QuickTime™ en een
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zijn vereist om deze afbeelding weer te geven.

Antagonistic traits in running

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Vanryckeghem Vincent

UZA

SPORTSstaf

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Carnosine

(b-alanyl-L-histidine)

QuickTime™ en een
TIFF (ongecomprimeerd)-decompr
n vereist om deze afbeelding weer

QuickTime™ en
IFF (ongecomprimeerd)-de
ereist om deze afbeelding

QuickTime™ en een
TIFF (ongecomprimeerd)-decompressor
zijn vereist om deze afbeelding weer te geven.

0,1 mmol/L

Vladimir Gulevich (RUS) 1900

- 5-8 mmol/L wet weight
  20-50 mmol/kg dry weight
- [Carnosine] ≈ ATP, taurine, carnitine
  < creatine
- Carnosine synthase, ATP-GD1 gen
  rate limiting precursor β-alanine
- Carnosinase CN1 (bloed) en CN2 (tissue), not in muscle, no non-enzymatic degradation
- Release of carnosine PEPT1, PEPT2 en PHT

pH-buffer

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pKa imidazole = 6.0
histidine = 6.5
carnosine = 6.83

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pH muscle = 6.5-7.1

<u>Histidine ratio</u>

proteins: 1/20
HCD: 1/2

Anti-oxidative potential

Metal chelation (2+)

Anti-glycation

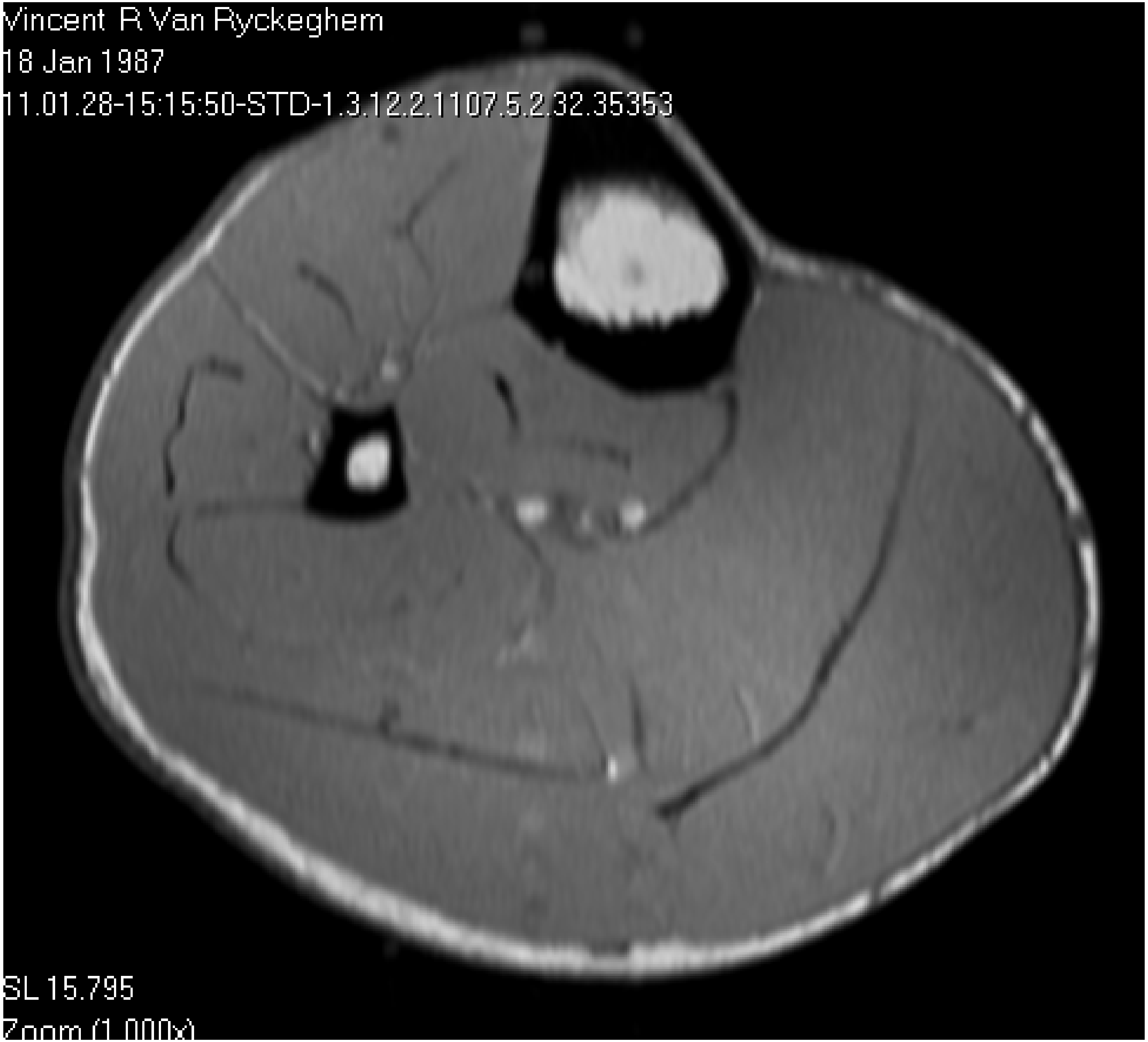
Actieve topatleten

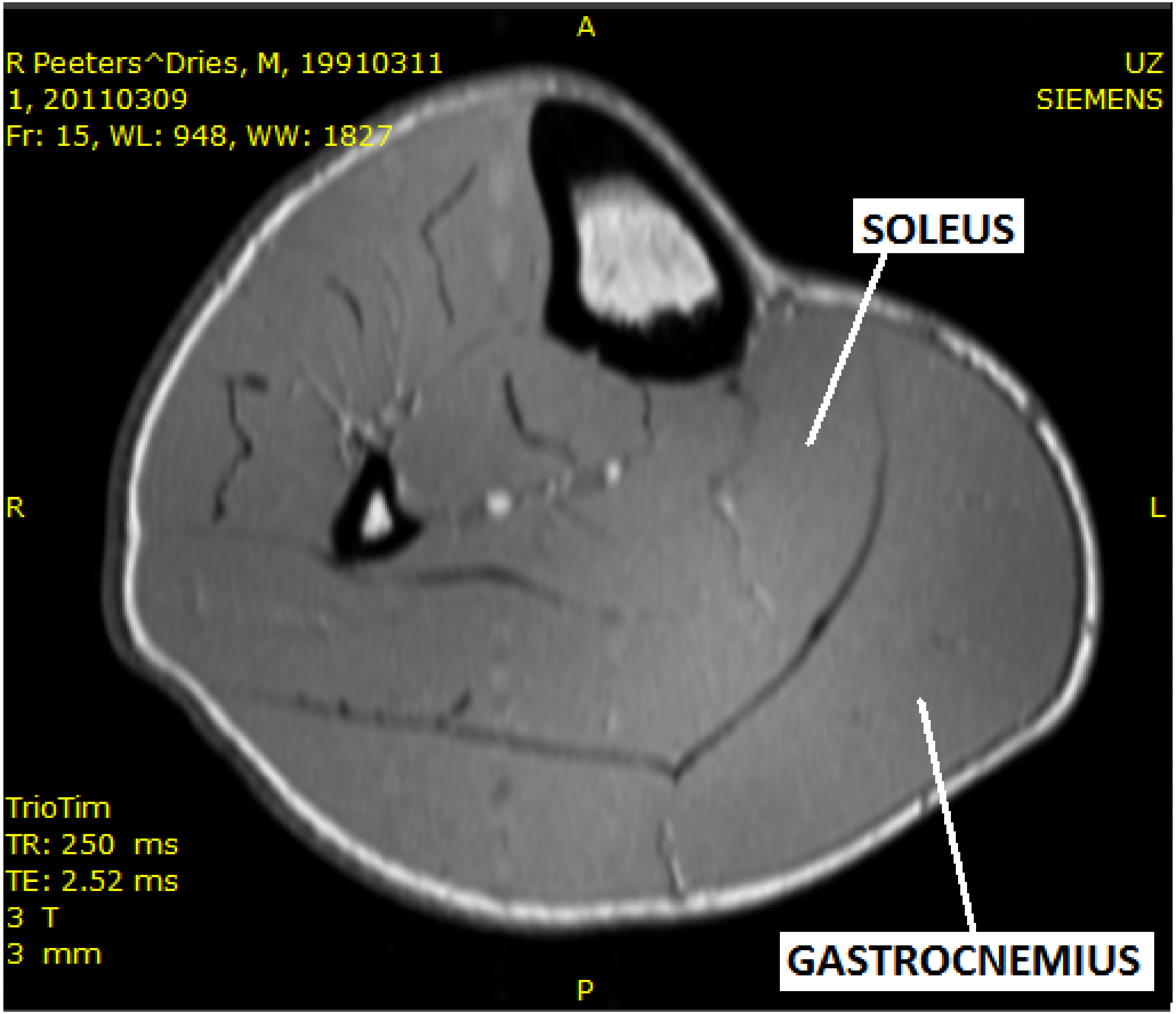
Aantal atleten per discipline	Man	Vrouw	Totaal
Sprint (100m-400m)	10	3	**13**
fond (800 -1500m)	7	2	**9**
Fond (3000m-marathon)	7	5	**12**
Springen	3	6	**9**
Werpen	3	2	**5**
10-kamp	5	/	**5**

Ex-topatleten

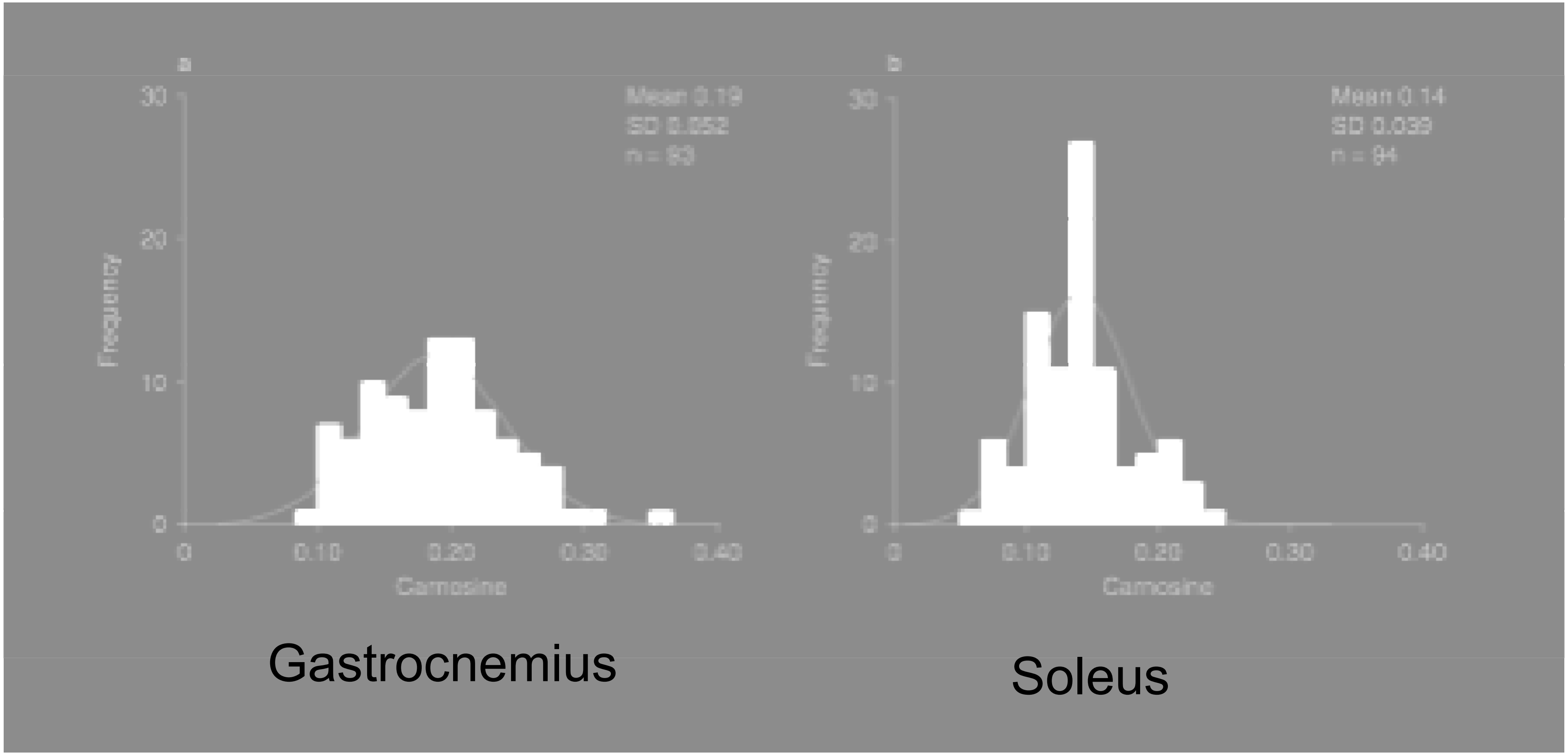
Aantal atleten per discipline	Man	Vrouw	Totaal
Sprint (100m-400m)	6	/	**6**
fond (800-1500m)	3	1	**4**
Fond (3000m-marathon)	8	1	**9**
Springen	1	2	**3**

TOTAAL=53+22=75

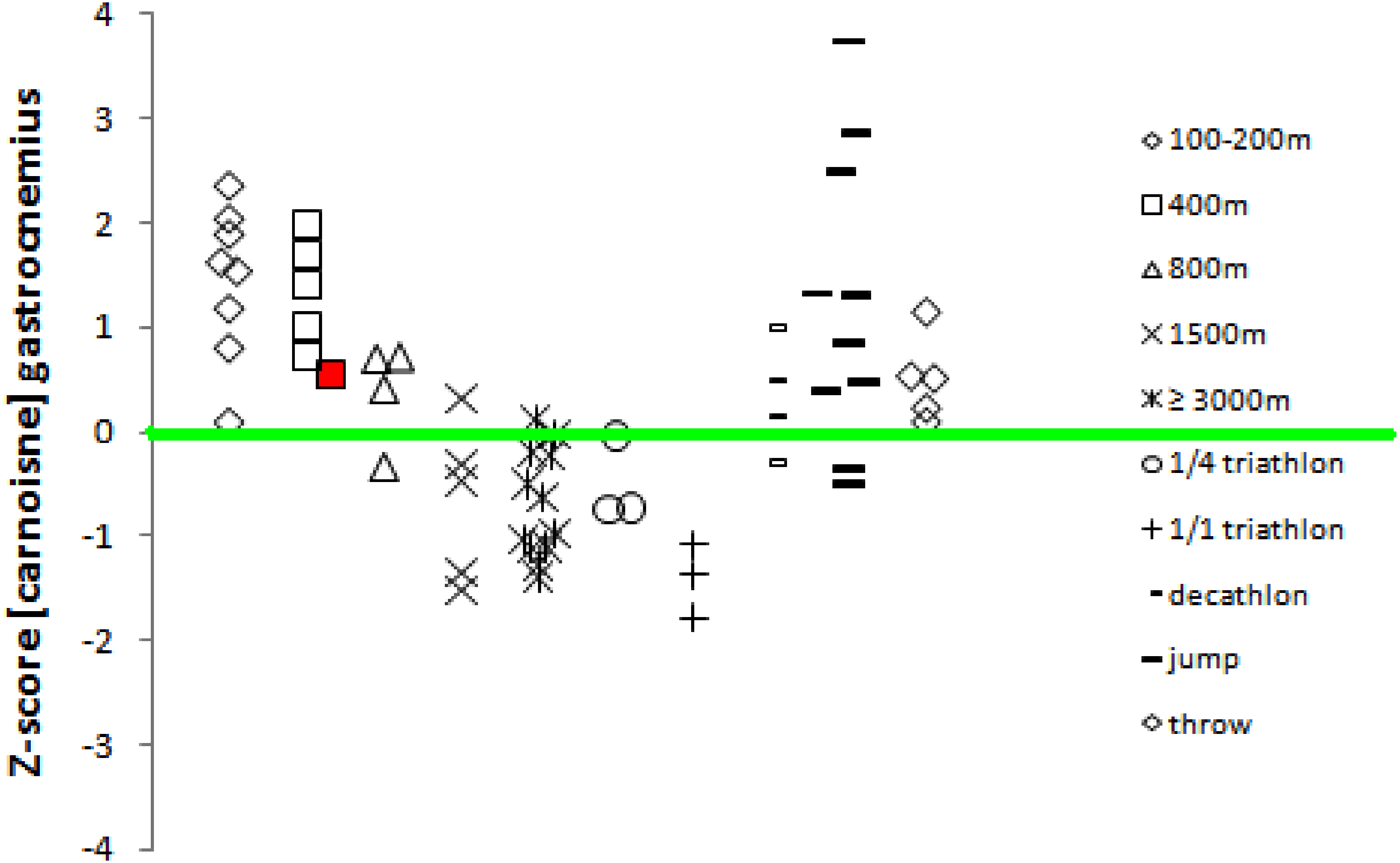

Vincent R Van Ryckeghem
18 Jan 1987
11.01.28-15:15:50-STD-1.3.12.2.1107.5.2.32.35353
SL 15.795
Zoom (1.000x)


A
R Peeters^Dries, M, 19910311
1, 20110309
Fr: 15, WL: 948, WW: 1827
UZ
SIEMENS
SOLEUS
R
L
TrioTim
TR: 250 ms
TE: 2.52 ms
3 T
3 mm
P
GASTROCNEMIUS

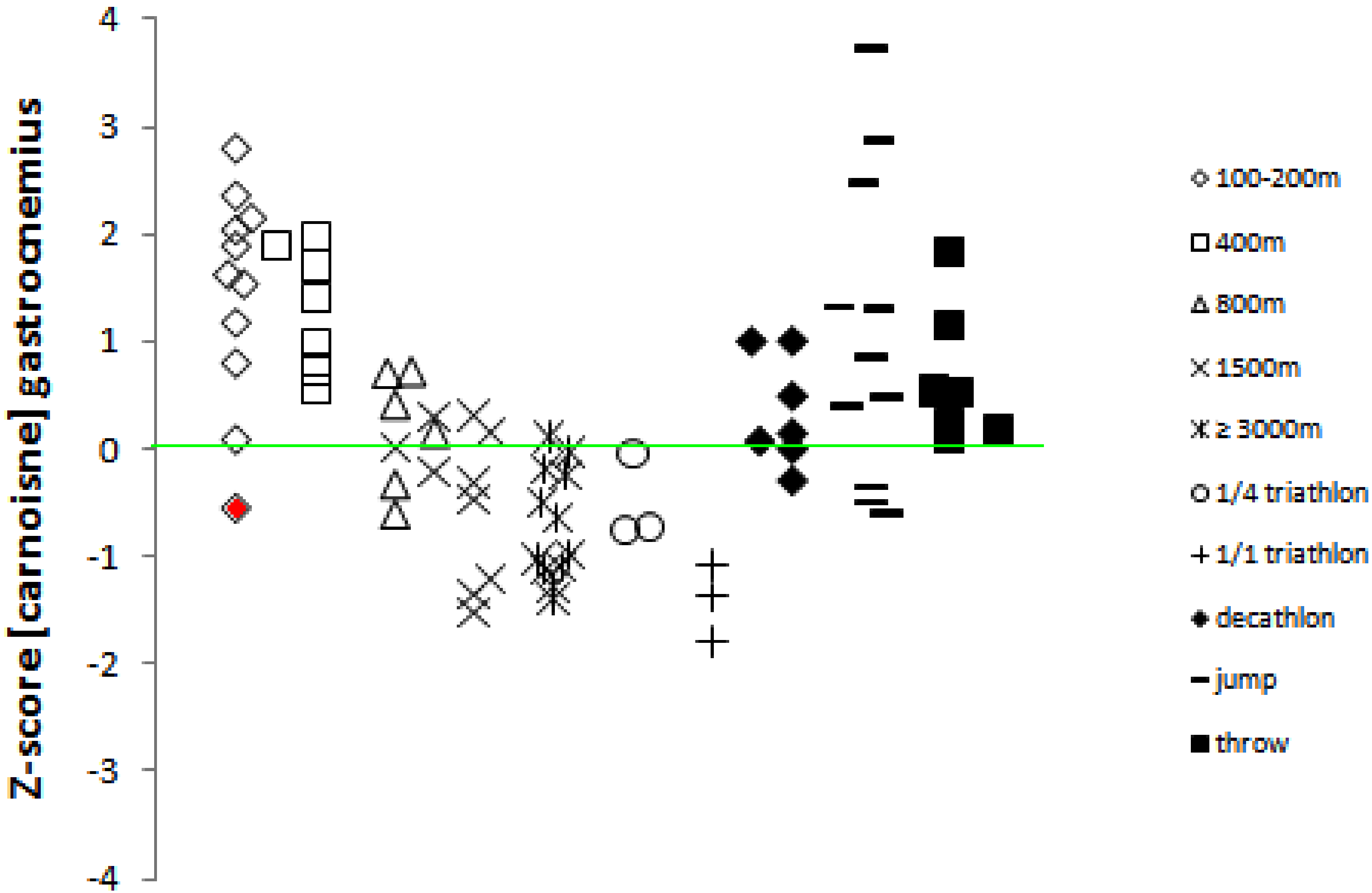
Fast vs. slow-twitch [carnosine] ratio = 1.3-2.0



QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.



Z-score [carnoisne] gastrocnemius
4
3
2
1
0
-1
-2
-3
-4
100-200m
400m
800m
1500m
≥ 3000m
1/4 triathlon
1/1 triathlon
decathlon
jump
throw



Z-score [carnoisne] gastrocnemius
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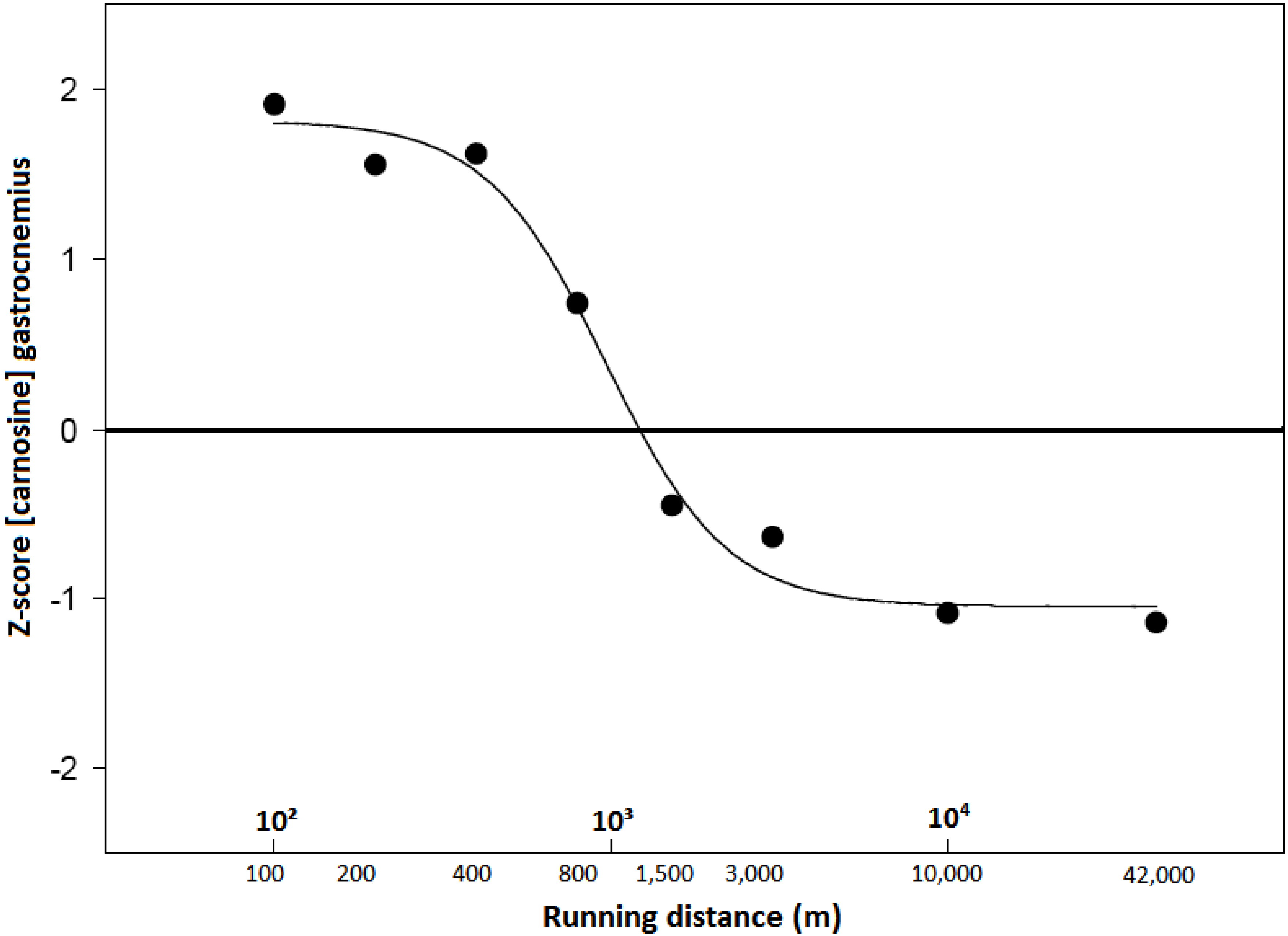
jump
throw



Z-score [carnosine] gastrocnemius
2
1
0
-1
-2
10²
10³
10⁴
100
200
400
800
1,500
3,000
10,000
42,000
Running distance (m)

Beta-alanine

- 100 mg/kg BW
- 4-6 g/d
- Multiple servings (6-8/d) (2h)
- Tot >9w na stop
- +60% in 4w
- +80% in 10w
- In type I and II
- High initial concentration does not impair effectiveness
- Paraesthesia!
- No weight gain!

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zijn vereist om deze afbeelding weer te geven.

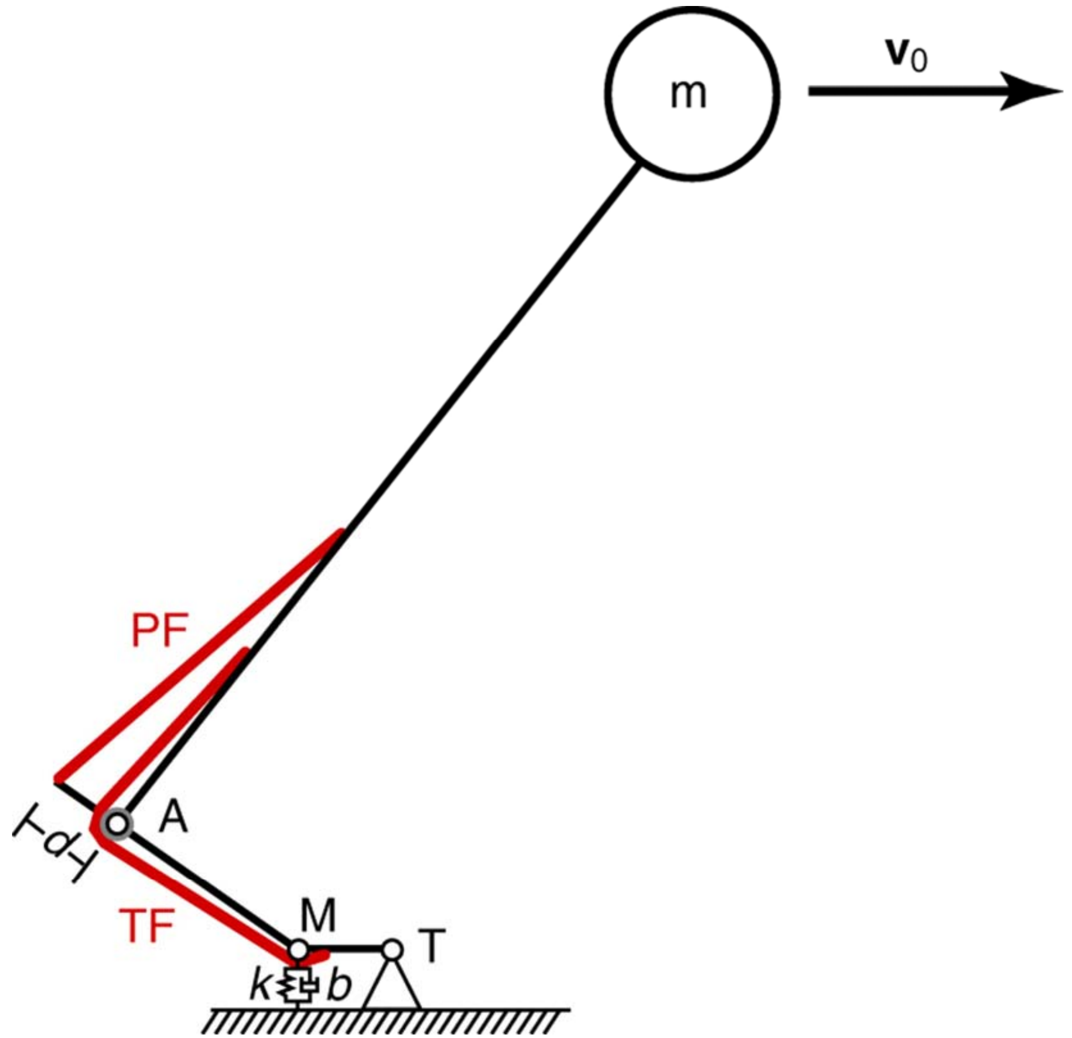
Possible mechanisms of performance improvement

• pH buffer	|	role in
• Increased Ca release	|	muscle
• ROS scavenger	|	fatigue

Biomechanical traits

- Lower leg volume
- Heel lenght
- Toe lenght
- ?

Planar three-segment, three-degree-of-freedom computational model used to



Lee, S. S. M. et al. J Exp Biol 2009;212:3700-3707

Short heel lever

= short plantarflexor moment arm

= short AT translation

- 25% longer in sprinters
- Seems mechanical disadvantage
- BUT longer contraction time (advant)

> more elastic energy

> higher power output

Toe length

= 1cm longer in sprinters

- Longer ground contact times

> higher power output

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Force-Length relationship
Length-Tension curve

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Force-Velocity relationship

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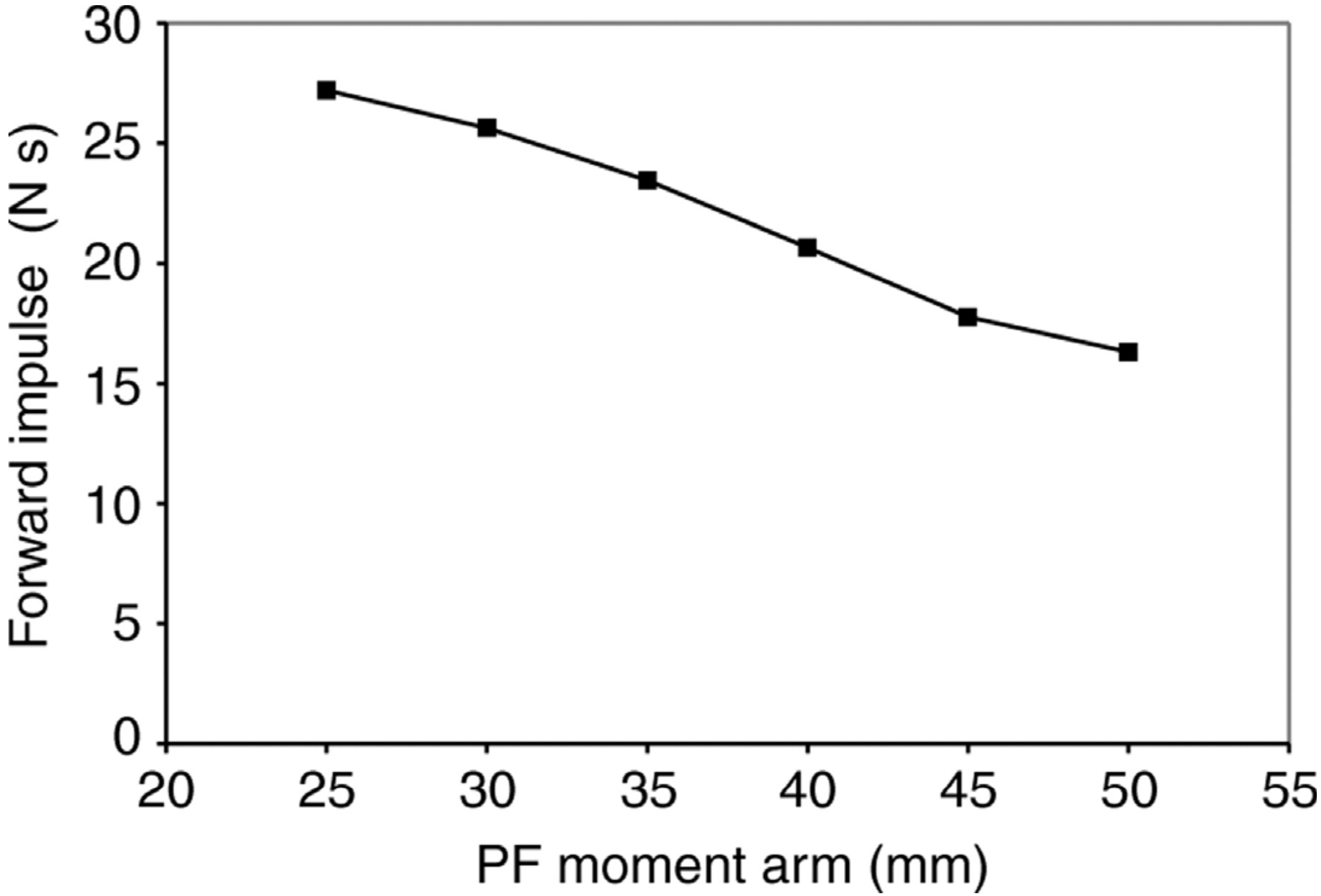
zijn vereist om deze afbeelding weer te geven.

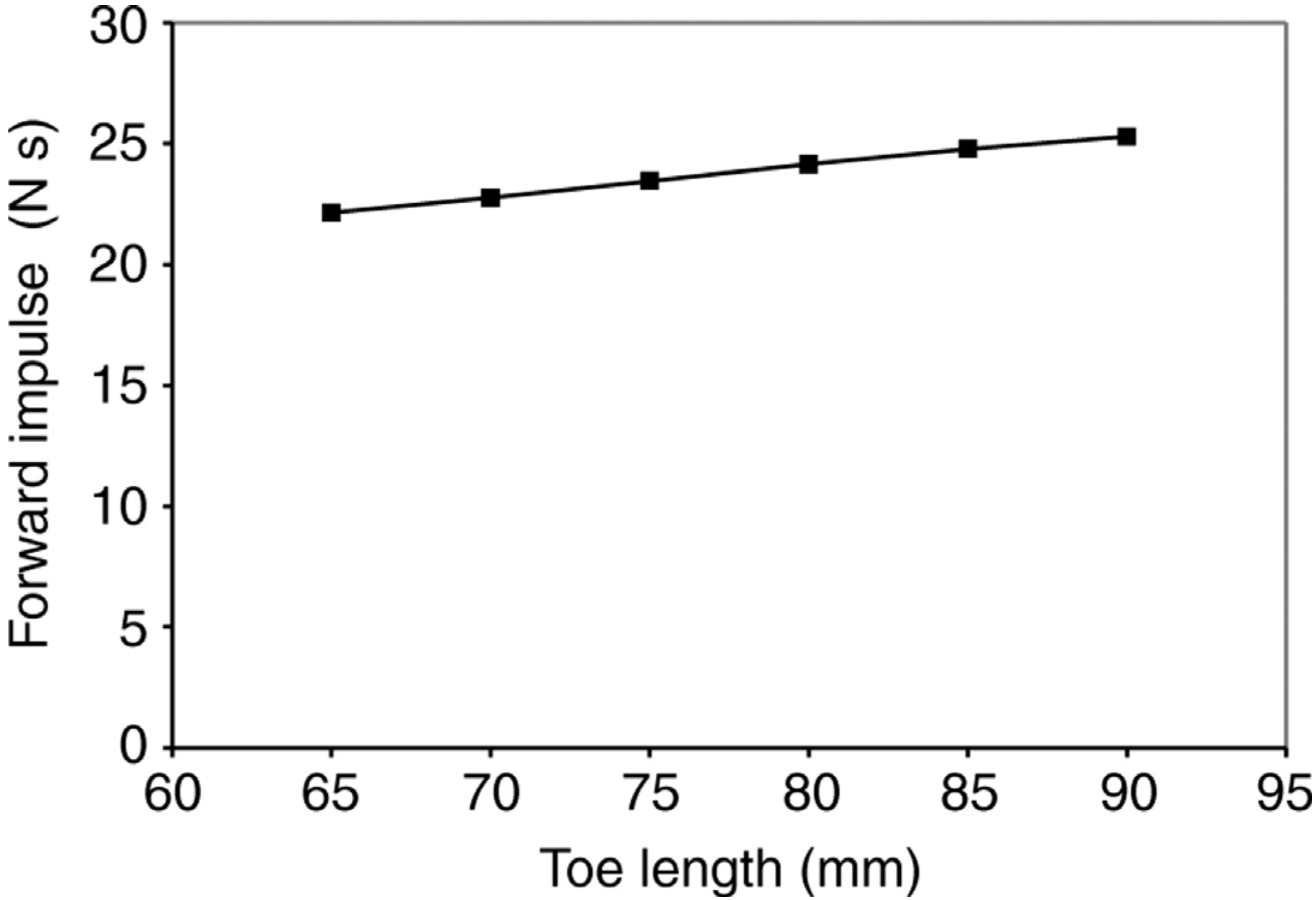
QuickTime™ en een
TIFF (ongecomprimeerd)-decompressor
zijn vereist om deze afbeelding weer te geven.

Forward impulse imparted to the mass during the push-off simulations for



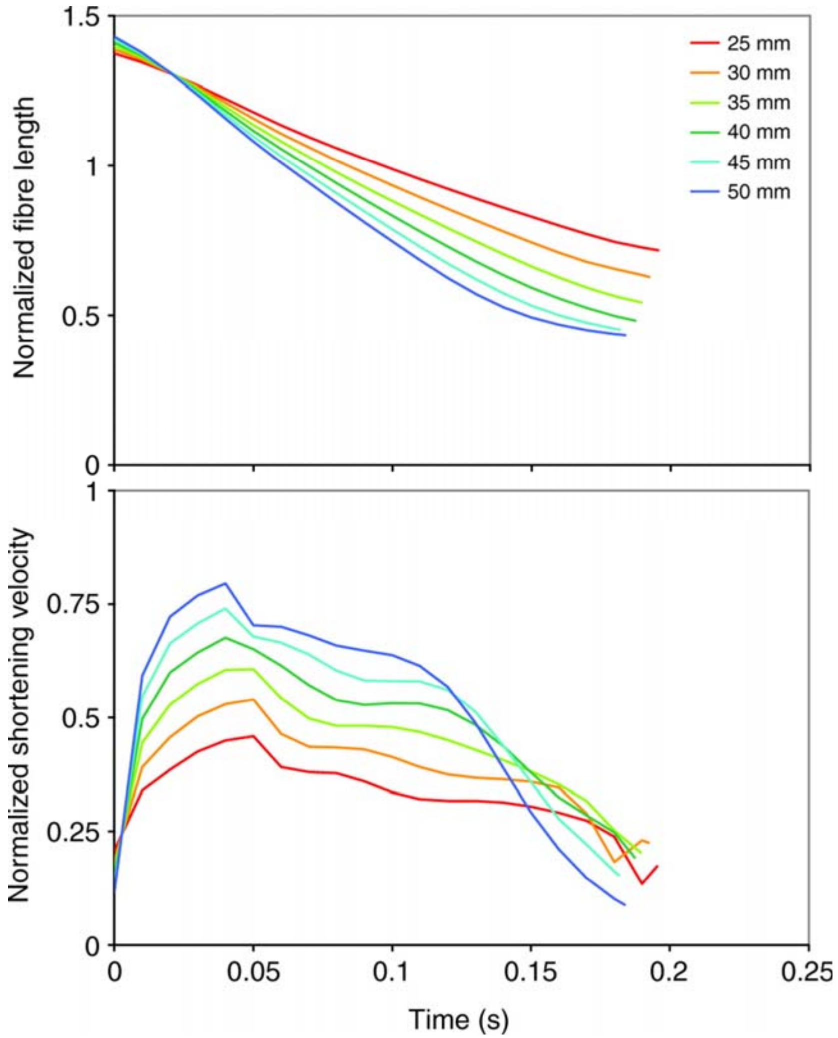
Lee, S. S. M. et al. J Exp Biol 2009;212:3700-3707

Forward impulse imparted to the mass during the push-off simulations for



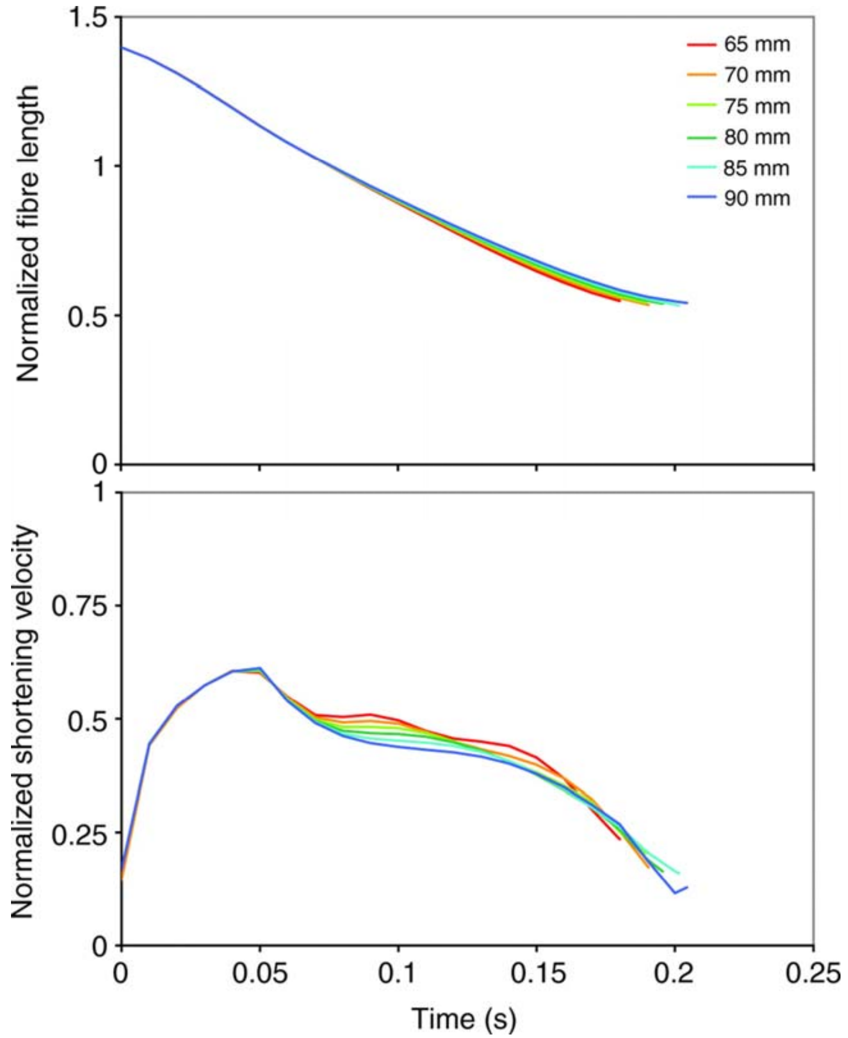
Lee, S. S. M. et al. J Exp Biol 2009;212:3700-3707

Plantarflexor muscle fibre behaviour during the push-off simulations for



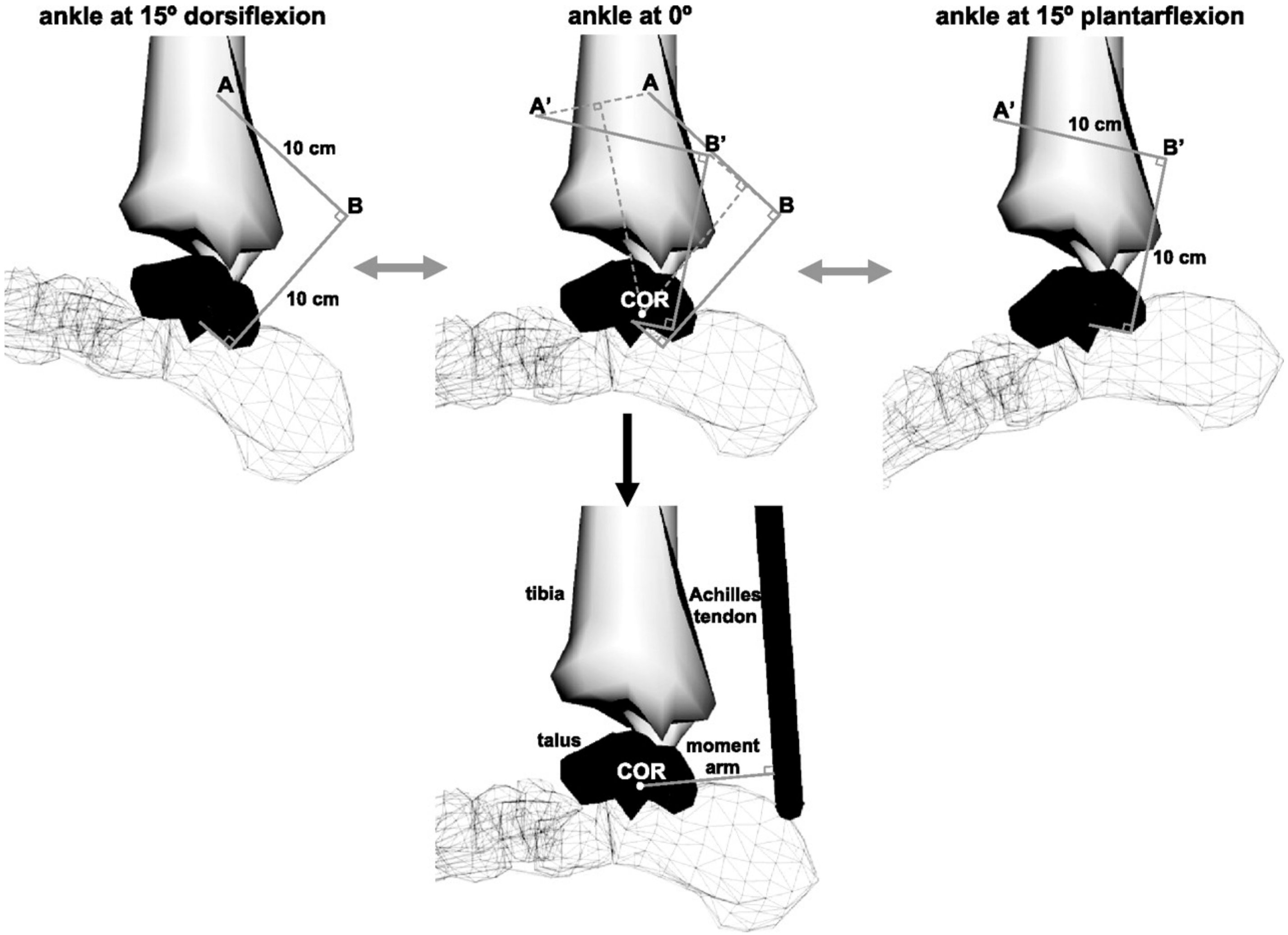
Lee, S. S. M. et al. J Exp Biol 2009;212:3700-370

Plantarflexor muscle fibre behaviour during the push-off simulations for



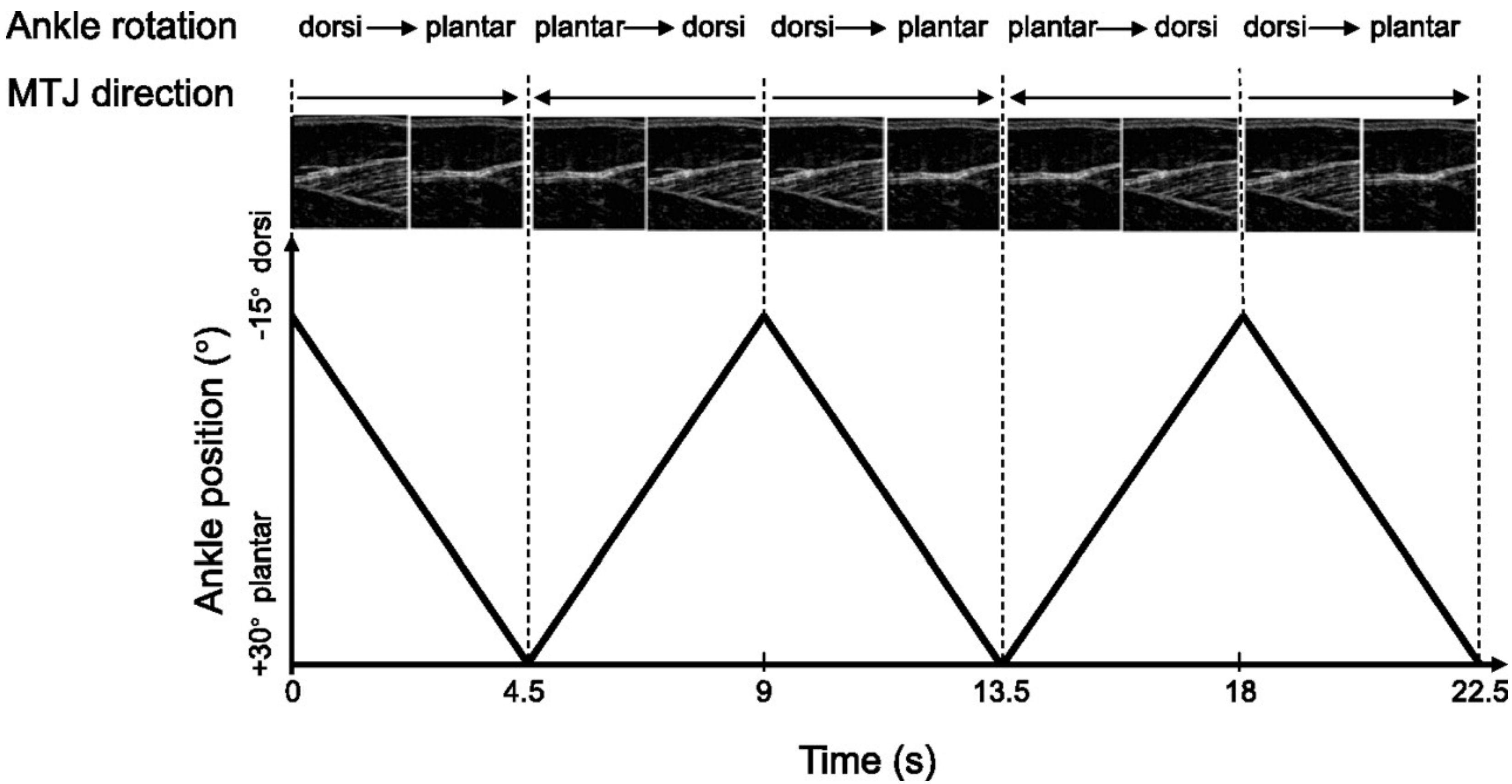
Lee, S. S. M. et al. J Exp Biol 2009;212:3700-370

Schematic illustration of the center of rotation (COR) method using Reuleaux' geometric method.



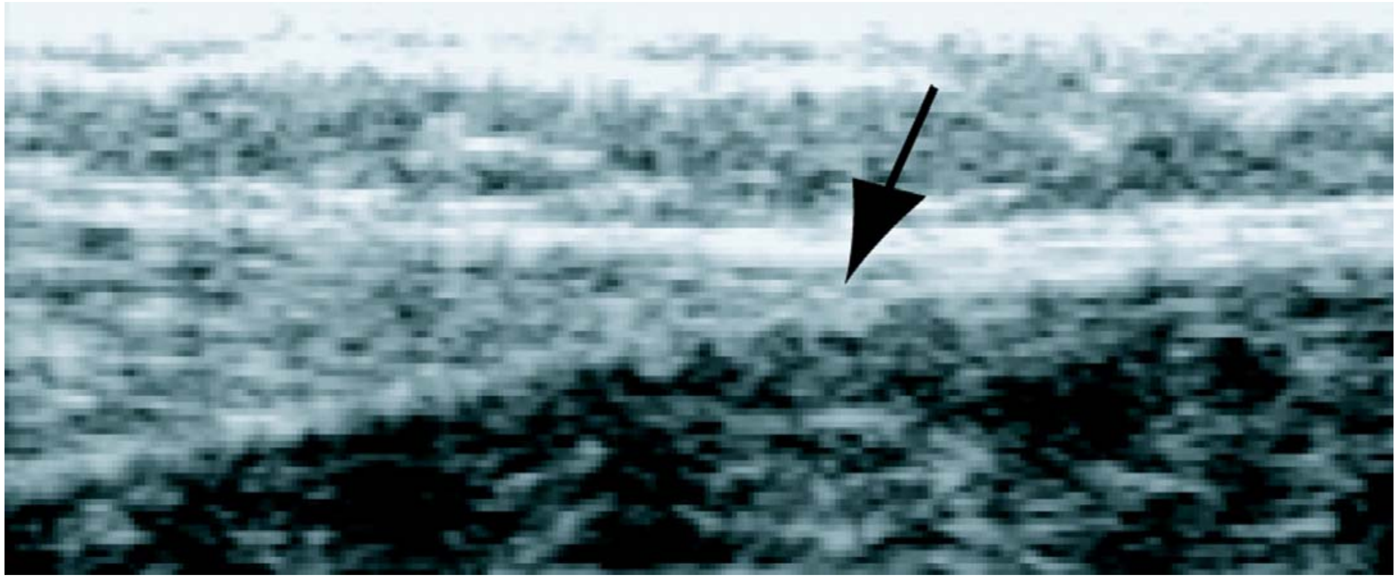
Fath F et al. J Appl Physiol 2010;109:1644-1652

Schematic illustration of the relationship between ankle rotation and movement of the muscle-tendon junction (MTJ) of the gastrocnemius medialis and the Achilles tendon.



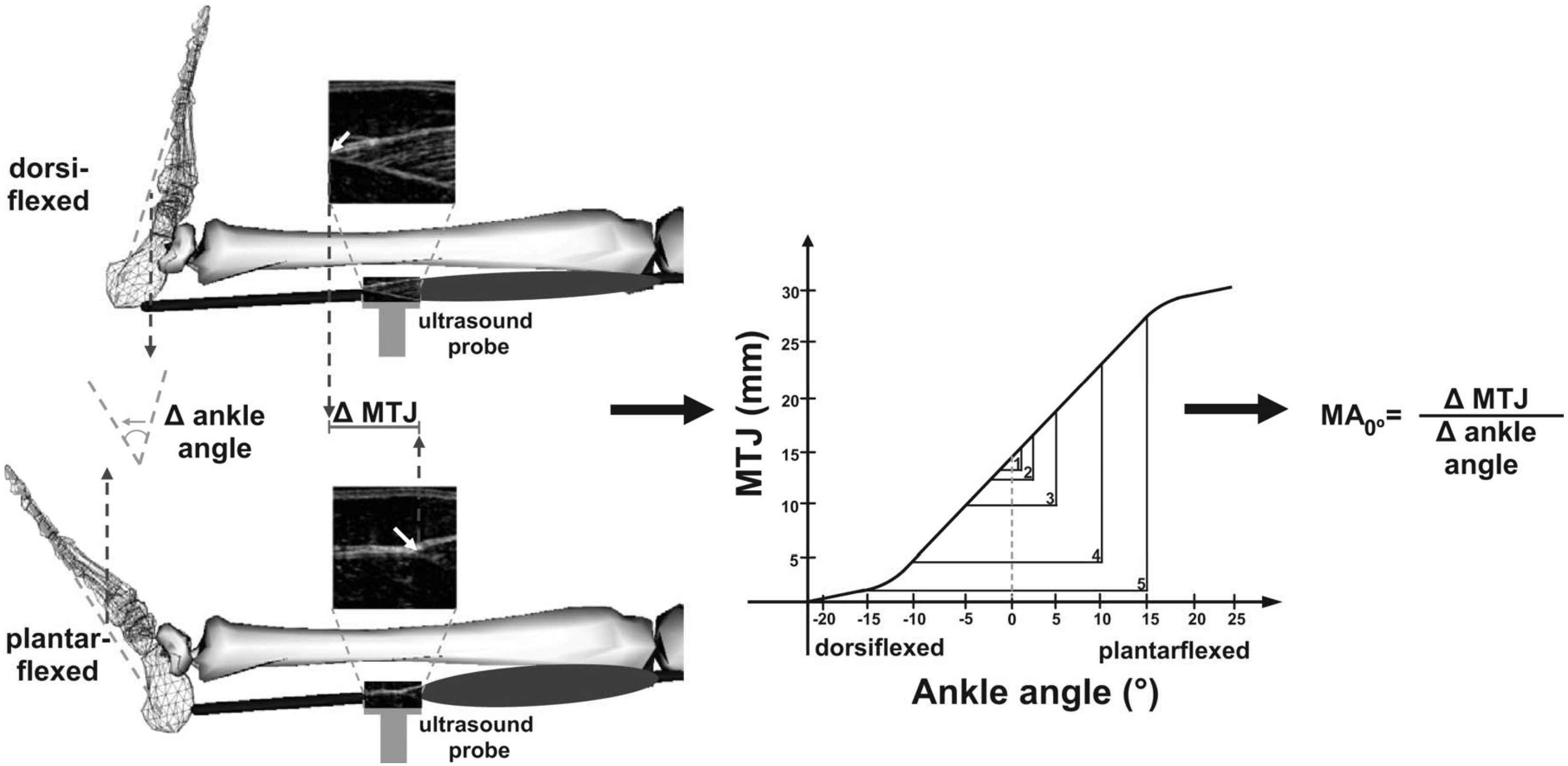
Fath F et al. J Appl Physiol 2010;109:1644-1652

Ultrasound image of the lateral gastrocnemius



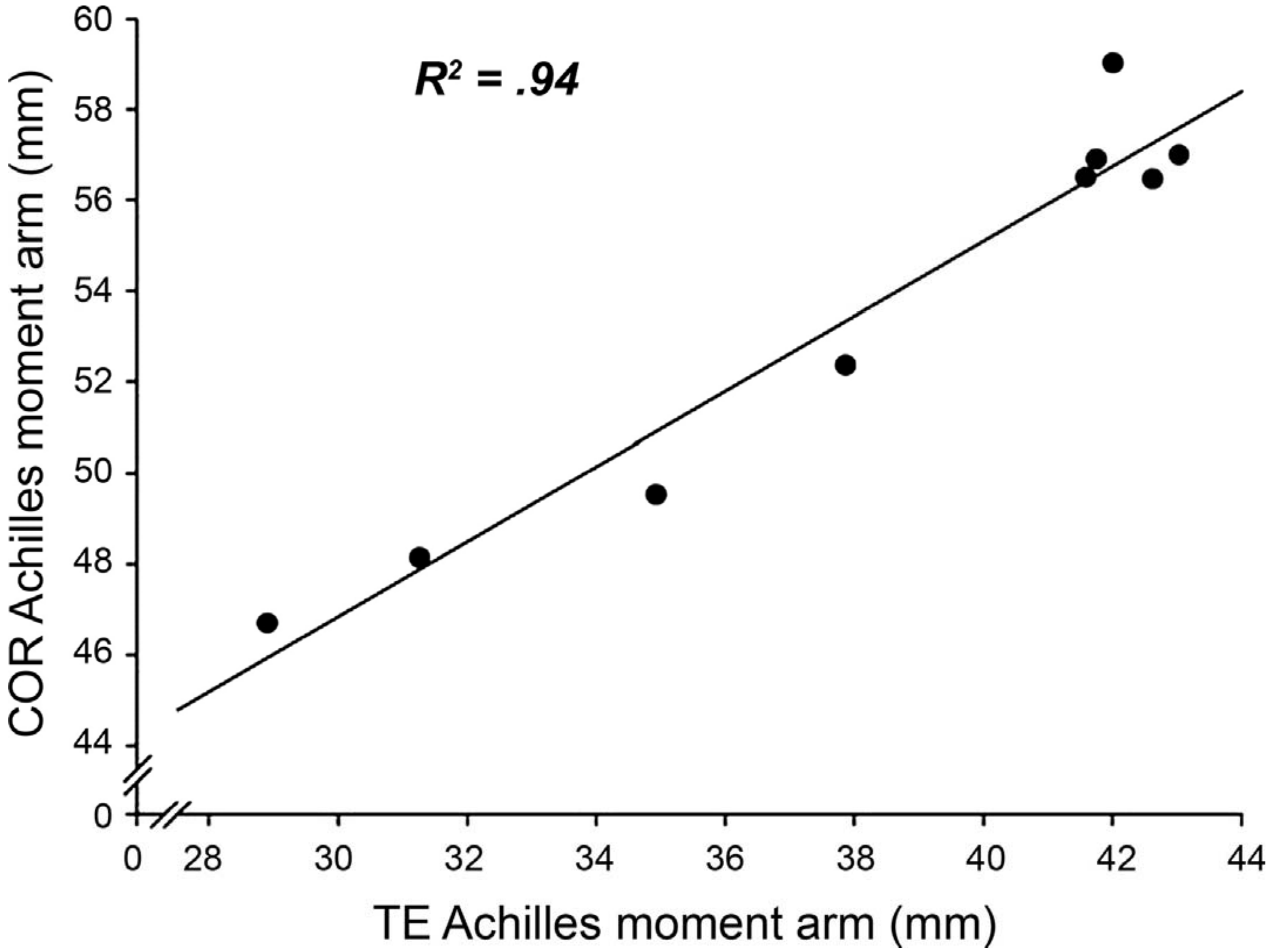
Lee, S. S. M. et al. J Exp Biol 2009;212:3700-3707

Schematic illustration of the tendon excursion (TE) method.



Fath F et al. J Appl Physiol 2010;109:1644-1652

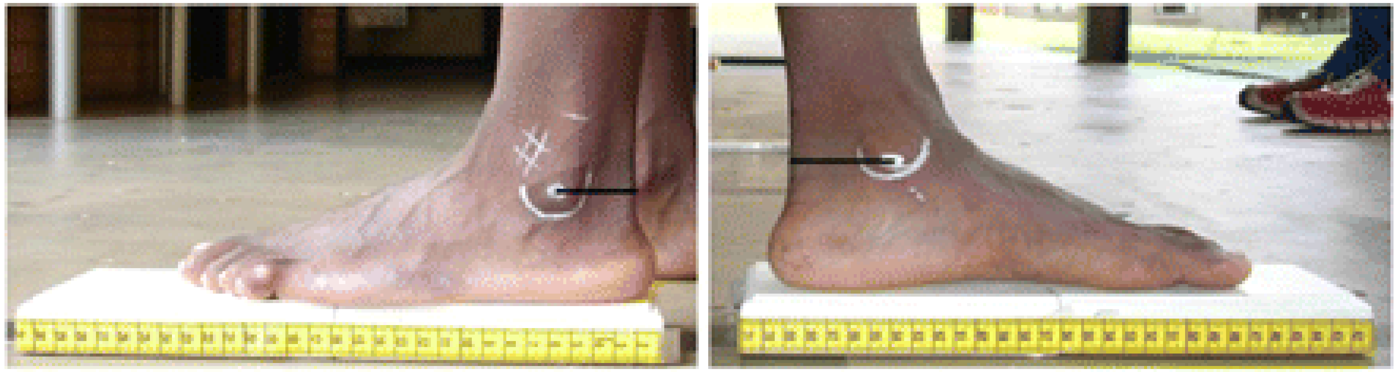
Highest correlation between Achilles tendon moment arms calculated using the COR method (MR imaging) and the TE method (ultrasound imaging).



Fath F et al. J Appl Physiol 2010;109:1644-1652

Distance running

Standardized picture of the lateral (A) and medial (B) side of the left



Scholz, M. N. et al. J Exp Biol 2008;211:3266-3271

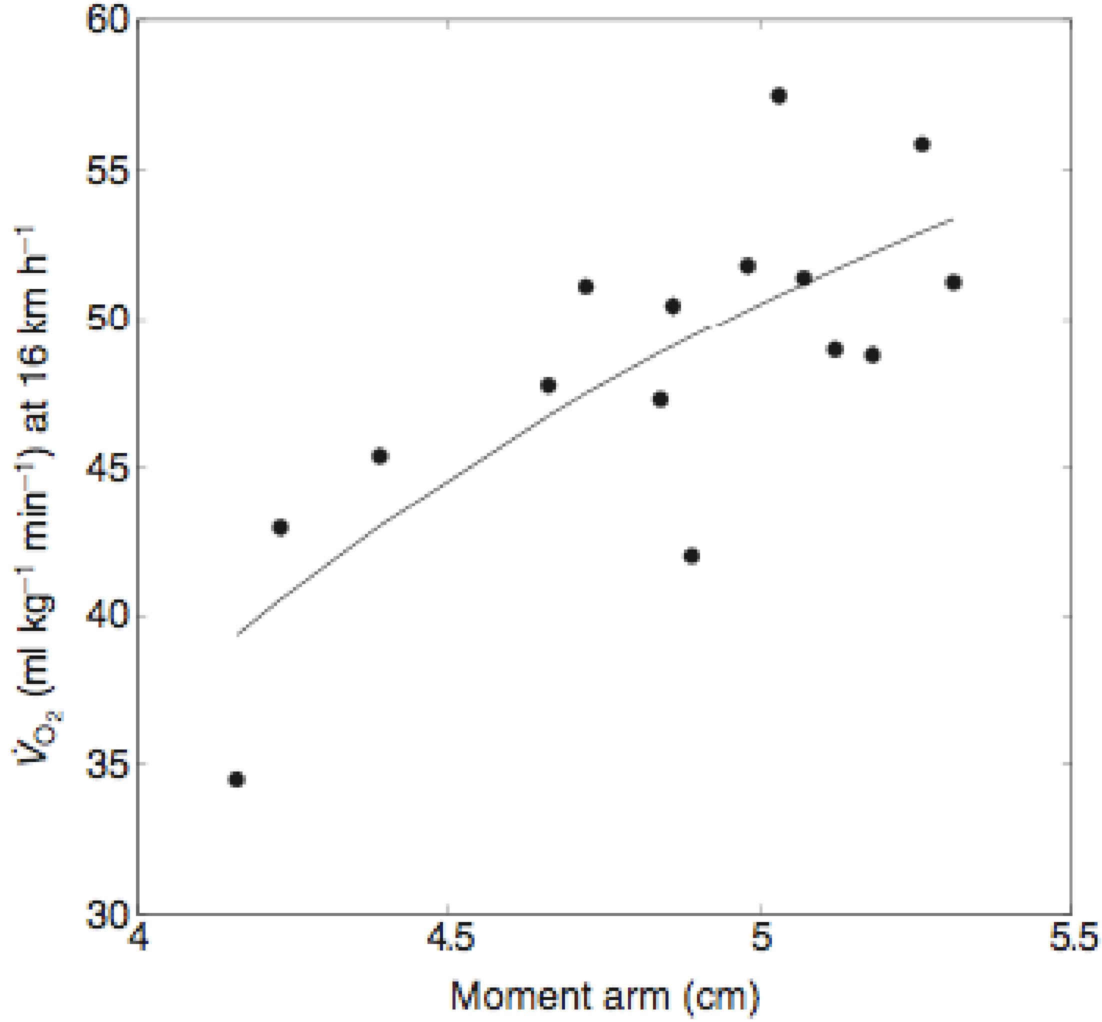


Fig. 2. Relationship between moment arm and oxygen consumption rate ($\dot{V}_{O_2}$) in ml kg^{-1} min^{-1} at 16 km h^{-1}. Dots are individual participants, the line is the best fit for the theoretical model $y=ax^{-2}+b$, where x is moment arm in cm and y is $\dot{V}_{O_2}$ in ml kg^{-1} min^{-1} at 16 km h^{-1} (a=–628.1, b=75.65, r=0.77). This model was derived from Eqn 7, assuming a linear spring (n=1). A very similar fit with r=0.76 can be obtained for the model $y=cx^{-1.5}+d$, which is based on the assumption that n=2.

Table 3. Correlations between anthropometric variables and $\dot{V}_{O_2}$ at 16 km h^{-1} (N=15)

Anthropometric variable	r^2	Slope	P-value
Mass	0.17	0.25	0.12
Height	0.09	0.22	0.29
Body mass index (BMI)	0.26	1.77	0.05*
Foot length	0.33	2.20	0.03*
Lower-leg length	0.18	1.43	0.12
Total leg length	0.14	0.47	0.17
Lower-leg volume	0.28	7.19	0.04*
Lower-leg moment of inertia	0.39	709	0.01*
Moment arm	0.56	11.91	0.00*
Lower-leg circumference	0.24	0.85	0.07

r^2, explained variance (*P≤0.05). N, number of subjects.

Table 4. Partial correlations between selected anthropometric variables and $\dot{V}_{O_2}$ at 16 km h^{-1}, corrected for covariation with moment arm (in parentheses) (N=15)

Anthropometric variable	r^2	P-value
BMI (moment arm)	0.00	0.85
Foot length (moment arm)	0.00	0.82
Lower-leg volume (moment arm)	0.00	0.98
Lower-leg moment of inertia (moment arm)	0.02	0.64

BMI, body mass index. r^2, explained variance. N, number of subjects.

Table 5. Partial correlations between moment arm and $\dot{V}_{O_2}$ at 16 km h^{-1}, corrected for covariance with selected anthropometric variables (in parentheses) (N=15)

Anthropometric variable	r^2	P-value
Moment arm (BMI)	0.41	0.01*
Moment arm (foot length)	0.35	0.03*
Moment arm (lower–leg volume)	0.38	0.02*
Moment arm (lower–leg moment of inertia)	0.29	0.05*

BMI, body mass index. r^2, explained variance (*$P\leq0.05$). N, number of subjects.

Moment arm 10% korter:

kracht op AP van 4700N naar 5170N

energie opslag van 35J naar 42,4J (21% toename)

elke landing, 3 landingen per sec tegen 16 km/h

CE efficiency van 25%

verschil is 4,2 ml/(kg.min) VO2

(=8% als VO2 is 50 tegen 16 km/h)

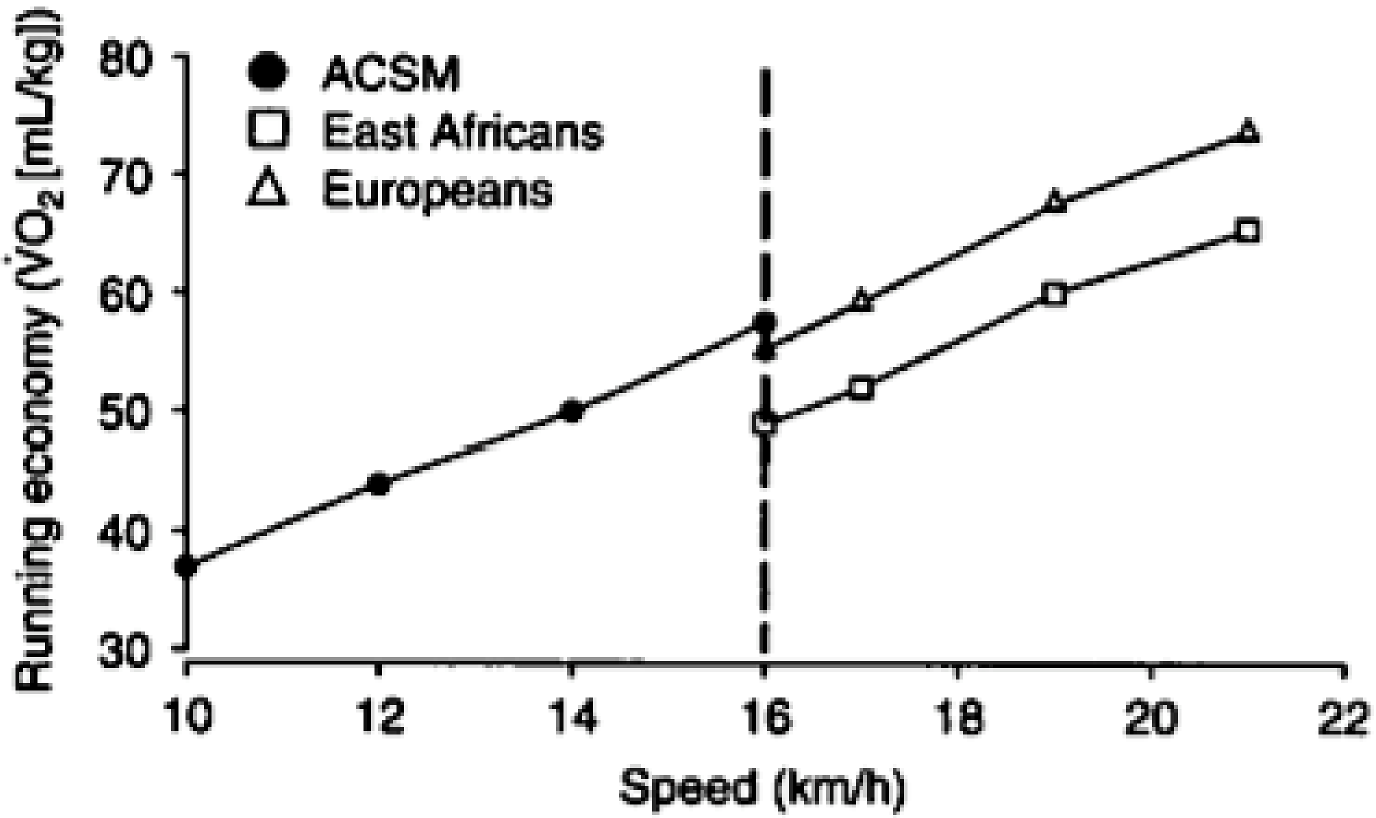


Fig. 1. Schematic values of the oxygen uptake cost of treadmill running (up a 1% gradient) in terms of normative data (from the American College of Sports Medicine [ACSM]), and based on pooled values for elite runners of European descent[1,3,6,7,9] and elite runners of East African descent.[5,7] The dashed vertical line represents a running velocity of 268 m/min, which is the most commonly used reference value. $\dot{V}O_2$ = oxygen uptake.

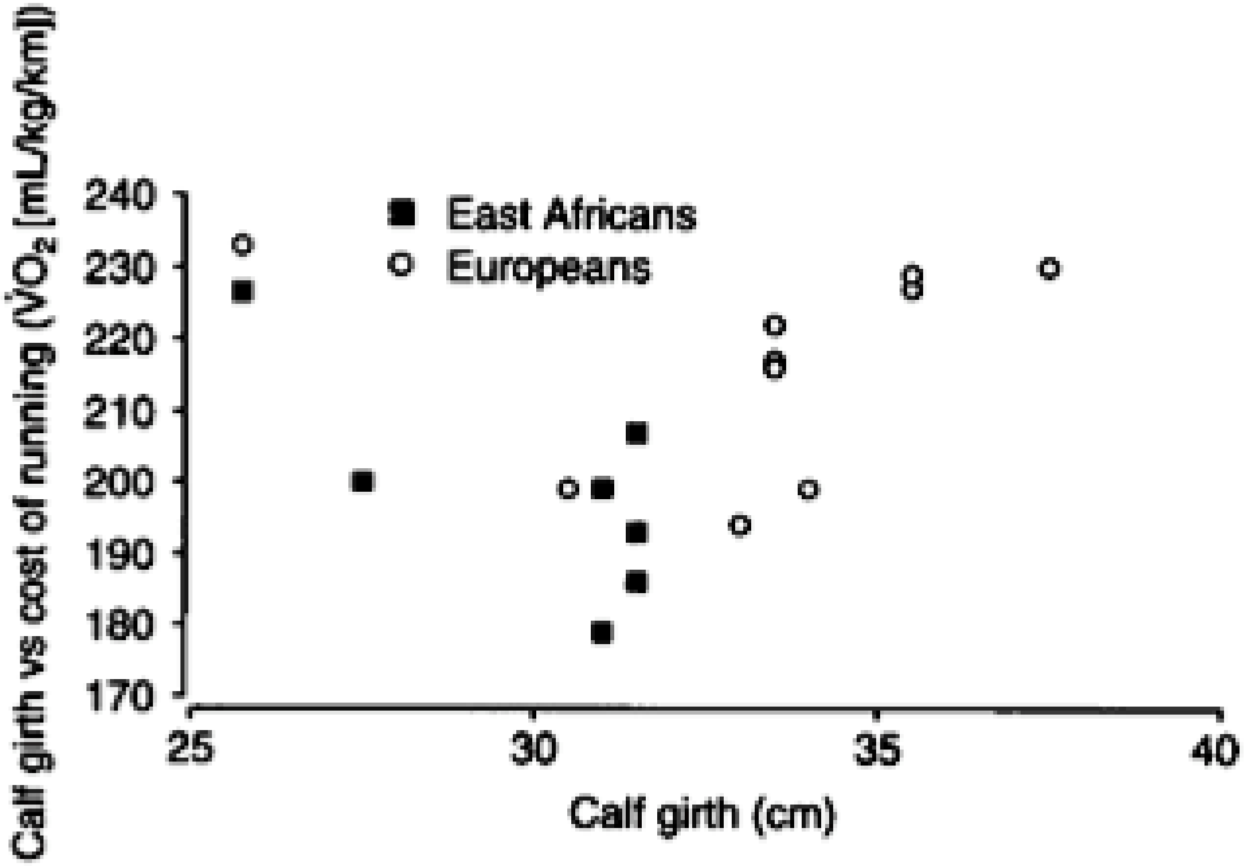


Fig. 3. Effect of calf girth on the oxygen uptake ($\dot{V}O_2$) cost of running (mL/kg/km) in elite runners of European and East African descent. Note that although the East Africans have both smaller calf girth and a generally lower cost of running, the relationship overlaps and is evident in the data from the European runners, suggesting that body dimensions, rather than area of origin, is the determinant of the cost of running.