Reserva anaeróbia e desempenho: o que sabemos até agora?

Prof. Dra. Valéria Leme Gonçalves Panissa

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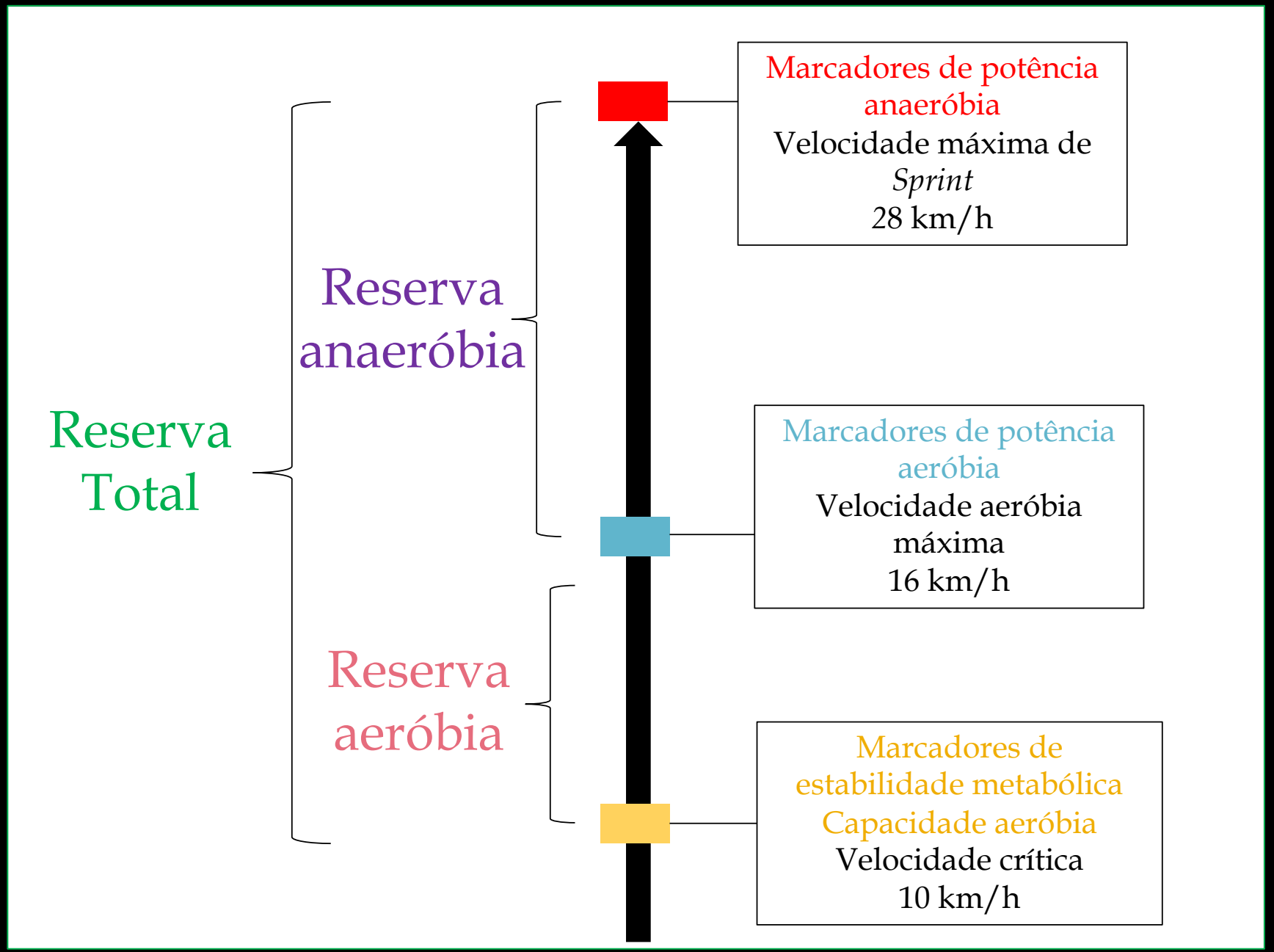
2021



O que é reserva anaeróbia?

Km/h ou watts

1) Reserva anaeróbia e associação com desempenho

2) Reserva anaeróbia na prescrição/predição de exercícios de alta intensidade

Reserva anaeróbia e associação com desempenho

- Relação com desempenho em tarefas de tempo limite acima da vVO2max *(Blondel et al. 2001)*
- Relação com desempenho esportivo em provas de endurance *(Sandford et al. 2019ª, 2019b)*
- Relação com desempenho em protocolos de *hiit* *(Franchini et al. 2021)*

Importante

Reserva anaeróbia na prescrição/predição

- Fazer predições de tempo de exaustão para esforços *all out* com duração entre 0 e 5 minutos (Sander & Hejber, 2018)

- Individualizar a prescrição de *hiit (Julio et al. 2018)*

Reserva anaeróbia e associação com desempenho

Training and Testing

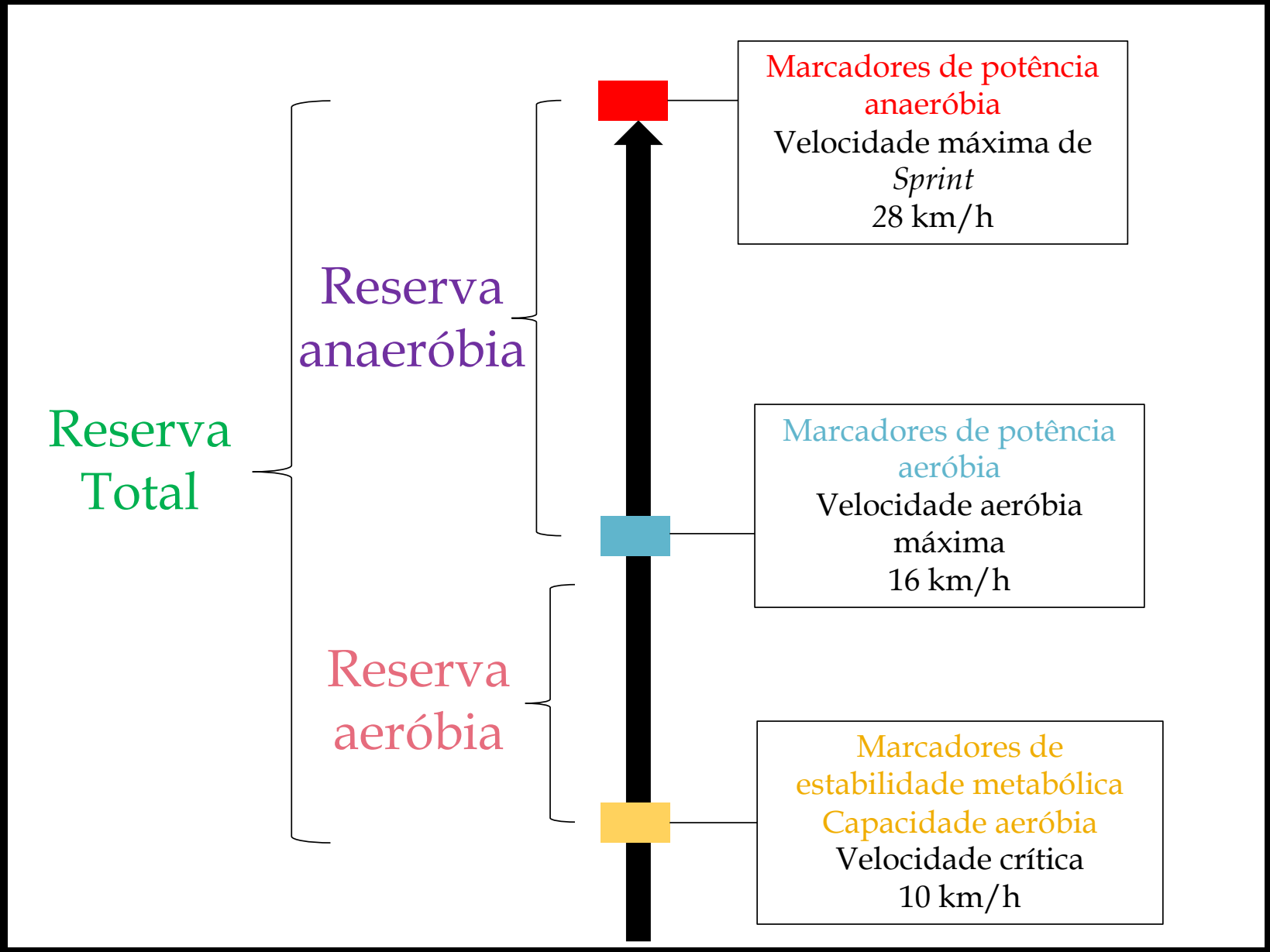
Relationship Between Run Times to Exhaustion at 90, 100, 120, and 140 % of $v\dot{V}O_2max$ and Velocity Expressed Relatively to Critical Velocity and Maximal Velocity

N. Blondel[1, 2], S. Berthoin[1], V. Billat[1], G. Lensel[1]

Int J Sports Med 2001; 22: 27 – 33

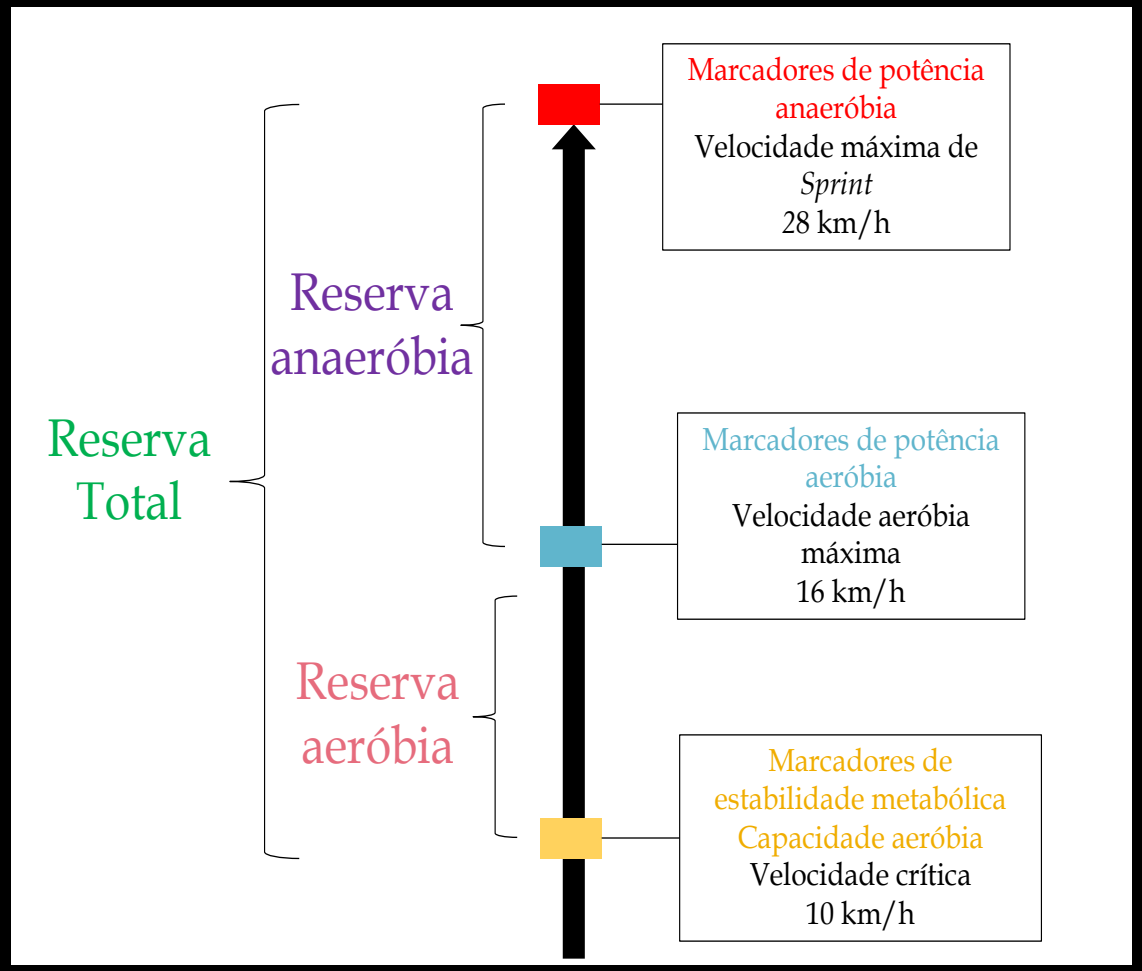
Características do estudo

- 10 fisicamente ativos
- Teste incremental máximo
  - 10 km/h com incremento de 2km/h a cada 4 min
- Teste máximo de Sprint (esforço)
  - 60 m (velocidade mais em 20 metros - fotocélula)
- Tlim em 90, 100, 120 e 140% vVO_2max
  - Performance (tempo), velocidade crítica- capacidade aeróbia)


Marcadores de potência anaeróbia
Velocidade máxima de *Sprint*
28 km/h
Reserva anaeróbia
Reserva Total
Marcadores de potência aeróbia
Velocidade aeróbia máxima
16 km/h
Reserva aeróbia
Marcadores de estabilidade metabólica
Capacidade aeróbia
Velocidade crítica
10 km/h

BLONDEL ET AL. (2001)

- Tlim 90% = 26% CV
- Tlim 100% = 31% CV
- Tlim 120% = 22% CV
- Tlim 140% = 26% CV



Tlim 90%

Tlim 100%

Tlim 120%

Tlim 140%

Regressões simples

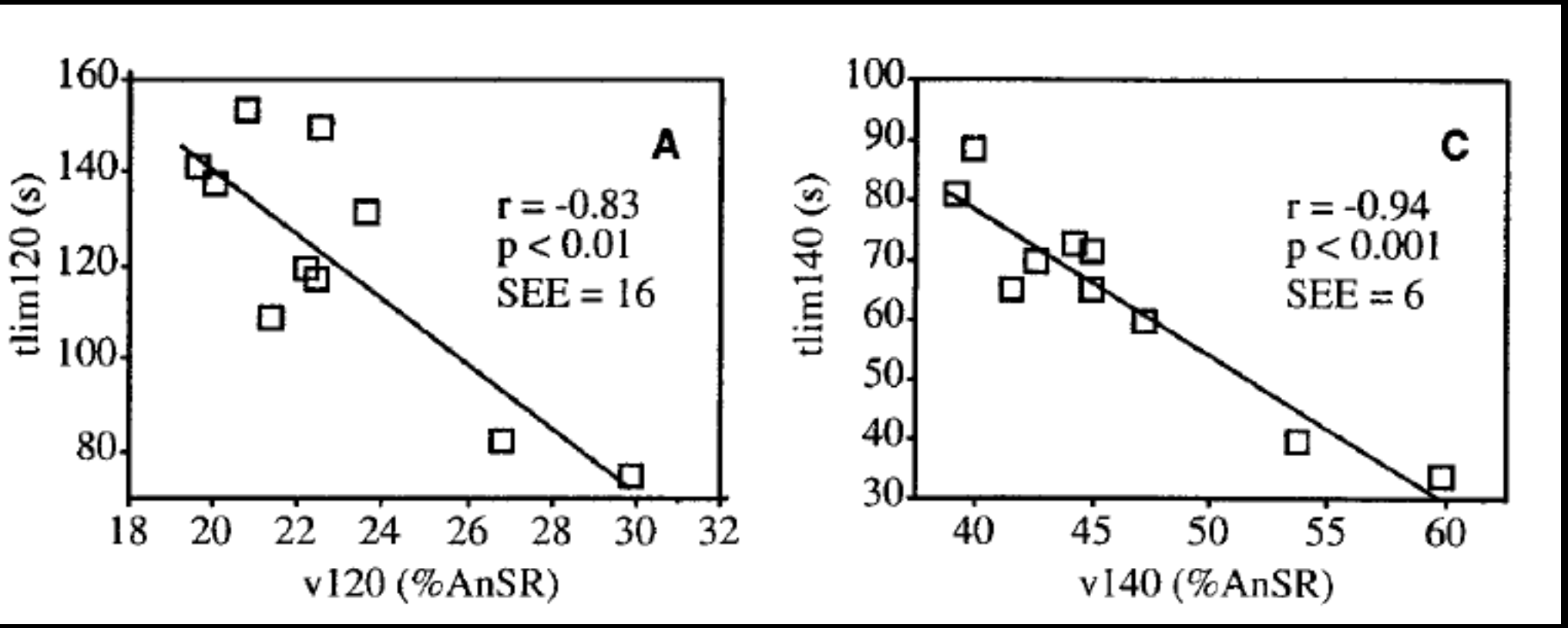
Resultados

Tlim 120% vVO_{2max}
Tlim 140% vVO_{2max}

Relação com % de uso da Reserva

Reserva anaeróbia

There was no relationship between tlim90, tlim100, tlim120, or tlim140 and the respective velocity when expressed as kilometers per hour



Sujeito 5
Vpico = 34,4 km/h
Vam = 17 km/h
Reserva = + 17,4 km/h
V120% = 20,4km/h (+ 3,4 km/h)
Uso da reserva = 20%

Section: Original Investigation

Article Title: Anaerobic Speed Reserve: A Key Component of Elite Male 800m Running

Authors: Gareth N. Sandford[1,2,3], Sian V. Allen[1], Andrew E. Kilding[1], Angus Ross[2,3] and Paul B. Laursen[1]

Affiliations: [1]Sport Performance Research Institute New Zealand (SPRINZ), Auckland University of Technology, Auckland, New Zealand. [2]High Performance Sport New Zealand, Auckland, New Zealand.

Journal: *International Journal of Sports Physiology and Performance*

Acceptance Date: September 28, 2018

Sports Med (2013) 43:313–338
DOI 10.1007/s40279-013-0029-x

REVIEW ARTICLE

High-Intensity Interval Training, Solutions to the Programming Puzzle

Part I: Cardiopulmonary Emphasis

Martin Buchheit · Paul B. Laursen

Características do estudo

- 19 de atletas de elite
- 800m = < 1’47s
- 1500m = < 3’40s
- VAM
- Vpico
- Reserva


OCEANO ÁRTICO
OCEANO ATLÁNTICO
OCEANO PACÍFICO
OCEANO ÍNDICO
OCEANO ATLÁNTICO
OCEANO PACÍFICO

Resultados

- Para uma mesma VAM houve uma correlação alta entre Vpico e reserva anaeróbia com o tempo nos 800m (r = -0,74)

- Para uma mesma Vpico houve uma correlação baixa entre ASR e VAM e o tempo nos 800m (r = -0,16)

Section: Brief Report

Article Title: Implementing Anaerobic Speed Reserve Testing in the Field: Validation of vVO_2max Prediction from 1500m Race Performance in Elite Middle-Distance Runners

Authors: Gareth N. Sandford [1,2,3], Simon A. Rogers[4,5], Avish P. Sharma[4,6], Andrew E. Kilding[1], Angus Ross [2,3] and Paul B. Laursen[1]

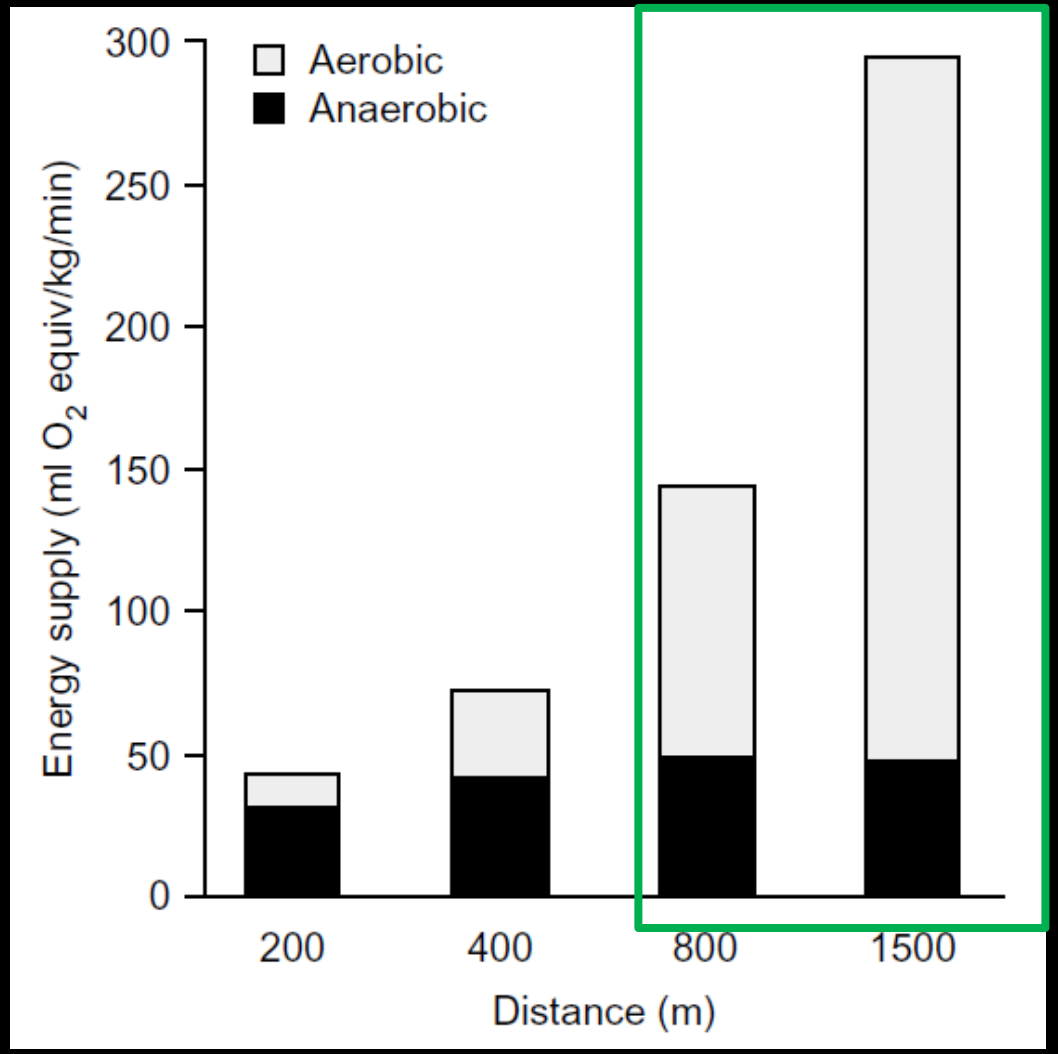
Affiliations: [1]Sports Performance Research Institute New Zealand (SPRINZ), Auckland University of Technology, Auckland, New Zealand. [2]High Performance Sport New Zealand, Auckland, New Zealand. [3]Athletics New Zealand, Auckland, New Zealand. [4]Australian New Zealand, Auckland, New Zealand. [5]Southern Cross University, Coffs Harbour, Australia. [6]University of Canberra Research Institute for Sport and Exercise (UCRISE), University of Canberra, Canberra, Australia.

Journal: *International Journal of Sports Physiology and Performance*

Acceptance Date: January 15, 2019

vVO2máx = -0,90

Reserva = -0,68



107s

Duration of exhaustive exercise (sec)	% Anaerobic	% Aerobic[a]
0-10	94	6
0-15	88	12
0-20	82	18
0-30	73	27
0-45	63	37
0-60	55	45
0-75	49	51
0-90	44	56
0-120	37	63
0-180	27	73
0-240	21	79

Gastin (2001)

Journal of Science in Sport and Exercise
https://doi.org/10.1007/s42978-021-00119-z

ORIGINAL ARTICLE

Assessment of the Anaerobic Speed Reserve during Specific High-Intensity Exercise in Judo Athletes

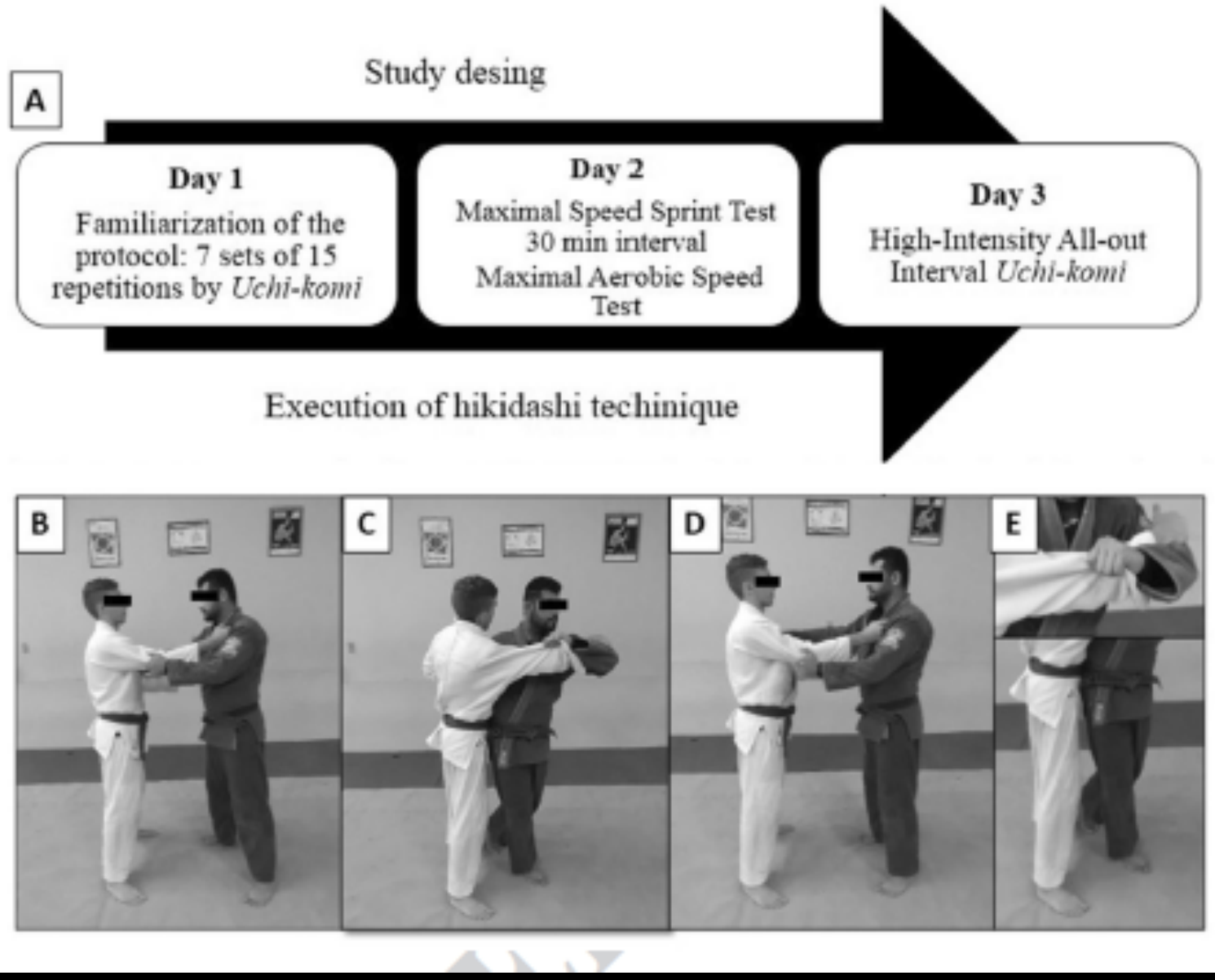
Emerson Franchini[1] · Rafael Lima Kons[2] · Valéria Leme Gonçalves Panissa[1] · Daniele Detanico[2]

Use of the anaerobic speed reserve during high-intensity interval exercise in judo athletes

- *Maximal sprint speed test (*5-repetition set of judo-specific movement (*hikidashi*) at all-out intensity)

- *Maximal aerobic speed test (*initial speed was set at 32 rep.min^{-1} and each stage lasted 1 min with 3 rep.min^{-1} increments)

- *High-intensity all-out interval uchi-komi protocol (*12 series of 20 seconds of *hikidashi* movement at all-out intensity with 10 seconds of interval between sets,)


A
Study desing
Day 1
Familiarization of the protocol: 7 sets of 15 repetitions by Uchi-komi
Day 2
Maximal Speed Sprint Test
30 min interval
Maximal Aerobic Speed Test
Day 3
High-Intensity All-out Interval Uchi-komi
Execution of hikidashi techinique
B
C
D
E

Use of the anaerobic speed reserve during high-intensity interval exercise in judo athletes

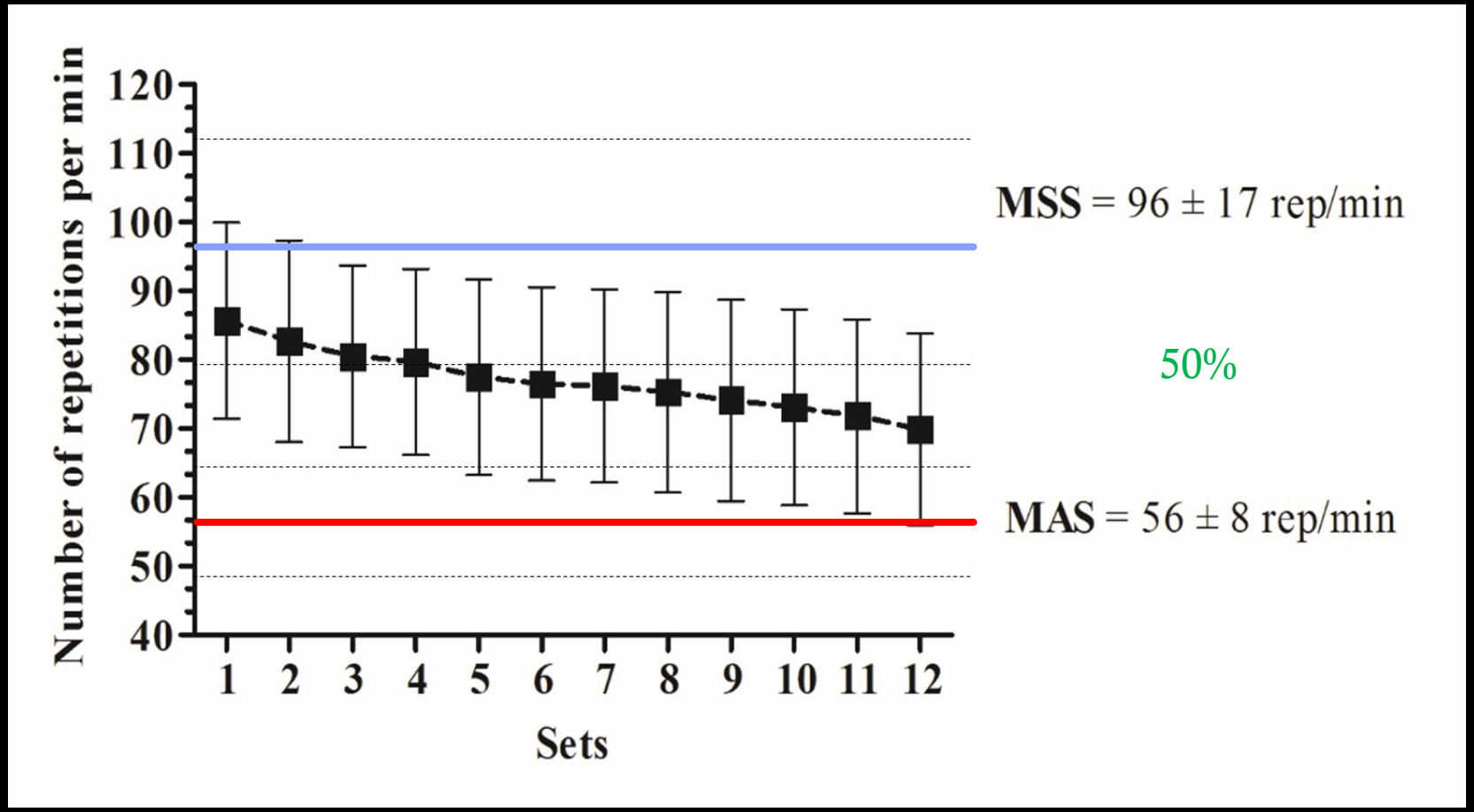


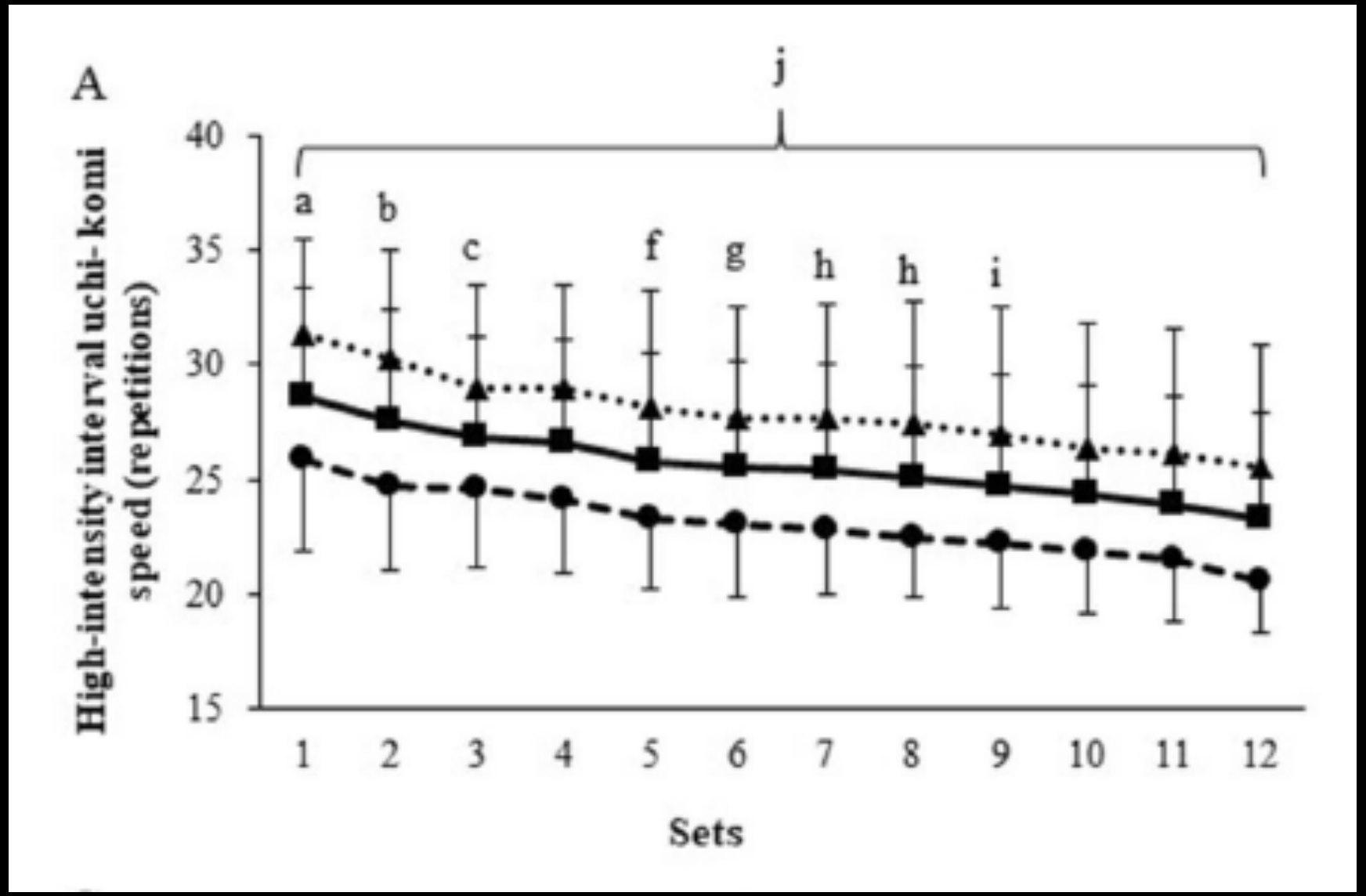
Table 1 Perceived and physiological responses in maximal sprint speed and maximal aerobic speed tests (mean ± standard deviation)

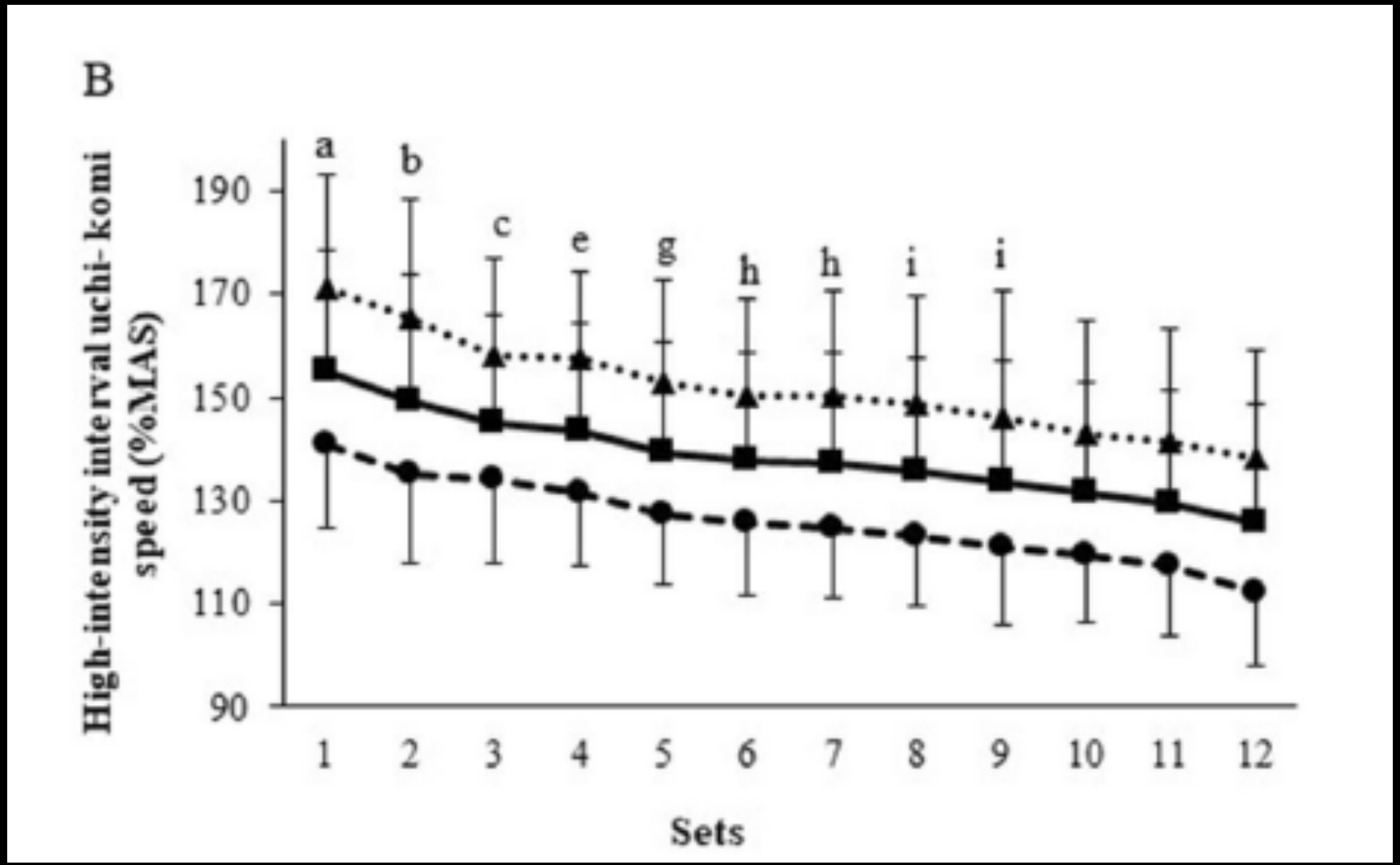
	All ($n=28$)	Low ASR ($n=12$)	High ASR ($n=12$)
Maximal sprint speed test			
RPE (a.u.)	7 ± 1	7 ± 0	7 ± 0
HR_{max} (bpm)	105 ± 23	116 ± 14	96 ± 30[a]
MSS (rep/min)	96.2 ± 17.4	82.2 ± 8.1	110.2 ± 14.5[b]
Maximal aerobic speed test			
RPE (a.u.)	19 ± 1	19 ± 0	19 ± 0
HR_{max} (bpm)	187 ± 5	189 ± 6	186 ± 5
MAS (rep/min)	55.8 ± 7.9	55.3 ± 7.1	55.3 ± 8.2

RPE rating of perceived exertion, *a.u.* arbitrary units, HR_{max} heart rate, *bpm* beat per minute, *MSS* maximal sprint speed, *MAS* maximal aerobic speed

[a]Higher than the low ASR group ($p<0.001$)

[b]Lower than the low ASR group ($p<0.001$)


A
j
40
35
30
25
20
15
a
b
c
f
g
h
h
i
1
2
3
4
5
6
7
8
9
10
11
12
High-intensity interval uchi-komi speed (repetitions)
Sets


B
High-intensity interval uchi- komi speed (%MAS)
190
170
150
130
110
90
a
b
c
e
g
h
h
i
i
1
2
3
4
5
6
7
8
9
10
11
12
Sets

Individualização e predição na prescrição do exercício de alta intensidade utilizando a reserva anaeróbia

Predições de desempenho em exercício de alta intensidade

JOURNAL OF SPORTS SCIENCES
https://doi.org/10.1080/02640414.2018.1522684

Routledge
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The anaerobic power reserve and its applicability in professional road cycling

Dajo Sanders[a,b] and Mathieu Heijboer[c]

[a]Physiology, Exercise and Nutrition Research Group, University of Stirling, Stirling, UK; [b]Sport, Exercise and Health Research Centre, Newman University, Birmingham, UK; [c]Team LottoNL-Jumbo professional cycling team, Amsterdam, Netherlands

Table 3. Record and predicted power outputs over different durations as well as the predicted power outputs by the original model and four modified approaches.

		Original model PO_{incr} PO_{sp} $k_1 = 0.026$	Modified Approach 1 → PO_{3min} PO_{sp} $k_1 = 0.026$	Modified Approach 2 PO_{incr} PO_{sp} → $k_2 = 0.0244$	Modified Approach 3 → PO_{3min} POsp → $k_2 = 0.0244$	Modified Approach 4 → PO_{3min} POsp → $k_3 = 0.0277$
	Record power output (W)	Predicted power output (W)	Predicted power output (W)	Predicted power output (W)	Predicted power output (W)	Predicted power output (W)
5 s	1210 ± 134	1173 ± 132	1177 ± 133	1179 ± 134	1183 ± 134	1170 ± 135
10 s	1110 ± 116	1086 ± 118	1095 ± 120	1096 ± 120	1105 ± 121	1083 ± 120
15 s	1013 ± 107	1009 ± 105	1023 ± 107	1023 ± 107	1030 ± 105	1008 ± 106
30 s	831 ± 69	831 ± 75	853 ± 80	849 ± 78	871 ± 82	835 ± 78
45 s	714 ± 66	711 ± 56	739 ± 63	729 ± 59	756 ± 66	722 ± 61
60 s	661 ± 69	629 ± 44	662 ± 54	646 ± 45	677 ± 55	646 ± 52
90 s	560 ± 47	536 ± 33	574 ± 46	548 ± 35	584 ± 46	563 ± 45
120 s	529 ± 44	494 ± 30	533 ± 43	501 ± 30	539 ± 44	528 ± 42
150 s	508 ± 44	474 ± 29	514 ± 43	479 ± 29	518 ± 43	512 ± 42
180s	500 ± 42	465 ± 29	506 ± 43	468 ± 29	508 ± 43	506 ± 42

Abbreviations: PO_{incr}, mean power output over the last 6 min stage of the incremental field tests; PO_{sp}, maximal sprint peak power output; PO_{3min}, record power output over 3 min; k_1, exponential decay constant proposed by Weyand et al. (2006); k_2, modified exponential decay constant determined with the individual best fits to the record power outputs using Equation (1); k_2, modified exponential decay constant determined with the individual best fits to the record power outputs using Equation (2)

Predição do tempo de exaustão baseado reserva anaeróbia

- P treino = PAM + (PP – PAM) * $e^{(-0,026*t)}$
- P treino = 458 + (1254 – 458) * $e^{(-0,026*20s)}$ = 931 W
- Um esforço com carga de 931watts terá duração de 20 segundos para esgotar as fontes energéticas!

Similar a modelos usando PC e CTA (distância/kJ)

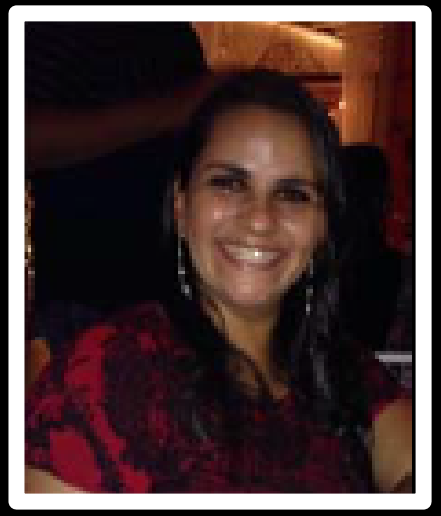
Individualização na prescrição

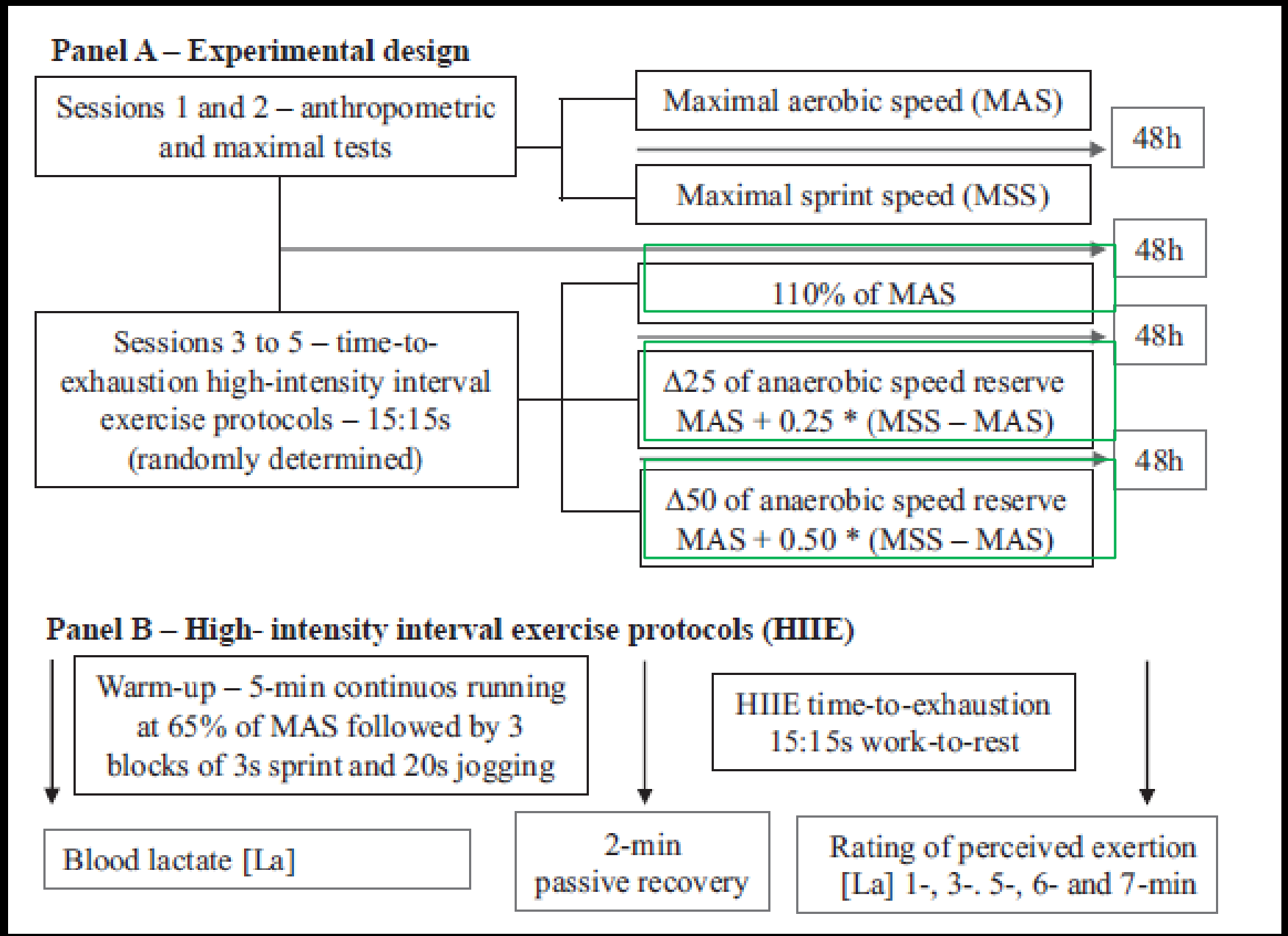
A ‘New’ Method to Normalise Exercise Intensity

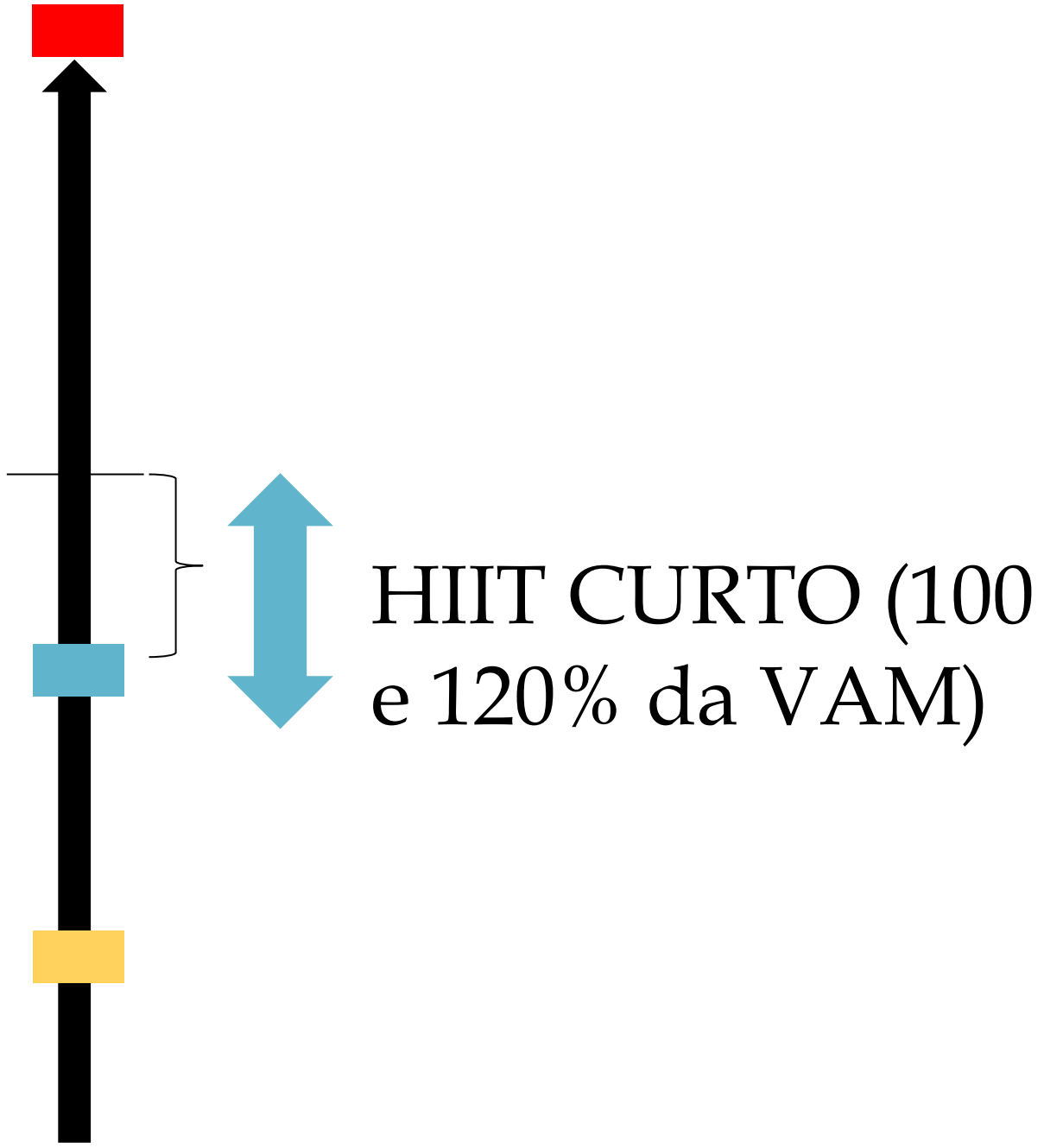
Authors	K. E. Lansley, F. J. DiMenna, S. J. Bailey, A. M. Jones
Affiliation	Exeter University, Sport and Health Sciences, Exeter, United Kingdom

Use of the anaerobic speed reserve to normalize the prescription of high-intensity interval exercise intensity

Ursula F. Julio, Valéria L. G. Panissa, Ana C. Paludo, Elaine D. Alves, Fábio A. D. Campos & Emerson Franchini




Panel A – Experimental design
Sessions 1 and 2 – anthropometric and maximal tests
Maximal aerobic speed (MAS)
Maximal sprint speed (MSS)
48h
48h
110% of MAS
48h
Δ25 of anaerobic speed reserve
MAS + 0.25 * (MSS – MAS)
48h
Δ50 of anaerobic speed reserve
MAS + 0.50 * (MSS – MAS)
Sessions 3 to 5 – time-to-exhaustion high-intensity interval exercise protocols – 15:15s (randomly determined)
Panel B – High- intensity interval exercise protocols (HIIE)
Warm-up – 5-min continuos running at 65% of MAS followed by 3 blocks of 3s sprint and 20s jogging
HIIE time-to-exhaustion 15:15s work-to-rest
Blood lactate [La]
2-min passive recovery
Rating of perceived exertion [La] 1-, 3-. 5-, 6- and 7-min


HIIT CURTO (100
e 120% da VAM)

Características *HIIT* esforços curtos ou intervalado intensivo

- Característica central – intensidades entre a ~100% e ~120% do vVO_2máx/VAM/PAM
- Duração do esforço inferior a 1 min
- Tempo acima de 90% do VO_2máx como objetivo a ser maximizado
- Exemplo comum: 15s 120% da VAM/PAM : 15s pausa passiva

Protocolos de HIIT curto comumente usados para maximizar o tempo acima de 90% do VO_2máx

Autores	Esforço	Pausa	90%VO_2máx
Dupont et al. (2002)	15s (110% VAM) 15s (120%VAM)	15s passiva 15s passiva	6 min 6 min
De Aguiar et al., (2013)	30s (100%v$VO_{2máx}$) 30s (110% v$VO_{2máx}$)	15s passiva 15s passiva	6min 6min
Cyprian et al. (2016)	15, 30 ou 60s (100%v$VO_{2máx}$)	15, 30 ou 60s (60%$VO_{2máx}$)	6 min
Billat et al. (2000)	15s (100%v$VO_{2máx}$)	15s 70%v$VO_{2máx}$	14 min
Thevenet et al. (2007)	30s (105% VAM)	30s (50%VAM)	12 min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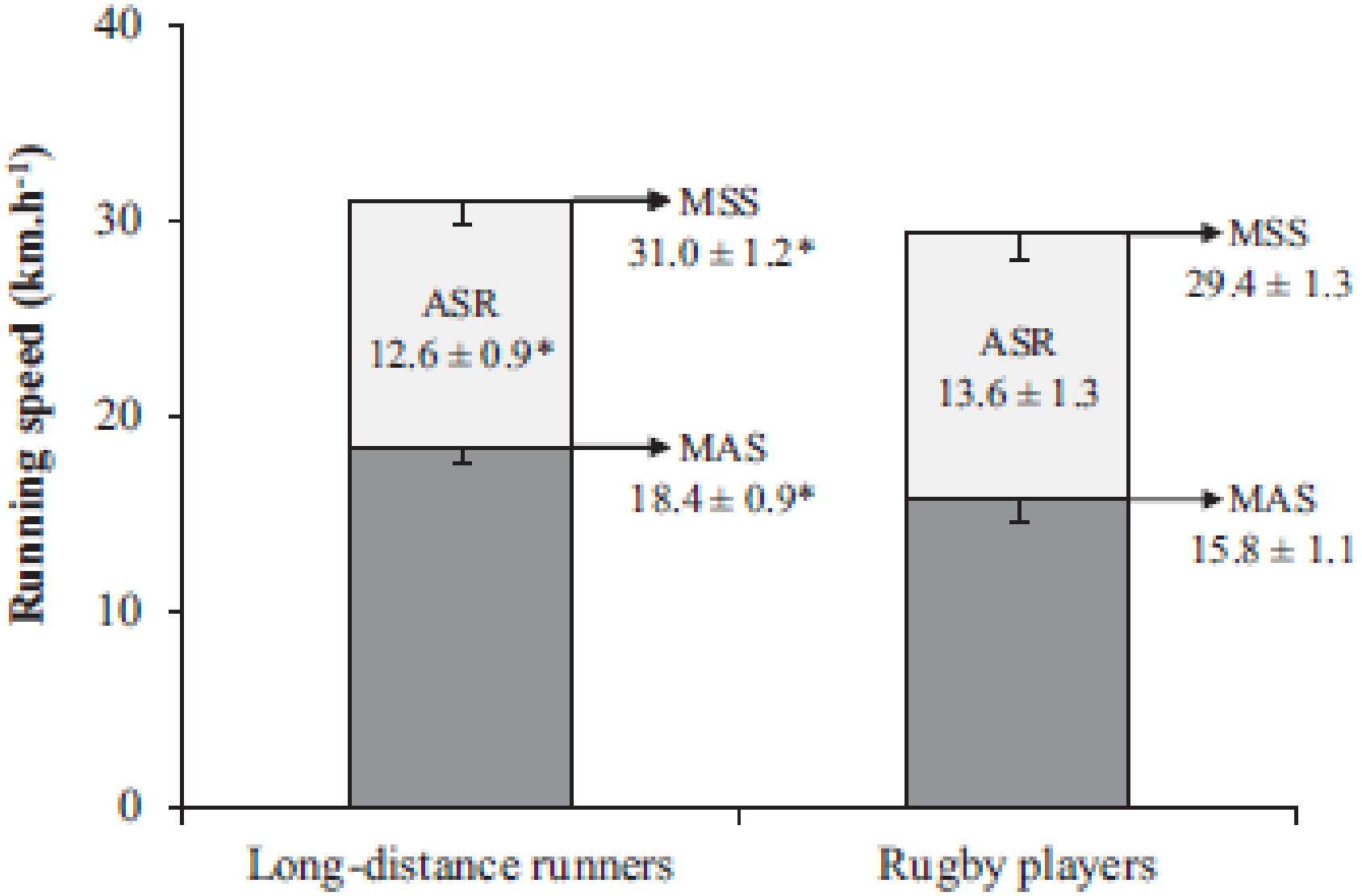
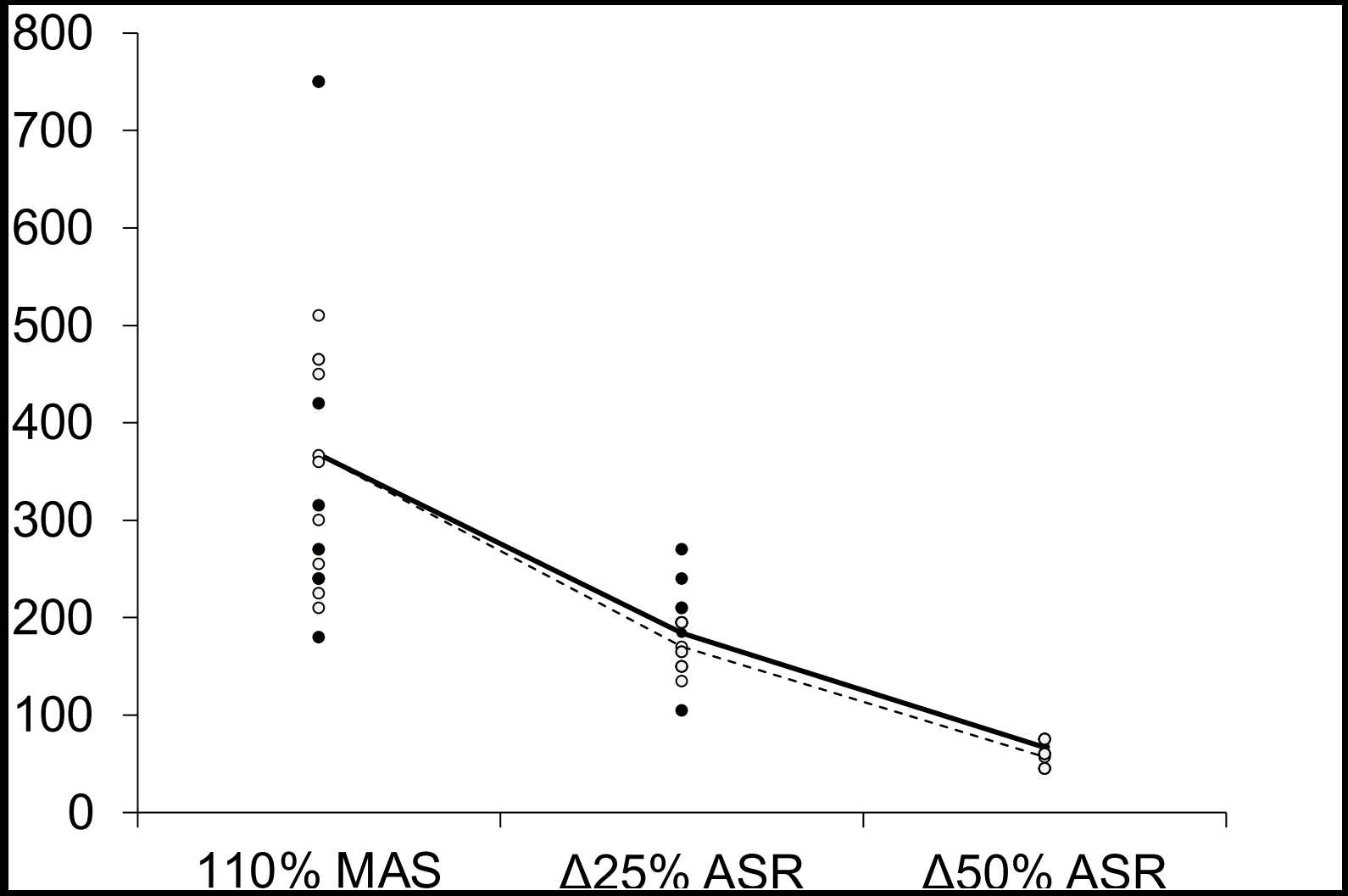
Bradesco


Marilson
M
1


Running speed (km.h-1)
40
30
20
10
0
MSS
31.0 ± 1.2*
ASR
12.6 ± 0.9*
MAS
18.4 ± 0.9*
MSS
29.4 ± 1.3
ASR
13.6 ± 1.3
MAS
15.8 ± 1.1
Long-distance runners
Rugby players

Menor variabilidade quando prescrevemos pela reserva anaeróbia



Contribuição dos sistemas em homens e mulheres durante exercícios intermitentes de alta intensidade para membros superiores

HIIT curto 15s 1205 PAM: 15s pausa passiva

HIIT curto ou intervalado intensivo

Autores	Esforço	Pausa	90%VO_2máx
Dupont et al. (2002)	15s (110% VAM) 15s (120%VAM)	15s passiva 15s passiva	6 min 6 min
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Thevenet et al. (2007)	30s (105% VAM)	30s (50%VAM)	12 min

Tlim 6 a 36 min

Resultados preliminares 15s a 120% PAM : 15s

Tempo total	Número de esforços
2130 (35 min)	71
3600 (60 min)	120
1680 (28 min)	56
2100 (35 min)	70
2370 (38 min)	79
3120 (52 minutos)	104

3 mulheres desistiram após mais de 35 minutos fazendo o protocolo

RESEARCH QUARTERLY FOR EXERCISE AND SPORT
https://doi.org/10.1080/02701367.2019.1576839

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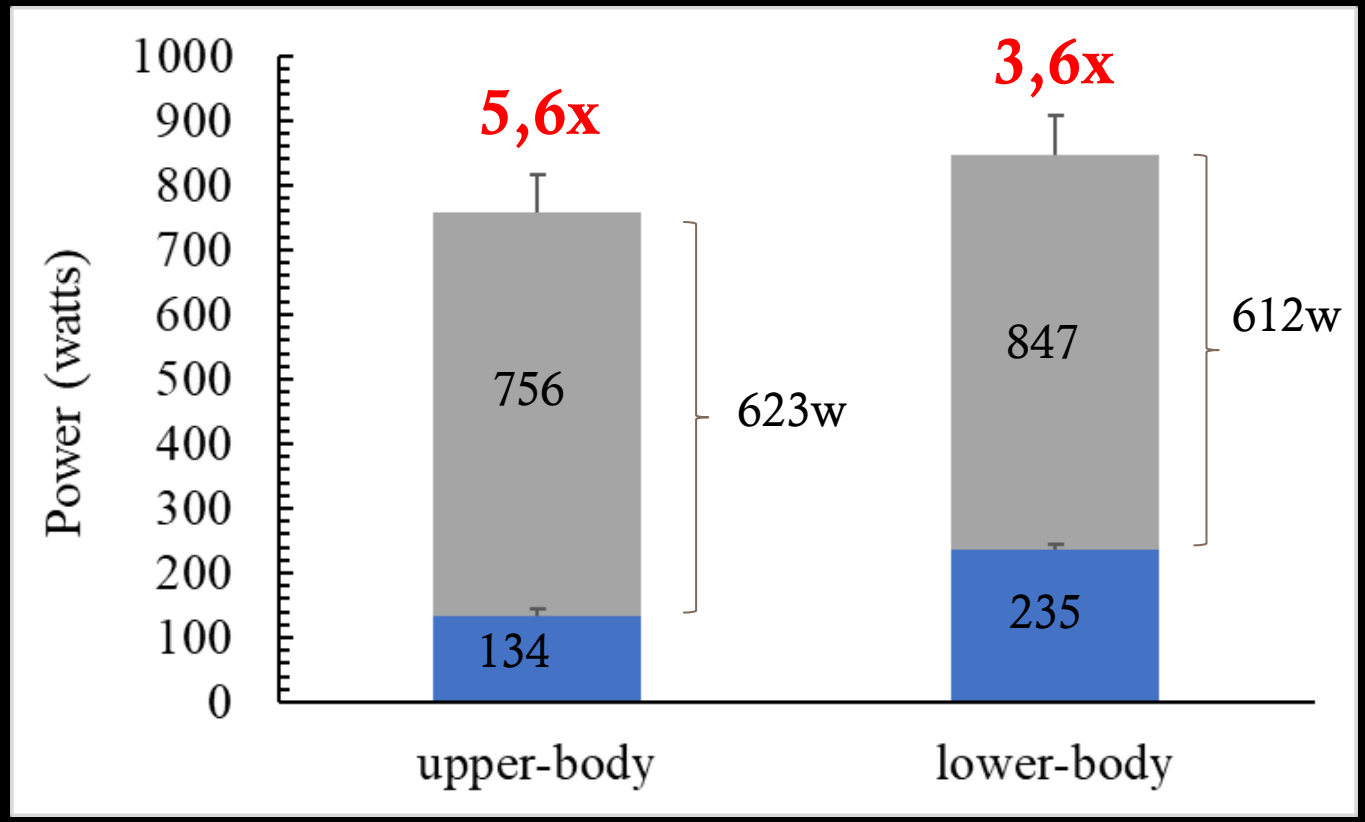
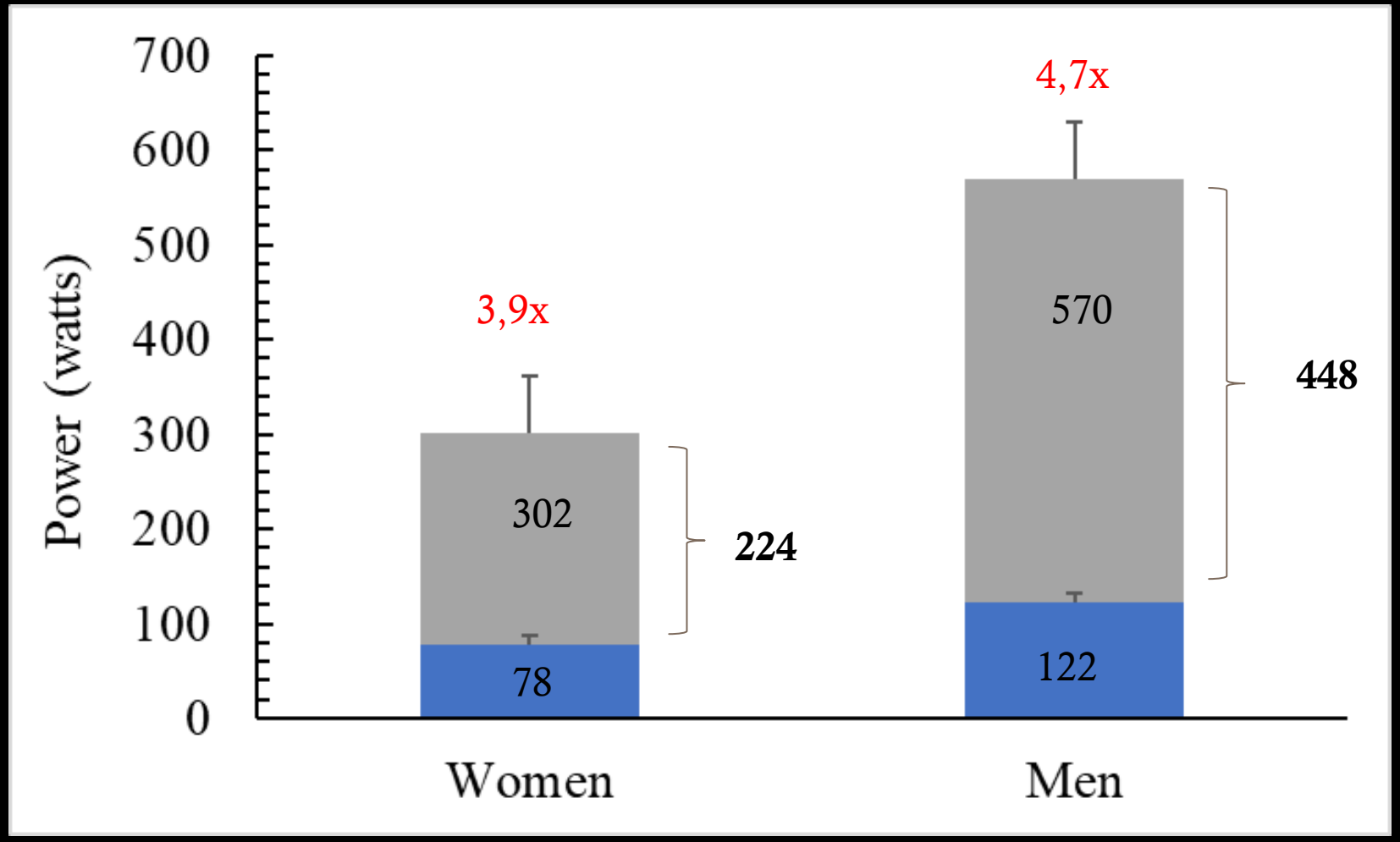
RESEARCH NOTE

Energy System Contributions in Upper and Lower Body Wingate Tests in Highly Trained Athletes

Ursula F. Julio, Valéria L. G. Panissa, Rubiana L. Cury, Marcus F. Agostinho, João V. D. C. Esteves, and Emerson Franchini

University of São Paulo


Power (watts)
1000
900
800
700
600
500
400
300
200
100
0
5,6x
3,6x
756
134
623w
847
235
612w
upper-body
lower-body


Power (watts)
700
600
500
400
300
200
100
0
3,9x
4,7x
302
570
78
122
224
448
Women
Men

O que sabemos até agora?

- **Associações com o desempenho em diversas tarefas**
  - Tempo até exaustão (Blondel et al., 2001)
  - Provas de 800m (Saunders et al., 2019)
  - *HIIT* (Franchini et al., 2021)

Alta intensidade

  - Predição e desempenho (somente um estudo)
  - Prescrição (somente um estudo)
    - ausência de variáveis fisiológicas como consumo de oxigênio
    - diferentes ergômetros, históricos ou estados de treinamento, homens e mulheres

Obrigada!

valeriapanissa@gmail.com

Contribuição dos sistemas em homens e mulheres durante exercícios intermitentes de alta intensidade para membros superiores

HIIT curto 15s 1205 PAM: 15s pausa passiva

HIIT curto ou intervalado intensivo

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Ursula F. Julio, Valéria L. G. Panissa, Rubiana L. Cury, Marcus F. Agostinho, João V. D. C. Esteves, and Emerson Franchini

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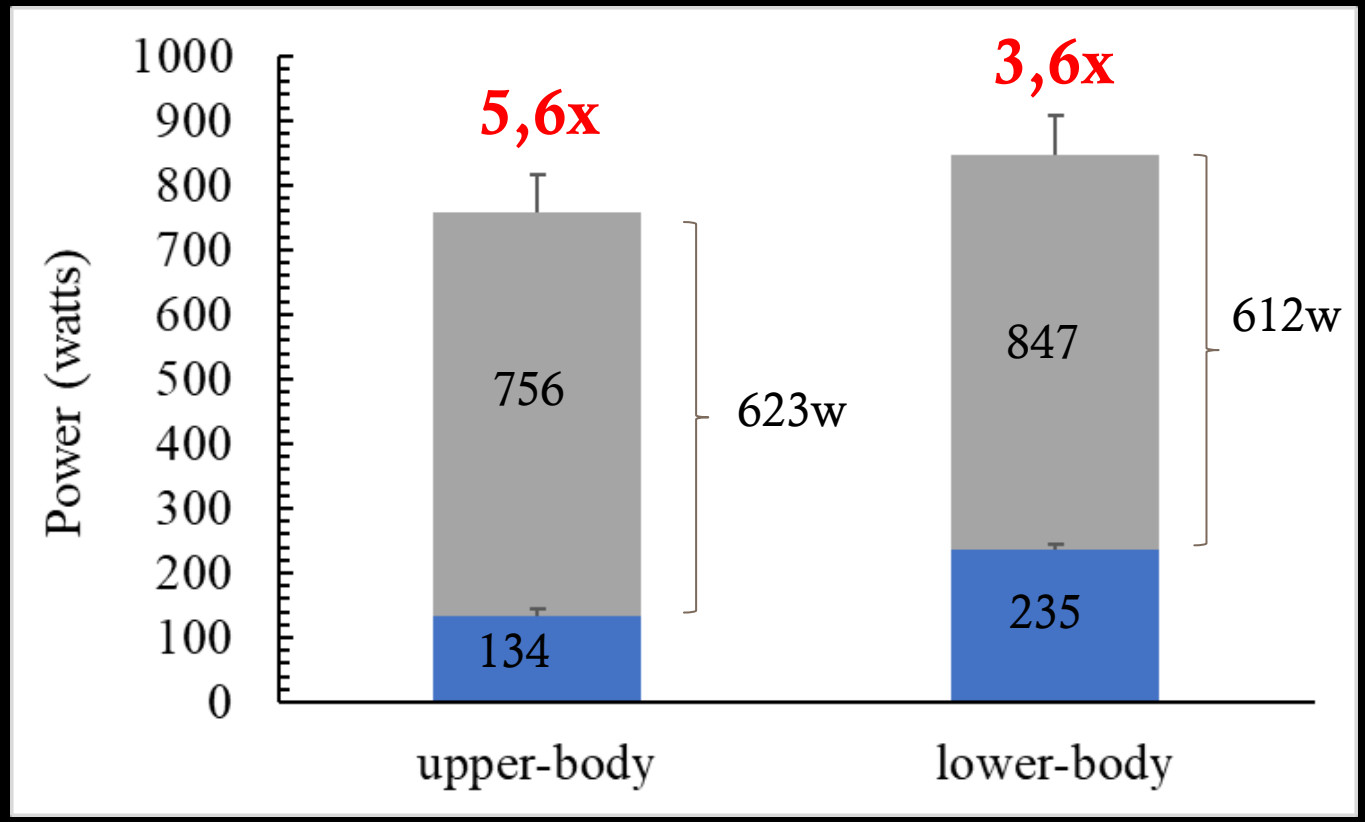
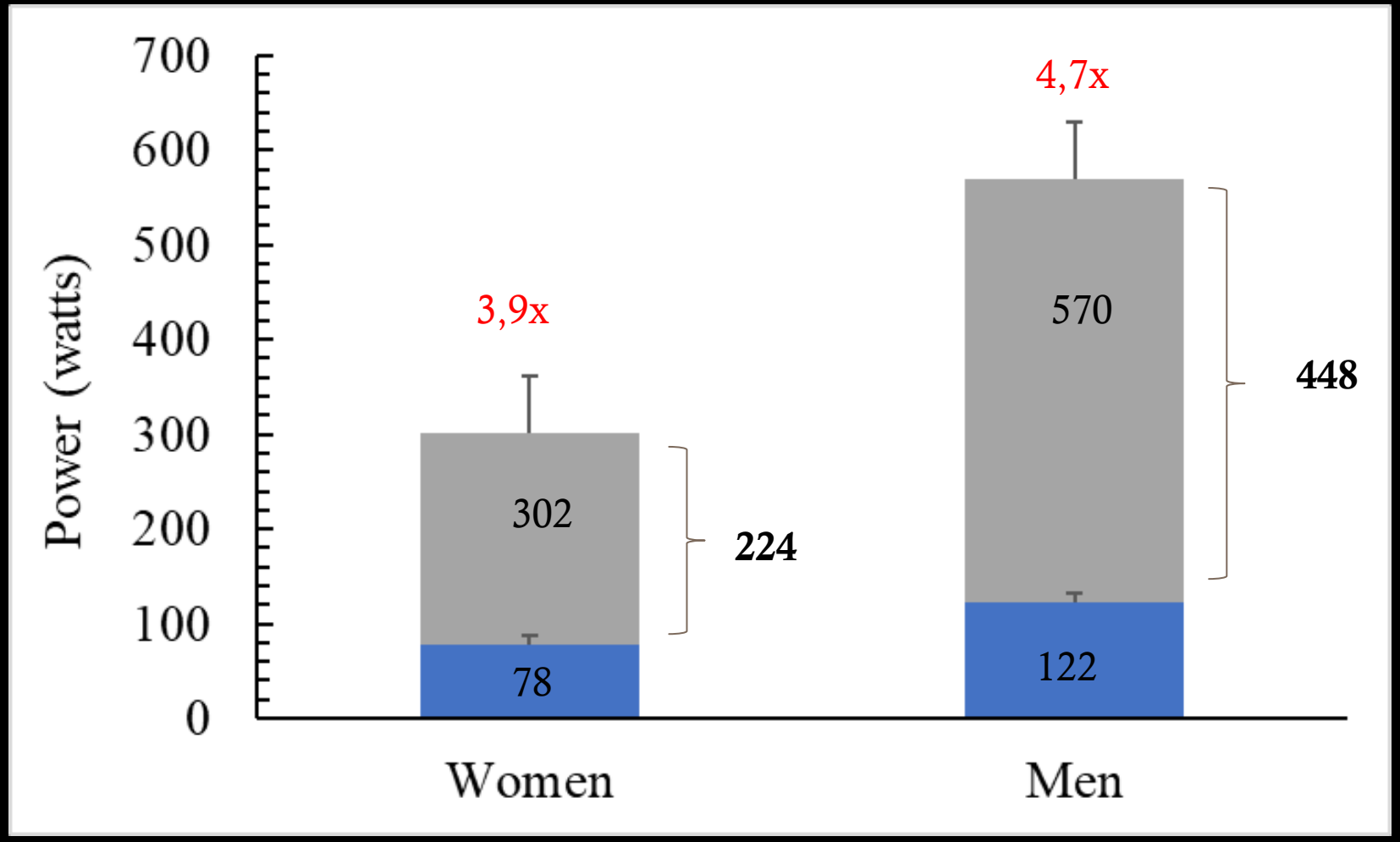

Power (watts)
1000
900
800
700
600
500
400
300
200
100
0
5,6x
3,6x
756
134
623w
847
235
612w
upper-body
lower-body


Power (watts)
700
600
500
400
300
200
100
0
3,9x
4,7x
302
570
78
122
224
448
Women
Men