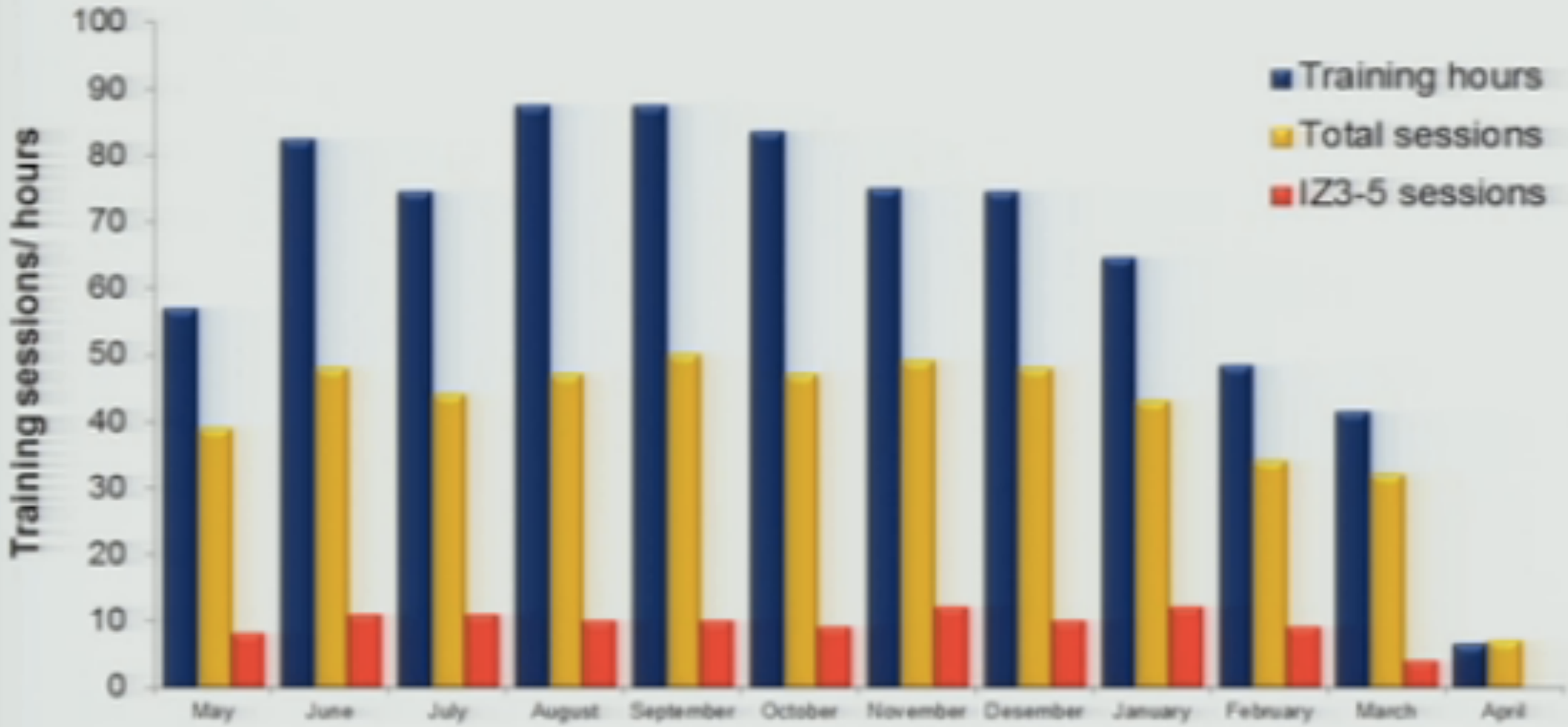
	18 år	19 år	20 år	21 år	22 år	23 år	24 år	25 år	26 år	27 år	28 år	29 år	30 år	31 år
I-sone 1	103	211	344	377	374,5	469,5	533,5	550	565	582,5	656	648	633	623
I-sone 2	176	135	84	45	70	60	52	78	93	70	54	59	44	47
I-sone 3	36,5	21	18,5	12,5	18,5	17,5	18	16,5	19	25	23,5	23,5	25	20
I-sone 4	18,5	30	31	22	26	40	34,5	40	48	50,5	37	29	47,5	43
I-sone 5	1,5	0,5		3	2,5		1,5	1	2,5	2,5	9	16,5	5,5	12

Tonnesssen et al.


Intensity distribution during a gold medal season
I-sone 1
I-sone 2
I-sone 3
I-sone 4
I-sone 5
I-sone 6
Data from Espen Tønnesen
Olympiatoppen with permission
hours
120
100
80
60
40
20
0
Oktober
November
Desember
Januar
Februar
Mars
April
Mai
Juni
Juli
August

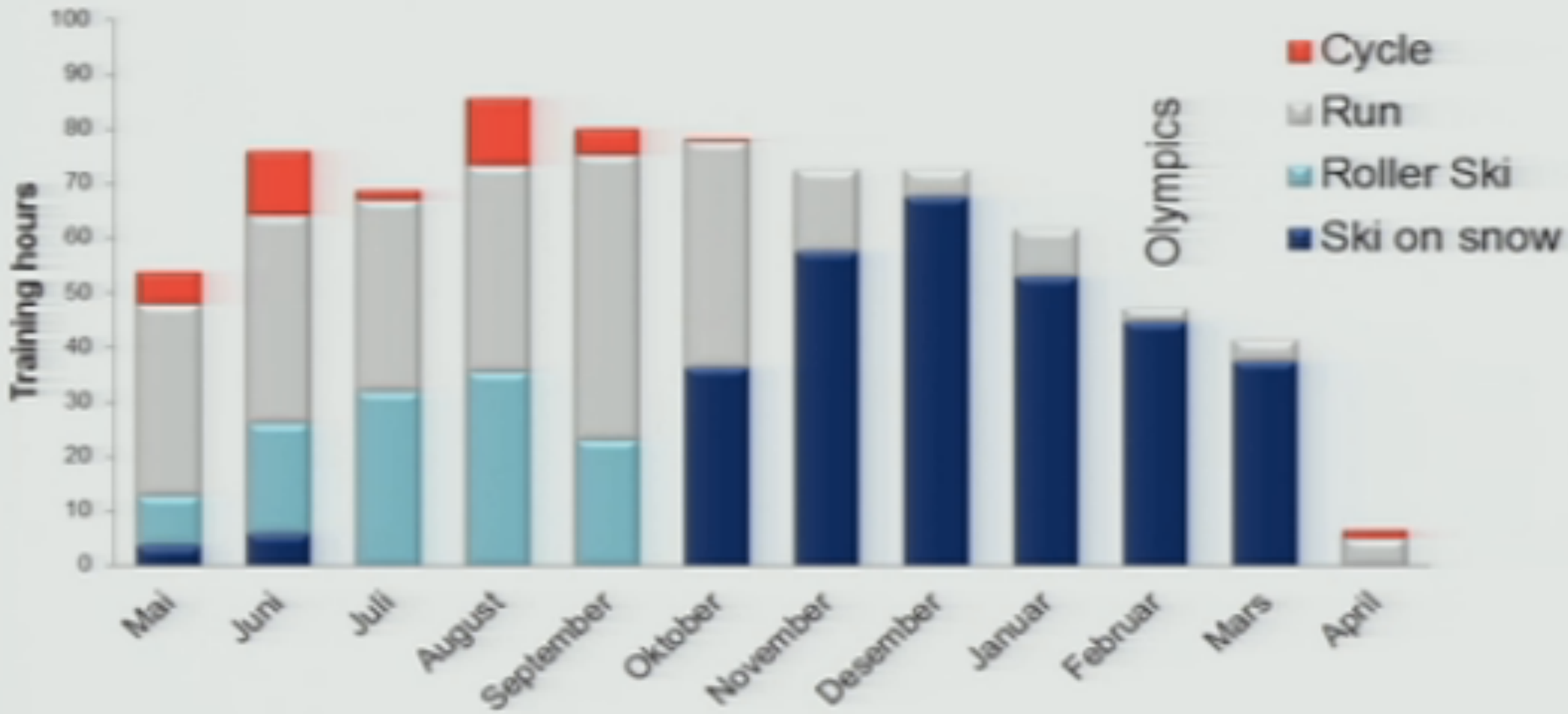
Seiler, 2013

Basic periodization- Champion Skier

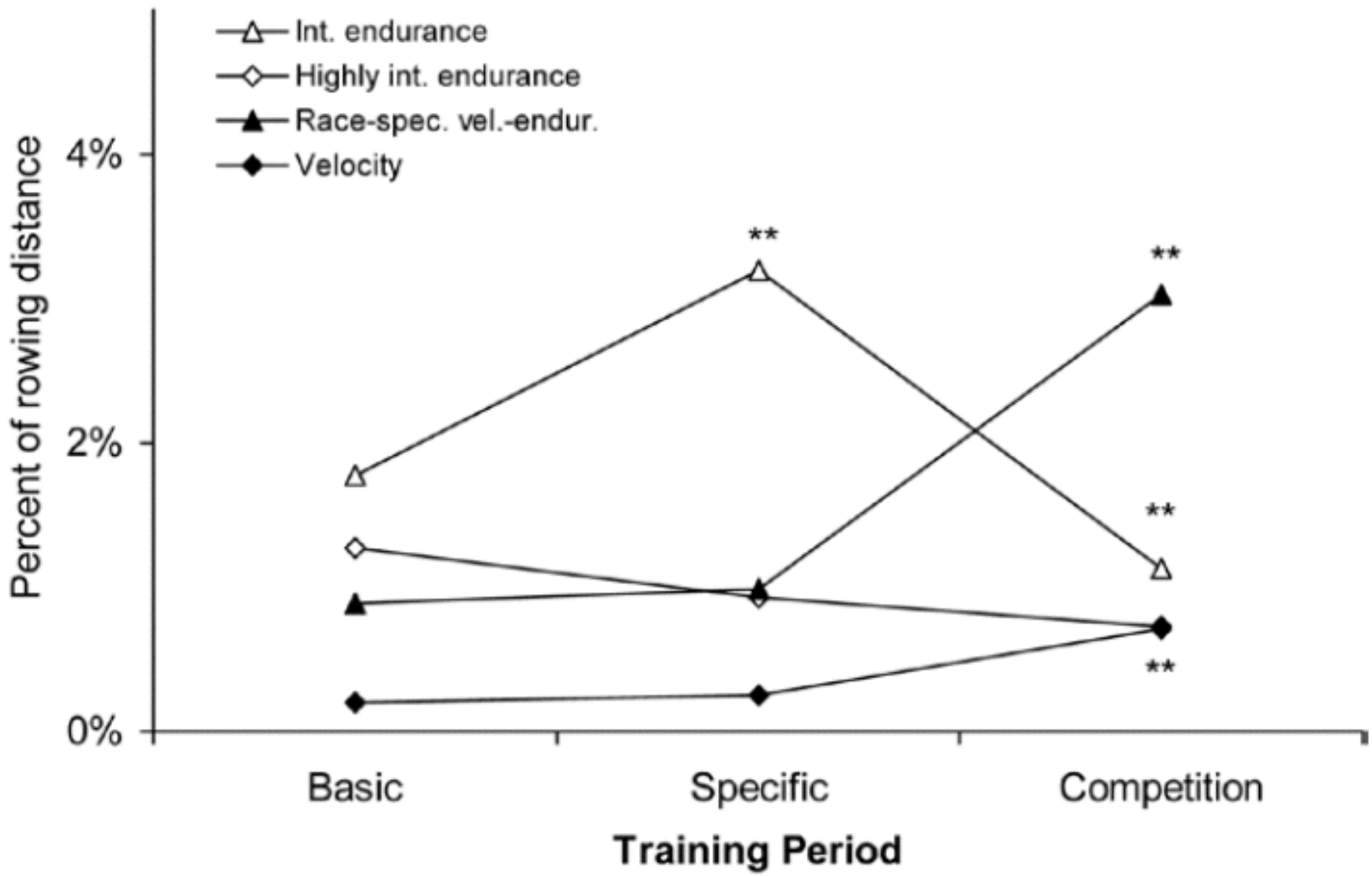


Seiler, ettekanne 2013

Training forms



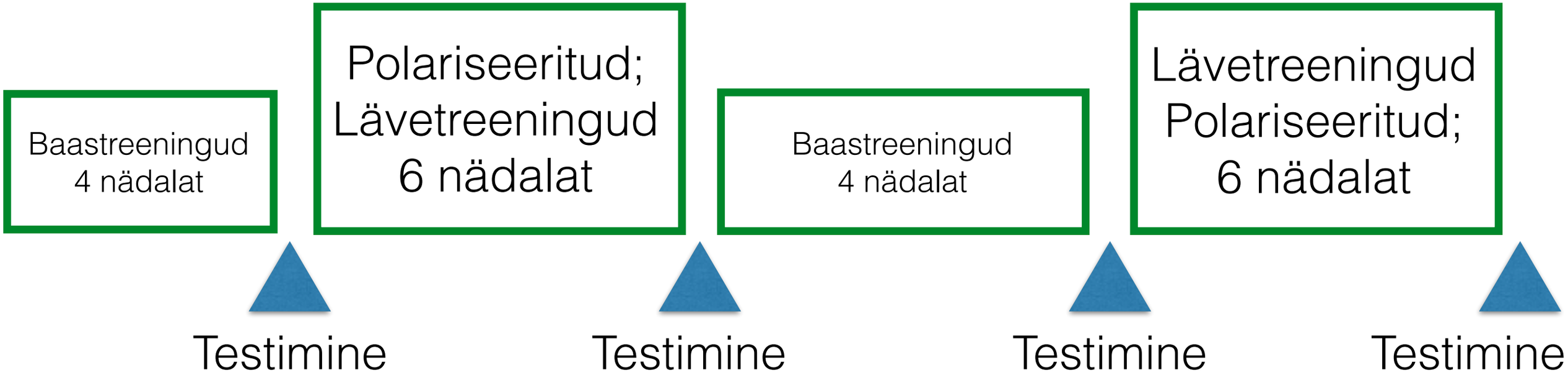
Training methods and intensity distributions in young world class rowers (Guellich jt. 2009)



Six weeks of a polarized training-intensity distribution leads to greater physiological and performance adaptations than a threshold model in trained cyclists

Craig M. Neal,[1] Angus M. Hunter,[1] Lorraine Brennan,[2] Aifric O'Sullivan,[2] D. Lee Hamilton,[1] Giuseppe DeVito,[3] and Stuart D. R. Galloway[1]

J Appl Physiol, 2013



	Units	POL	THR
Total training time	min/wk	381 (±85)	458 (±120)*
Training load	intensity zone × duration	517 (±90)	633 (±119)*
Zone 1	% of training time	80 (±4)	57 (±10)*
Zone 2	% of training time	0 (±0)	43 (±10)*
Zone 3	% of training time	20 (±4)	0 (±0)*

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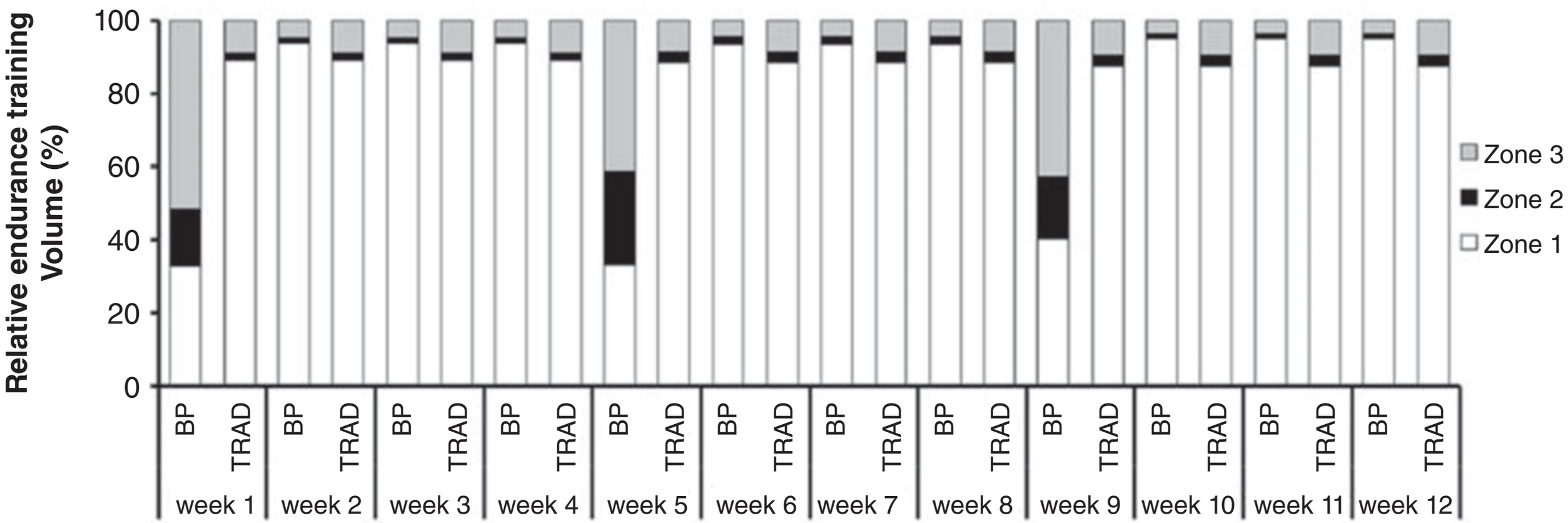
J Appl Physiol, 2013

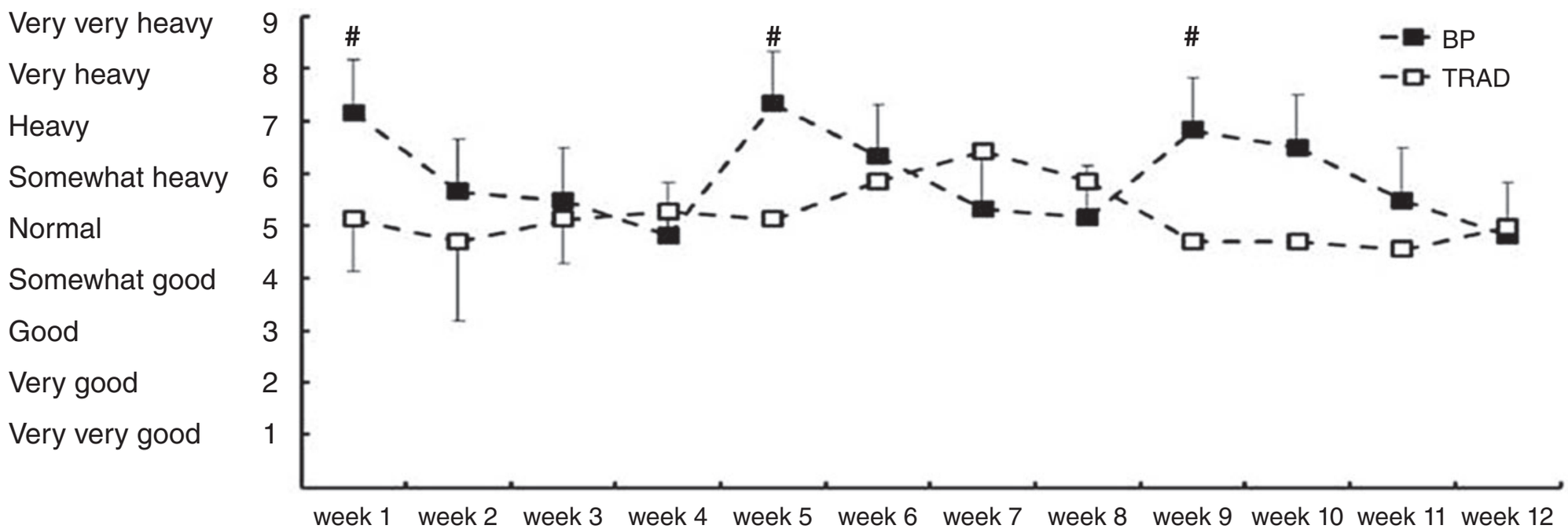
Training Model	Measure	Δ, %	Effect Size	Descriptor*
POL	40-km TT MPO, W	8 (±8)	0.57	Moderate
	LT, W	9 (±9)†	0.59	Moderate
	LTP, W	6 (±10)	0.40	Small
	PPO, W	8 (±5)†	0.77	Moderate
	95% exercise capacity, s	85 (±43)†	2.44	Large
THR	40-km TT MPO, W	4 (±6)	0.35	Small
	LT, W	2 (±14)	0.11	Trivial
	LTP, W	4 (±7)	0.34	Small
	PPO, W	3 (±4)	0.26	Small
	95% exercise capacity, s	37 (±45)	0.99	Large

Effects of 12 weeks of block periodization on performance and performance indices in well-trained cyclists (Ronnestad jt, 2014)

	BP ($n = 8$)	TRAD ($n = 7$)
Body mass (kg)	76 ± 7	78 ± 7
Body height (cm)	181 ± 5	182 ± 6
Age (years)	32 ± 7	34 ± 6
Experience (years)	6 ± 4	6 ± 4
VO_{2max} (L/min)	4.7 ± 0.5	4.9 ± 0.5

- Astmeline koormustest
- 40 km time-rial





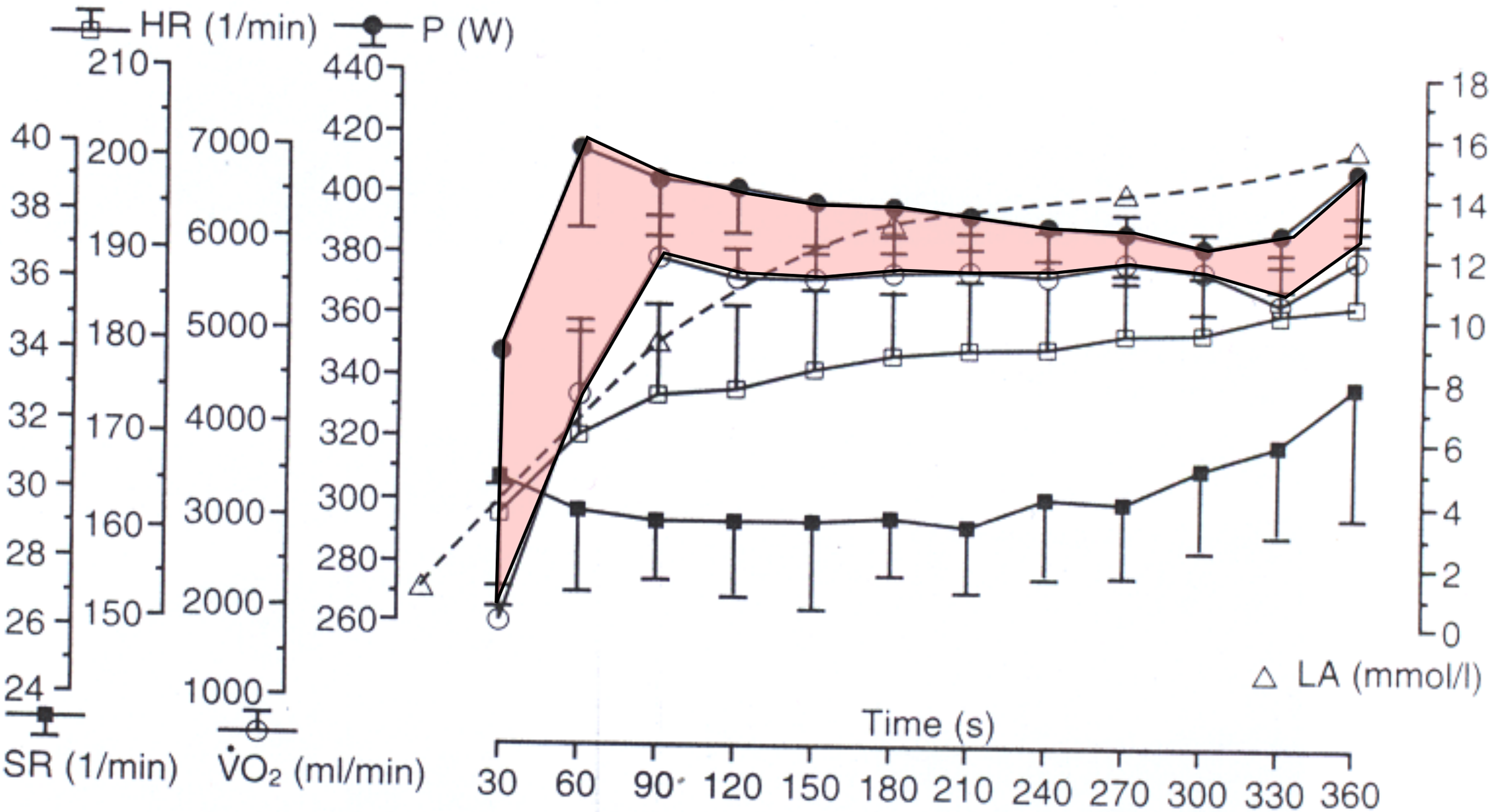
	BP ($n = 8$)		TRAD ($n = 7$)		Magnitude o
	Pre	Post	Pre	Post	BP vs TRAD
VO_{2max} (L/min)	4.7 ± 0.5	5.1 ± 0.6*‡	4.9 ± 0.5	5.1 ± 0.6*	0.99
(mL/kg/min)	62 ± 2	68 ± 5*†	63 ± 3	66 ± 4*	1.08
HR_{peak} (beats/min)	187 ± 15	186 ± 15	182 ± 12	179 ± 12	
[La^-] (mmol/L)	13 ± 2	12 ± 3	11 ± 1	12 ± 2	
RPE	19 ± 1	19 ± 1	19 ± 1	19 ± 1	
W_{max} (W/kg)	5.40 ± 0.33	5.80 ± 0.43*	5.45 ± 0.32	5.67 ± 0.40	0.62
Hemoglobin mass (g)	999 ± 136	1053 ± 130*	1088 ± 123	1098 ± 120	0.83
$Power_{2mmol/L}$ (W/kg)	2.89 ± 0.50	3.49 ± 0.46*‡	3.23 ± 0.43	3.56 ± 0.41*	1.12
$\%VO_{2max}$	64 ± 9	67 ± 8	68 ± 7	70 ± 7	
Gross efficiency (%)	20.3 ± 0.8	20.9 ± 0.7	19.6 ± 0.4	19.5 ± 0.4	1.10
$Power_{40\ min}$ (W/kg)	3.71 ± 0.38	4.00 ± 0.31*	3.98 ± 0.31	4.14 ± 0.30*	0.89

Ronnestad jt, 2014

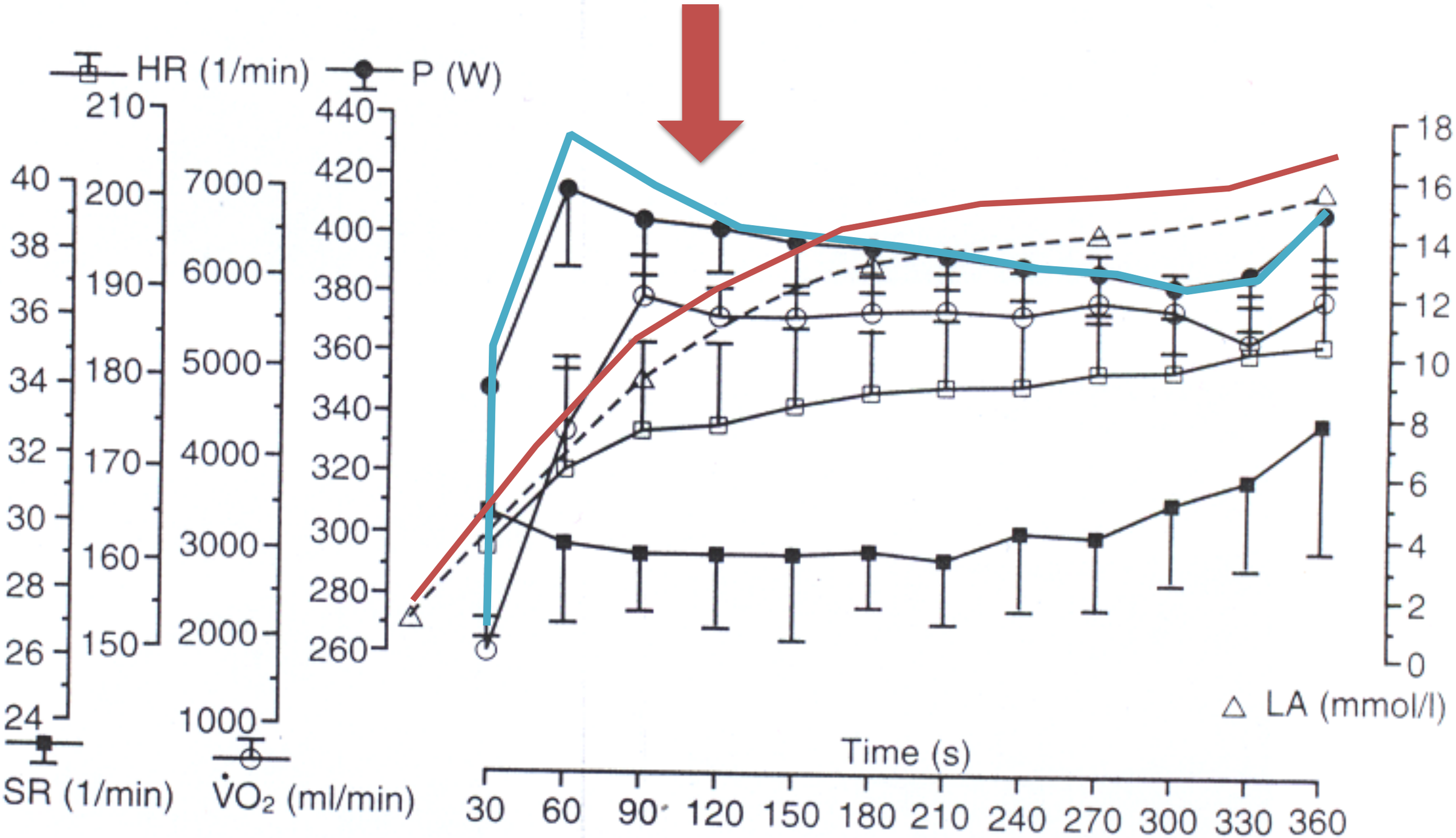
Austraalia sõudekoondise funktsionaalsed näitajad

	Heavyweight men's sweep	Heavyweight men's sculling
Physiological characteristics		
VO_2max ($L \cdot min^{-1}$)	6.3 (5.9–6.8)	6.5 (6.3–6.7)
Power at VO_2max (W)	422 (400–458)	425 (406–431)
Final step MPO (W)	514 (439–564)	483 (449–509)
[BLa] at LT1 ($mmol \cdot L^{-1}$)	1.5 (1.1–2.2)	1.8 (1.5–2.2)
Power at LT1 (W)	275 (220–312)	271 (246–303)
[BLa] at LT2 ($mmol \cdot L^{-1}$)	3.3 (2.5–4.2)	3.9 (2.8–4.6)
Power at LT2 (W)	358 (312–393)	356 (335–372)
Time trial performances		
100 m (ss.s)	14.5 (13.7–14.9)	14.6 (14.5–15.1)
500 m (m:ss.s)	1:17.6 (1:13.2–1:19.6)	1:18.4 (1:17.7–1:20.0)
2000 m (m:ss.s)	5:48.9 (5:40.8–5:58.7)	5:52.6 (5:50.6–5:58.1)
6000 m (m:ss.s)	18:56.3 (18:35.9–19:53.6)	19:03.1 (18:49.1–19:11.8)

Energiatootmine 2000m

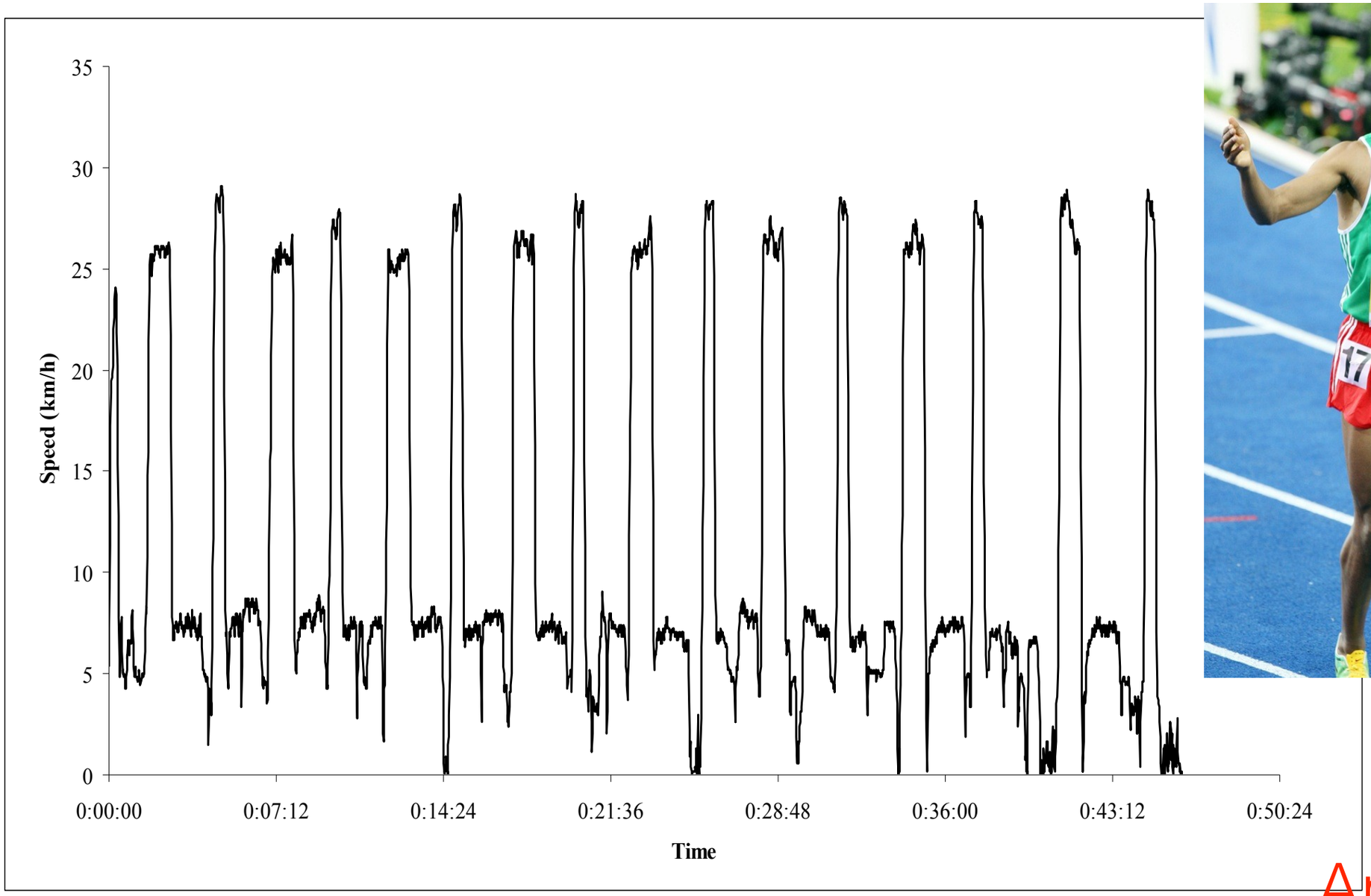


Hartmann, 2007



Hartmann, 2007

Intervalltreening: Kenenisa Bekele



AnL

MAX

VO2max

8 x 400 m 52-54 sek

8 x 200 m 24-25 sek

Kokkuvõte

- Intervalltreeningud on olulised sportlase töövõime arendamisel
- Intervalltreeningute eelduseks on hea aeroobne baas, läbimõeldud planeerimine
- Intervalltreeningute mahtu on võimalik suurendada lävetreeningute arvel
- 80:20 suhe madala ja kõrge intensiivsusega treenigute vahel

Tänan tähelepanu eest!