La Florida
CORPORACIÓN DEL DEPORTE

Fisiología del entrenamiento de la fuerza y la hipertrofia

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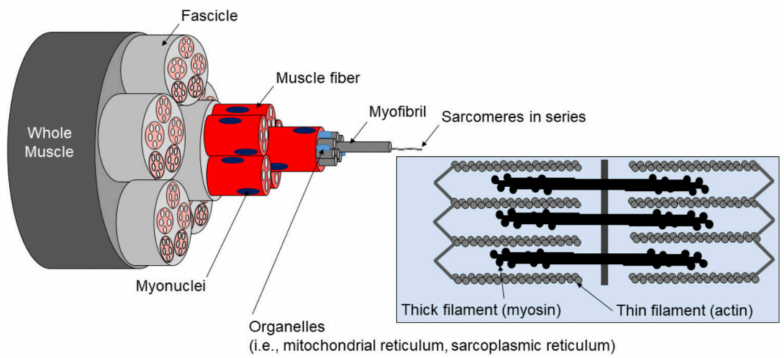
UNIVERSIDAD Finis Terrae

nft_chile

Cómo es la composición muscular?



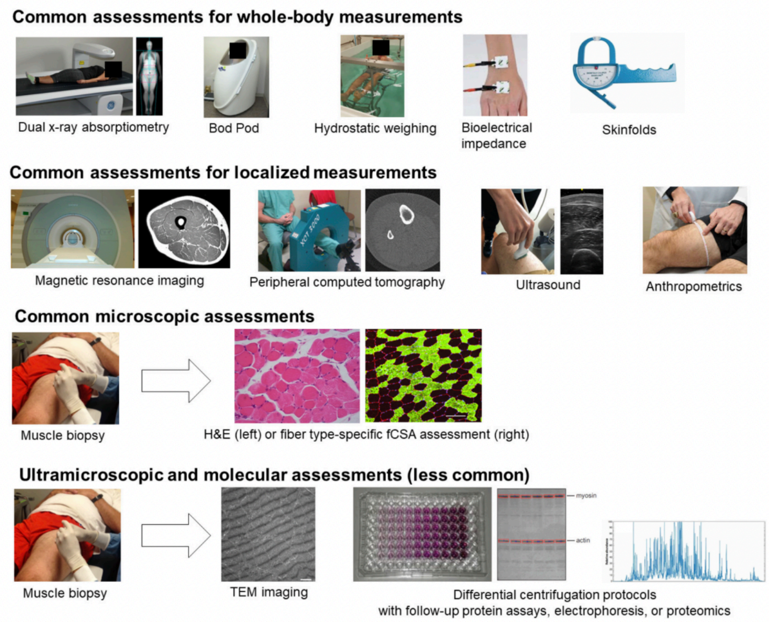


FIGURE 3 | Different assessments used to monitor resistance training-induced adaptations. The diagramed techniques are utilized to measure whole-body adaptations down to molecular adaptations to resistance training. Particular attention in this review is devoted to localized, microscopic, ultramiscroscopic, and molecular assessments. Images are either from our laboratory or were obtained online where reuse for educational purposes was not restricted.

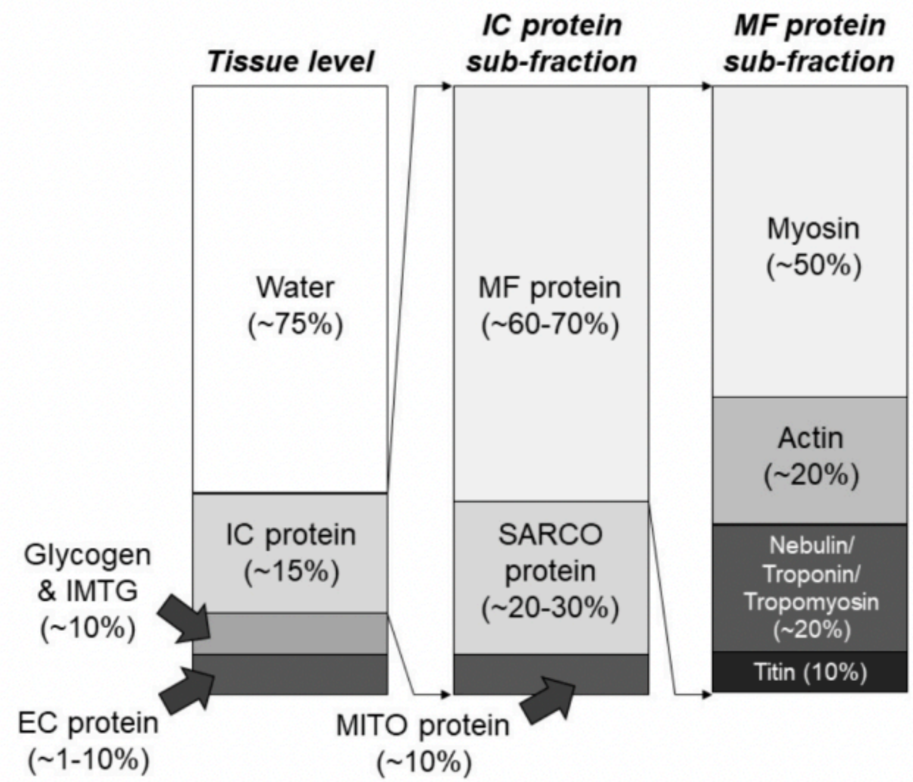
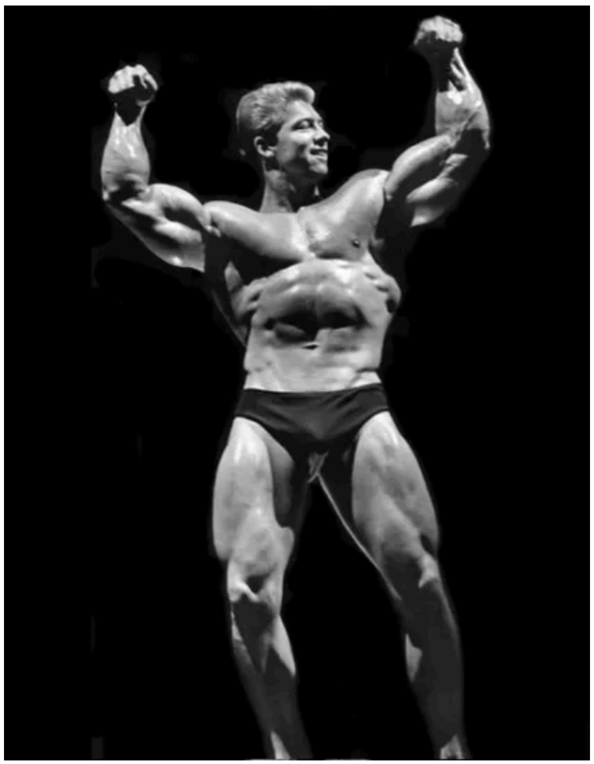


FIGURE 2 | Composition of skeletal muscle tissue. These composition estimates are based upon numerous studies which have utilized biochemical and proteomics-based assessments described in text. IMTG, intramuscular triglycerides; EC, extracellular; IC, intracellular; MF, myofibrillar; SARCO, sarcoplasmic; MITO, mitochondrial.

doi:10.3389/fphys.2019.00247

Es un tejido con gran plasticidad

1965-1966

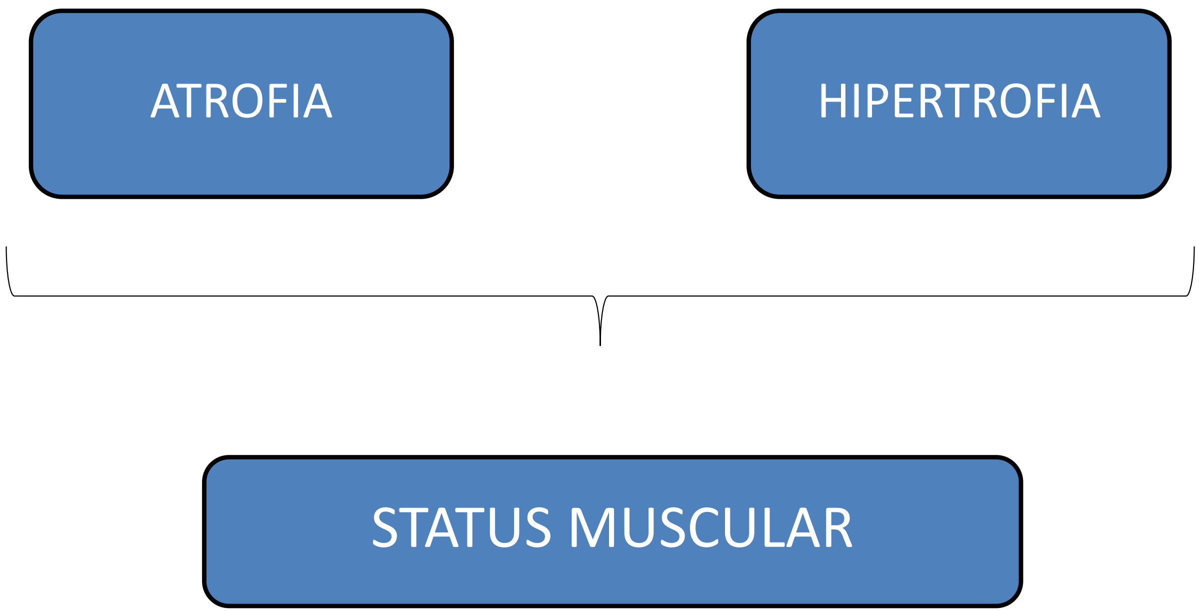


1998-2005

2024


2018
2024

Homeostasis Muscular




DailyPlanner
PRIMARY GOAL
DAY
TASKS FOR TODAY
NOTES + IDEAS
TODAY'S AGENDA
7
8
9
10
11
12
1
2
3
4
5
6
TASKS FOR TOMORROW
CONTACTS + EMAILS


DailyPlanner
PRIMARY GOAL
DAY
TASKS FOR TODAY
Hipertrofia
NOTES + IDEAS
Atrofia
TODAY'S AGENDA
7
8
9
10
11
12
1
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4
5
6
TASK
CONTACTS + EMAILS


DailyPlanner
PRIMARY GOAL
DAY
TASKS FOR TODAY
Hipertrofia
NOTES + IDEAS
Atrofia
TODAY'S AGENDA
TASKS FOR TOMORROW
CONTACTS + EMAILS

Fisiología de la Hipertrofia muscular

- Factores que facilitan la hipertrofia

  - Mecánicos
    - Entrenamiento

  - Nutricionales
    - Balance energético positivo
    - Proteínas - aminoácidos

  - Hormonales
    - Testosterona
    - Insulina
    - Hormona de crecimiento
  - Celulares
    - mTor
    - IGF-1

Cómo se incrementa el tamaño muscular?

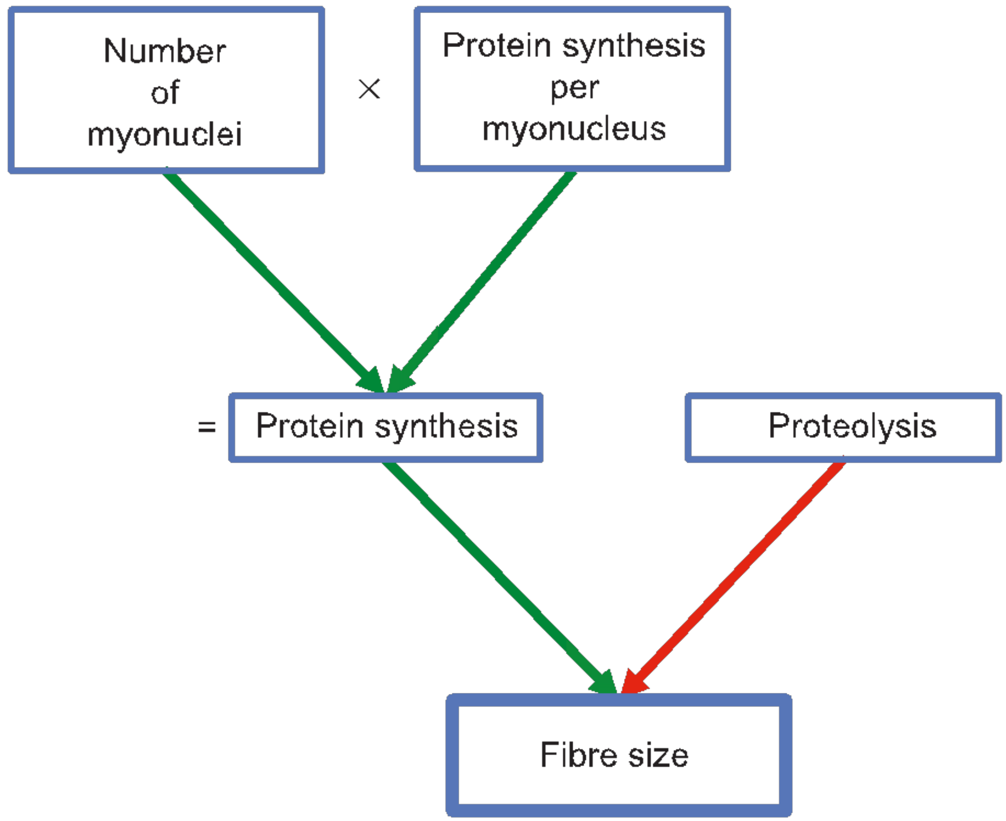
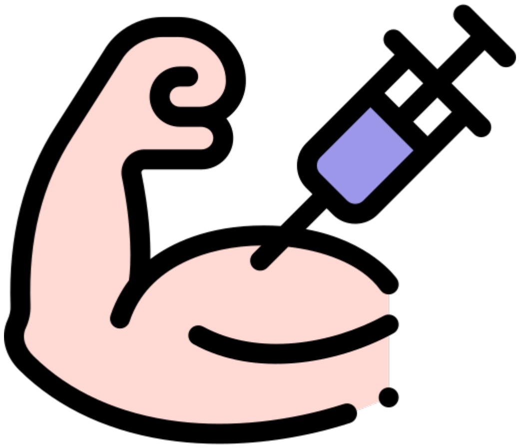


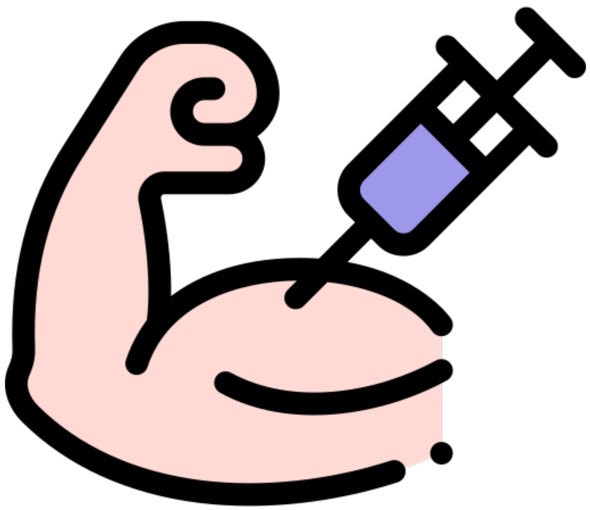
Fig. 1. Major determinants of muscle fibre size. Changes in fibre size occur by changing the balance between protein synthesis and protein degradation. Total protein synthesis is, by definition, the product of the number of myonuclei and synthesis per nucleus.

Journal of Experimental Biology (2016) 219, 235-242



El camino fácil¡¡¡

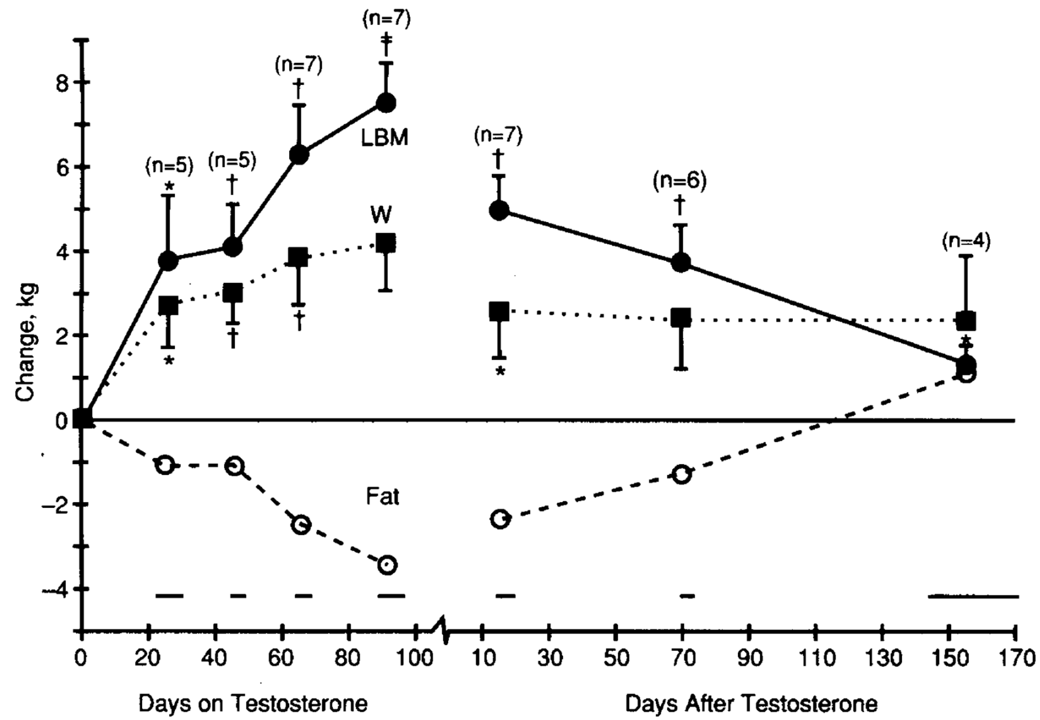


Sequence of Changes in Body Composition Induced by Testosterone and Reversal of Changes After Drug Is Stopped

Gilbert B. Forbes, MD; Cheryl R. Porta; Barbara E. Herr, MS; Robert C. Griggs, MD

(*JAMA*. 1992;267:397-399)

3 mg/kg/sem
Enantato de testosterona



Time course of weight (W) change (dotted lines), lean body mass (LBM) change (solid lines), and body fat change (dashed lines) in response to testosterone administration and following cessation of drug. Time zero for the latter was taken as 21 days after the last testosterone injection. Data given are means ±SEM; number of subjects is shown in parentheses. Statistical significance was determined by one-tailed *t* tests. Horizontal lines at bottom of Figure indicate mean assay intervals ±SEM; asterisks, $P<.05$; daggers, $P<.01$; and double dagger, $P<.001$.

Tipos de Estudios

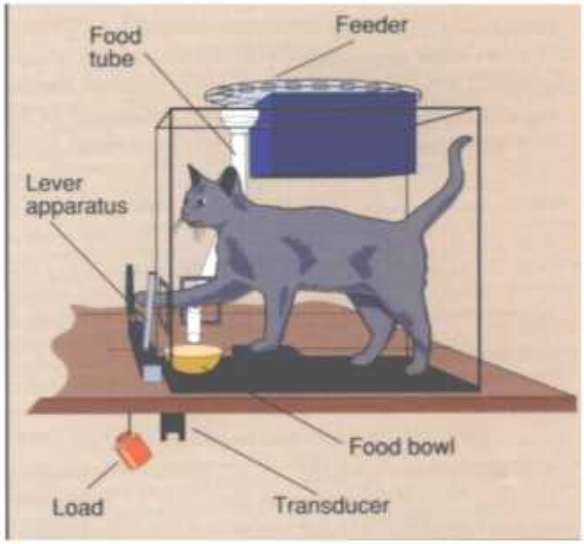
Efectos Agudos

1. Señalización
2. MPS
3. MPB

Efectos crónicos

1. Fuerza
2. Masa Corporal
3. Masa Muscular

MPS=Síntesis de proteínas musculares
MPB =Ruptura de proteínas musculares



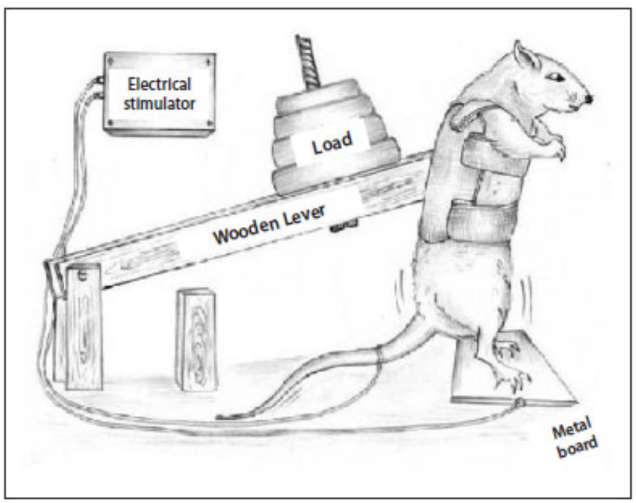
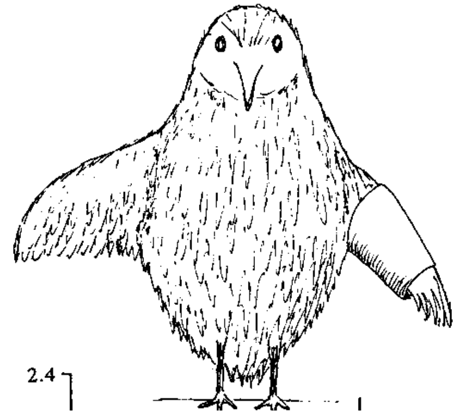


Figure 1. Strength training apparatus adapted from Tamaki et al. (1992).



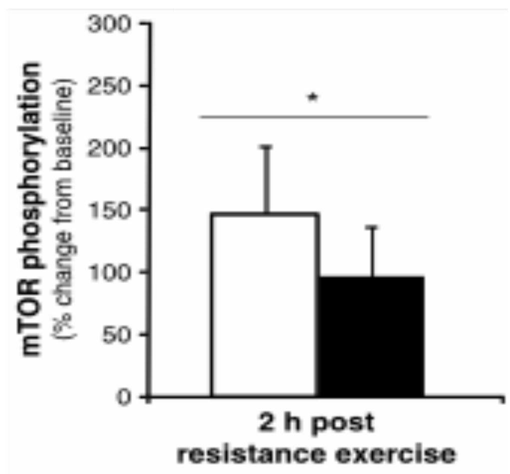
Efectos Agudos

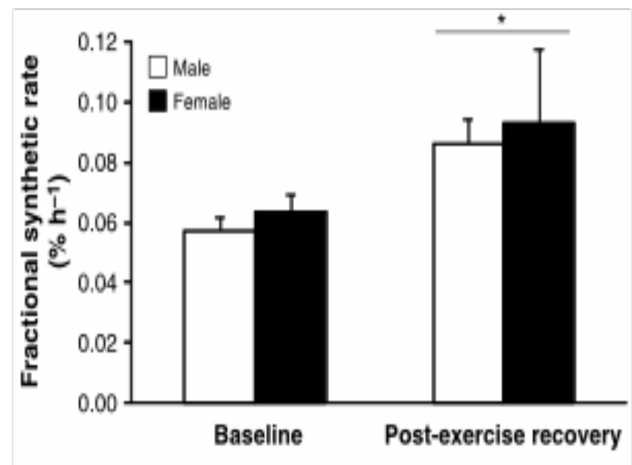
Estímulo

Vías de señalización

Aumento síntesis proteínas

10 series * 10 rep
leg extension
70% 1RM
c/ 3 min pausa





Dreyer, 2010

Received: 29 October 2023 | Revised: 17 June 2024 | Accepted: 4 July 2024

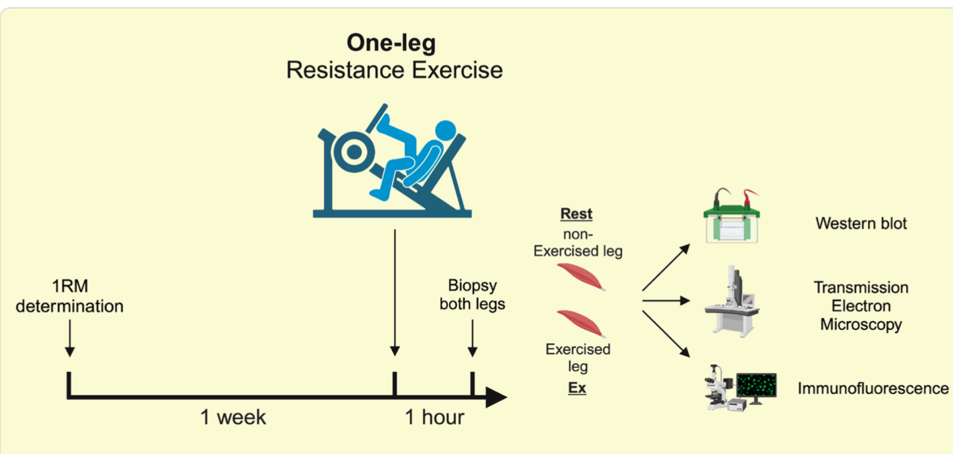
DOI: 10.1111/apha.14203

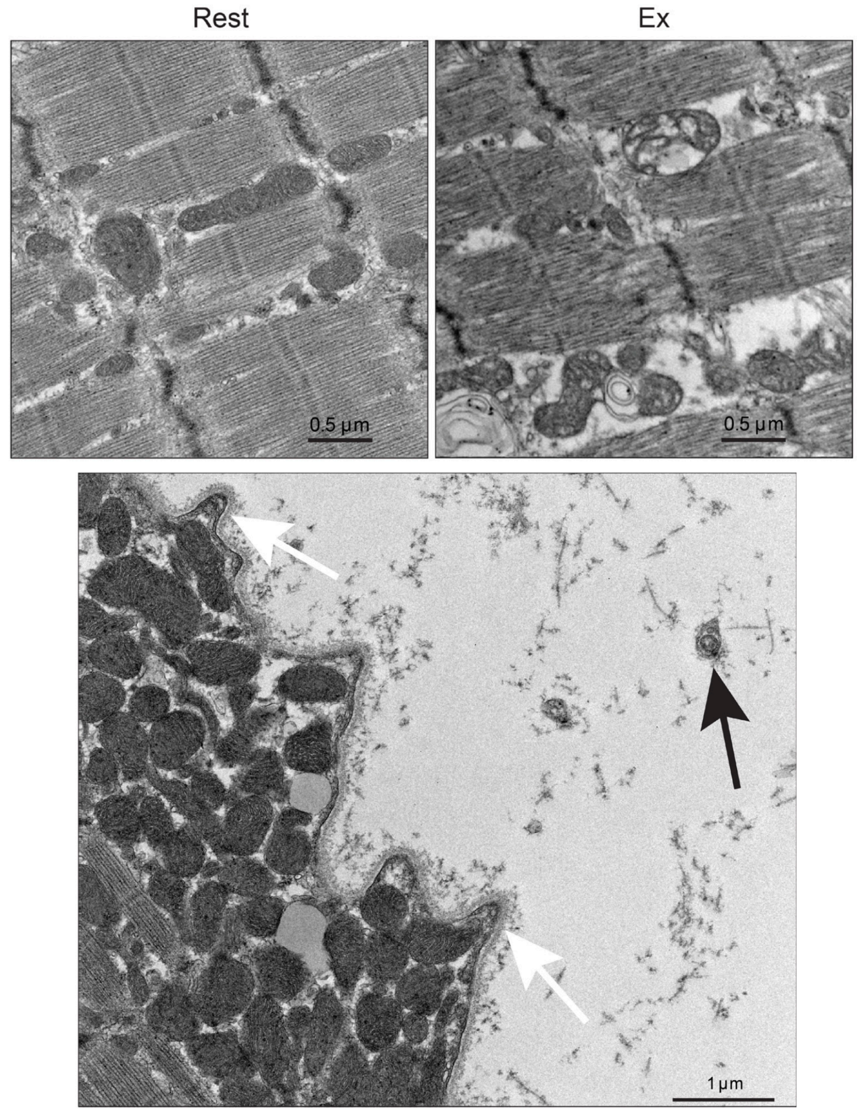
RAPID COMMUNICATION

ACTA PHYSIOLOGICA

A single bout of resistance exercise triggers mitophagy, potentially involving the ejection of mitochondria in human skeletal muscle

Francisco Díaz-Castro[1,2,3] | Mauro Tuñón-Suárez[1] | Patricia Rivera[2,3] | Javier Botella[4] | Jorge Cancino[1] | Ana María Figueroa[1] | Juan Gutiérrez[1] | Claudette Cantin[5] | Louise Deldicque[6] | Hermann Zbinden-Foncea[1,7] | Joachim Nielsen[8] | Carlos Henríquez-Olguín[1,9] | Eugenia Morselli[3] | Mauricio Castro-Sepúlveda[1]





Alguien ha investigado el efecto de 10*10 a largo plazo?

Effect of 10 Sets versus 5 Sets of Resistance Training on Muscular Endurance

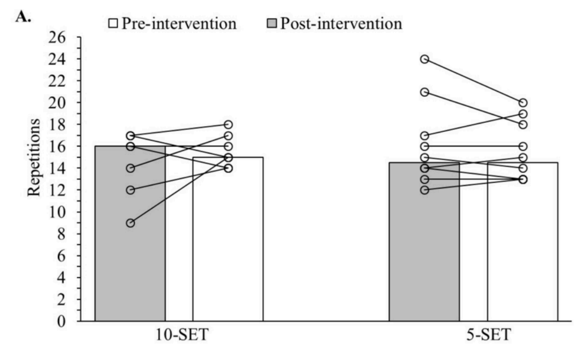
Daniel HACKETT, Timothy B. DAVIES, Angelo SABAG

The Journal of Sports Medicine and Physical Fitness 2021 May 10
DOI: 10.23736/S0022-4707.21.12484-3

6 semanas 3 x sem

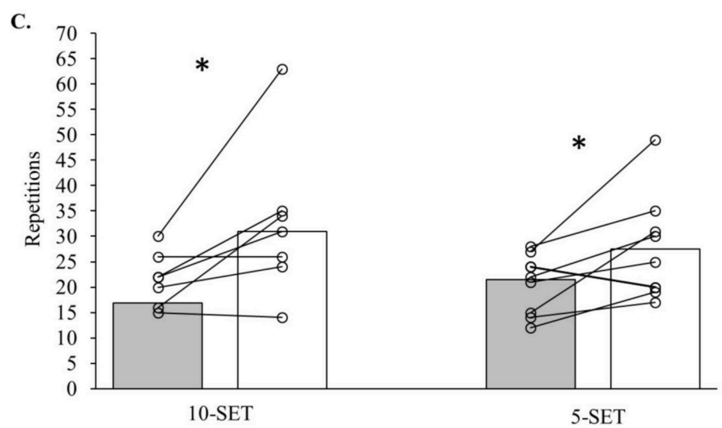
Sólo un estudio y no indagó sobre hipertrofia

Bench press

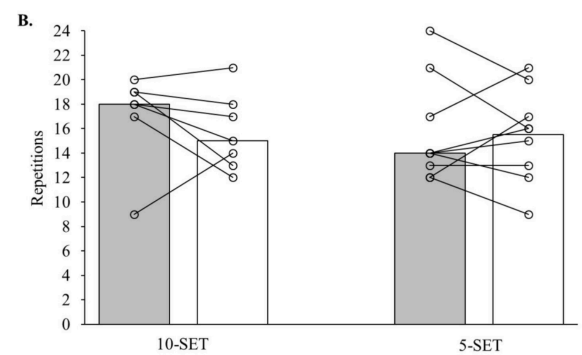


Sin diferencias

Leg Press



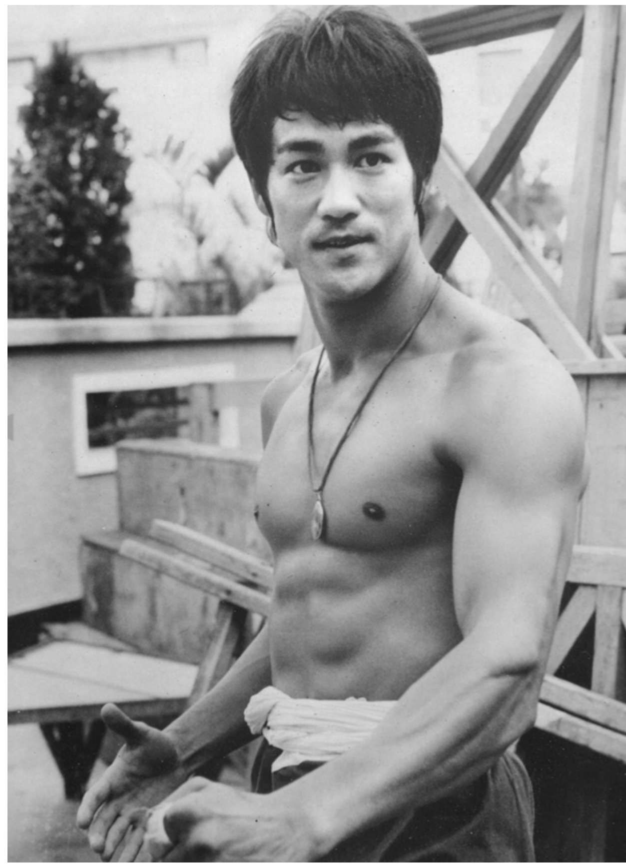
Lat pulldown

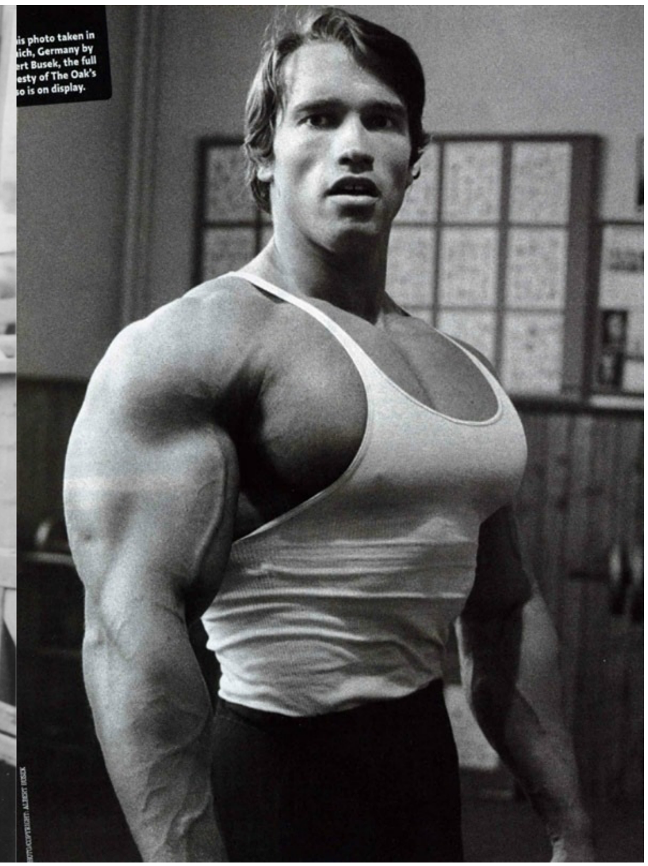


Entonces, qué hacer para maximizar la hipertrofia muscular?

Tipos de Hipertrofia

Miofibrilar vs sarcoplásmica?



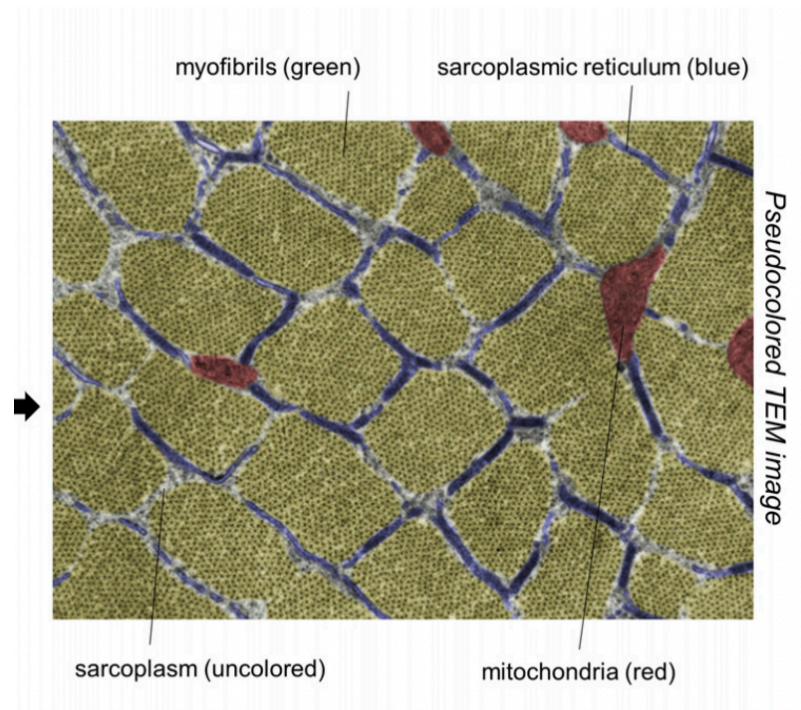


Sarcoplasmic Hypertrophy in Skeletal Muscle: A Scientific "Unicorn" or Resistance Training Adaptation?

Michael D. Roberts[1,2], Cody T. Haun[3], Christopher G. Vann[1], Shelby C. Osburn[1] and Kaelin C. Young[1,2]*

Evidencia a favor y contra

Hipertrofia Sarcoplásmica



Estudios con sujetos entrenados tienden a mostrar más hipertrofia sarcoplásmica que estudios con sujetos no entrenados.

Hay una creencia **no sustentada** que mayores cargas inducen más hipertrofia miofibrilar y que más volumen provoca más hipertrofia sarcoplasmática

Front. Physiol. 11:816. doi: 10.3389/fphys.2020.00816

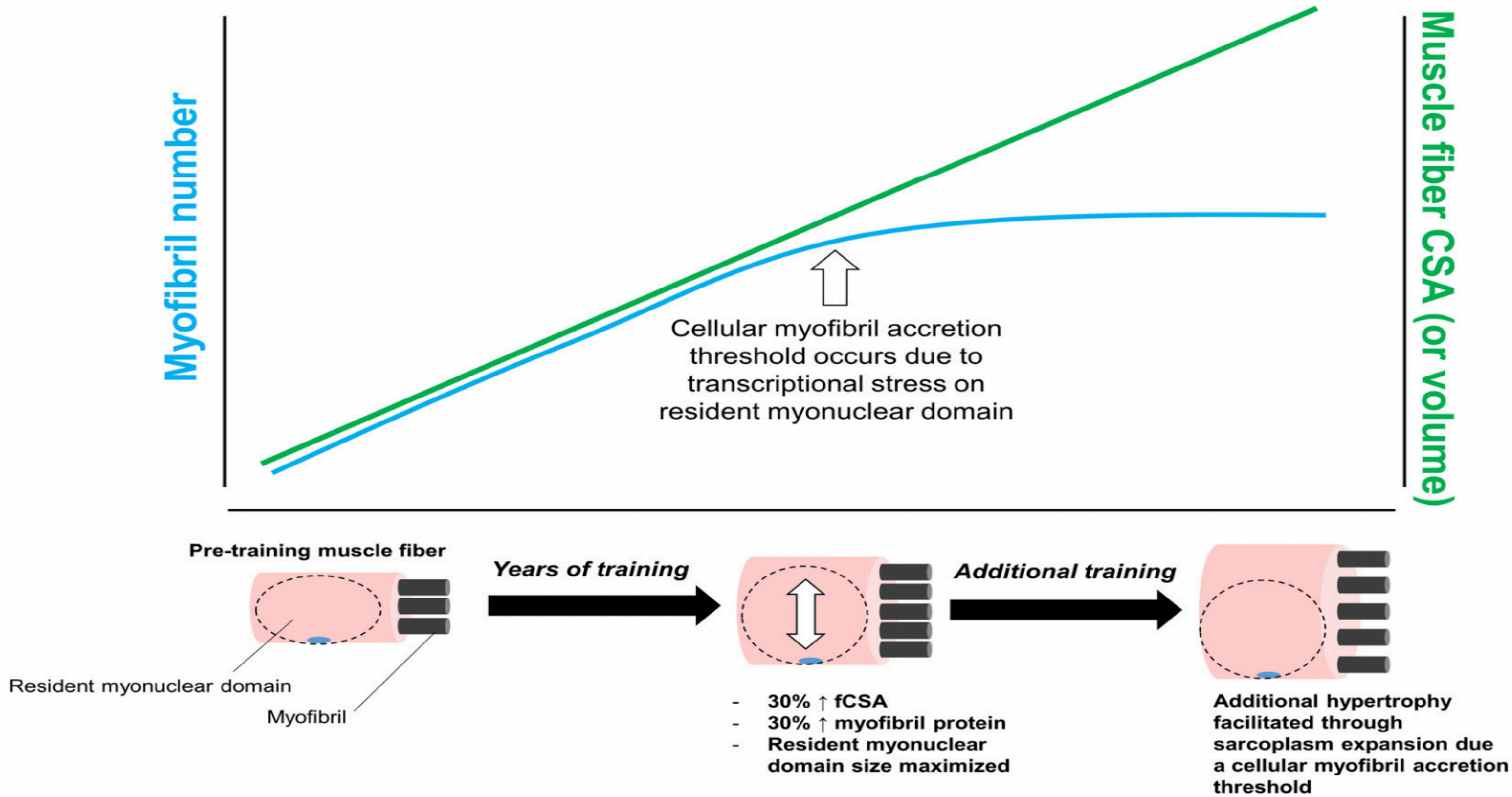


FIGURE 5 | This figure puts forth the hypothesis that sarcoplasmic hypertrophy with years of resistance training may be due to large muscle fibers exceeding a myofibril accretion threshold. This phenomenon is similar to the transcriptional stress theory posited in **Figure 3**. Specifically, we propose muscle cells grow via myofibril accretion due to a certain threshold size. Thereafter, fibers can no longer add myofibrils due to significant stress to resident myonuclear domains. Based on limited evidence cited in-text, we propose this mechanism may be evident in individuals who engage in higher volume training for years (e.g., bodybuilders).

Carga de entrenamiento e hipertrofia

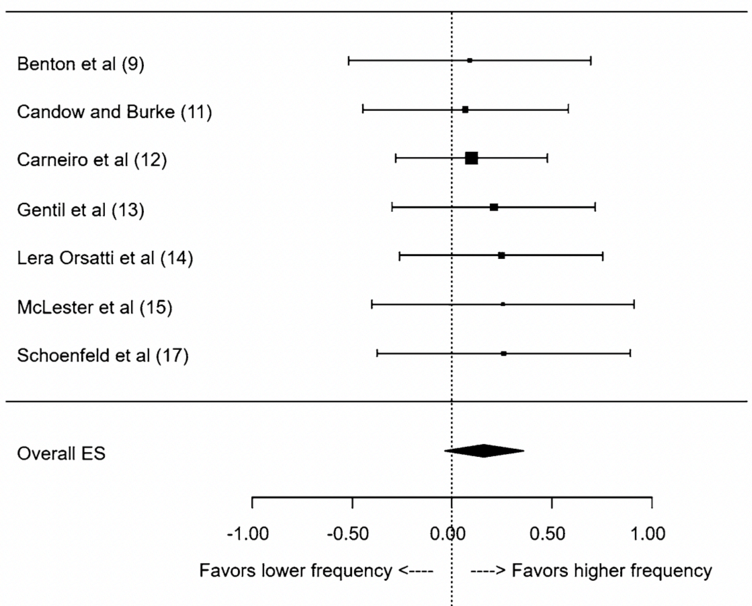
Frecuencia de entrenamiento

Sports Med (2016) 46:1689–1697
DOI 10.1007/s40279-016-0543-8

SYSTEMATIC REVIEW

Effects of Resistance Training Frequency on Measures of Muscle Hypertrophy: A Systematic Review and Meta-Analysis

Brad J. Schoenfeld[1] · Dan Ogborn[2] · James W. Krieger[3]



When comparing studies that investigated training muscle groups between 1 to 3 days per week on a volume-equated basis, the current body of evidence indicates that frequencies of training two times per week promote superior hypertrophic outcomes compared to one time. It can therefore be inferred that the major muscle groups should be trained at least twice a week to maximize muscle growth; whether training a muscle group three times per week is superior to a twice-per-week protocol remains to be determined.

8 -12 rep * 50-80% 1RM

N° series

Single vs. Multiple Sets of Resistance Exercise for Muscle Hypertrophy: A Meta-Analysis

James W. Krieger

Journal of Pure Power, Colorado Springs, CO

J Strength Cond Res 24(4): 1150–1159, 2010

2-3 series por ejercicio

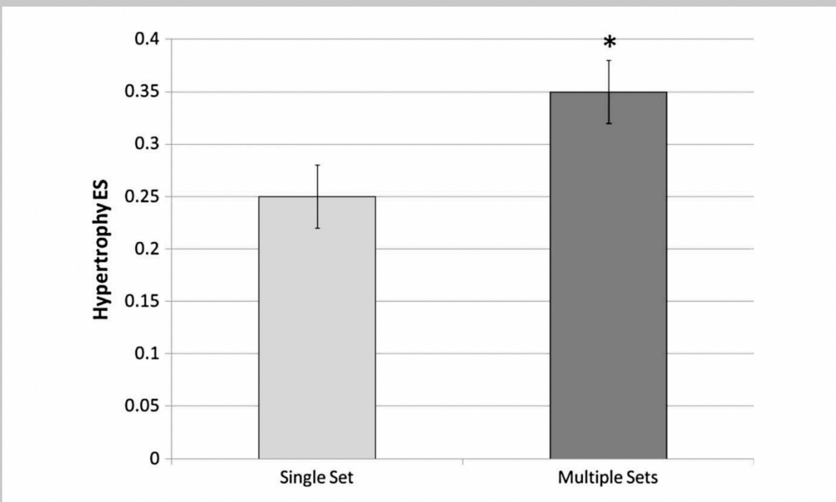


Figure 1. Mean hypertrophy effect size for single vs. multiple sets per exercise. Data are presented as means ± *SE*. *Significant difference from 1 set per exercise ($p < 0.05$).

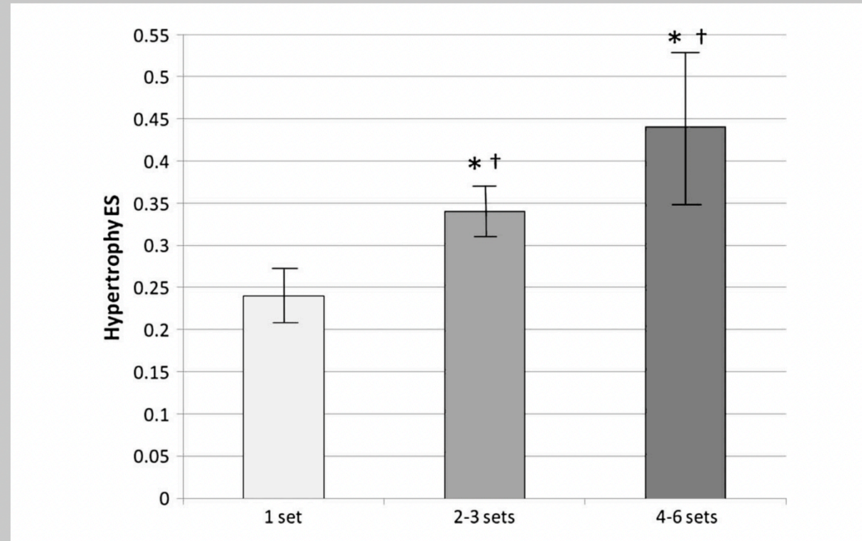


Figure 2. Dose–response effect of set volume on hypertrophy. Data are presented as means ± *SE*. ES = effect size. *Trend toward difference from 1 set per exercise according to Hochberg-adjusted standard *p* value ($p < 0.10$). †Significantly different from 1 set per exercise according to Hochberg-adjusted permutation *p* value ($p < 0.01$).

In conclusion, multiple sets are associated with 40% greater hypertrophy-related ESs than 1 set, in both trained and untrained subjects.

Duración de la repetición — Tiempo bajo tensión

Sports Med
DOI 10.1007/s40279-015-0304-0

SYSTEMATIC REVIEW

Effect of Repetition Duration During Resistance Training on Muscle Hypertrophy: A Systematic Review and Meta-Analysis

Brad J. Schoenfeld · Dan I. Ogborn · James W. Krieger

fast/heavy (sets of 6–12) with a total repetition duration of 0.5–4 s), fast/light (sets of 20–30)with a total repetition duration of 0.5–4 s), medium (sets of 6–12) with a total repetition duration of 4–8 s), or slow (sets of 6–12) with a total repetition duration of > 8 s)

Current evidence indicates that hypertrophic outcomes are similar when training with repetition durations ranging from 0.5 to 8 s to concentric muscular failure.

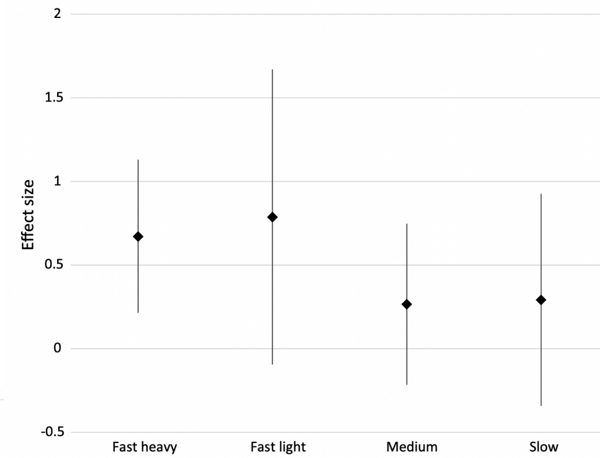


Fig. 2 Mean effect size and 95 % confidence interval for each tempo category

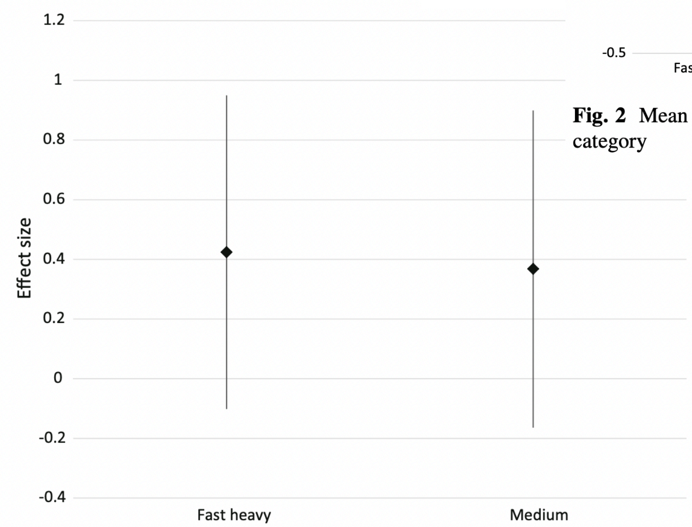


Fig. 3 Mean effect size and 95 % confidence interval for each tempo category: studies with direct hypertrophy measurements only

Hasta el fallo¡

OPEN ACCESS Freely available online

PLoS one

Low-Load High Volume Resistance Exercise Stimulates Muscle Protein Synthesis More Than High-Load Low Volume Resistance Exercise in Young Men

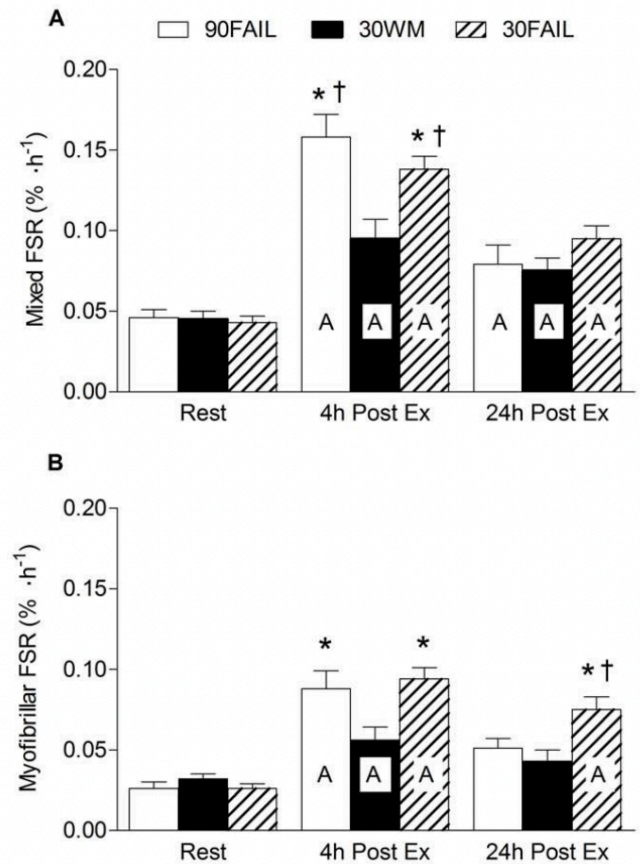
Nicholas A. Burd[1], Daniel W. D. West[1], Aaron W. Staples[1], Philip J. Atherton[2], Jeff M. Baker[1], Daniel R. Moore[1], Andrew M. Holwerda[1], Gianni Parise[1,3], Michael J. Rennie[2], Steven K. Baker[4], Stuart M. Phillips[1]*

1 Exercise Metabolism Research Group, Department of Kinesiology, McMaster University, Hamilton, Ontario, Canada, **2** School of Graduate Entry Medicine and Health, City Hospital, University of Nottingham, Derby, United Kingdom, **3** Department of Medical Physics and Applied Radiation Sciences, McMaster University, Hamilton, Ontario, Canada, **4** Department of Neurology, Michael G. DeGroote School of Medicine, McMaster University, Hamilton, Ontario, Canada

Table 2. Acute unilateral resistance exercise variables during the experimental exercise trial.

	90FAIL	30WM	30FAIL
Load (kg)	82±5*‡	28±4	28±3
Repetitions[a]	5±0.2	14±0.5†	24±1.1*†
Volume Load (kg)[ab]	710±30.0	632±28.4	1073±69.9*†
Time under tension (s)[a]	16.3±1.1	27.1±1.85†	43.3±1.9*†

Values are means ± S.E.M.
[a]Averages for all 4 sets.
[b]product of repetitions performed multiplied by load (kg) lifted.
*Significantly different from 30WM, P<0.05.
†Significantly different from 90FAIL, P<0.05.
‡Significantly different from 30WM and 30FAIL, P<0.05.
doi:10.1371/journal.pone.0012033.t002



Cargas ligeras ejecutadas con modalidad "hasta el fallo" pueden estimular la síntesis de proteínas en mayor magnitud que cargas más pesadas con menores tiempos bajo tensión.

OPEN

Resistance Training Load Effects on Muscle Hypertrophy and Strength Gain: Systematic Review and Network Meta-analysis

PEDRO LOPEZ[1,2], RÉGIS RADAELLI[3], DENNIS R. TAAFFE[1,2], ROBERT U. NEWTON[1,2,4], DANIEL A. GALVÃ
GABRIEL S. TRAJANO[5], JULIANA L. TEODORO[3], WILLIAM J. KRAEMER[6], KEIJO HÄKKINEN[7], and RONEI S.

. Med. Sci. Sports Exerc., Vol. 53, No. 6, pp. 1206–1216, 2021

Carga

Low load >15 RM
Moderate load 9-15 RM
High load < 8 RM

Hipertrofia

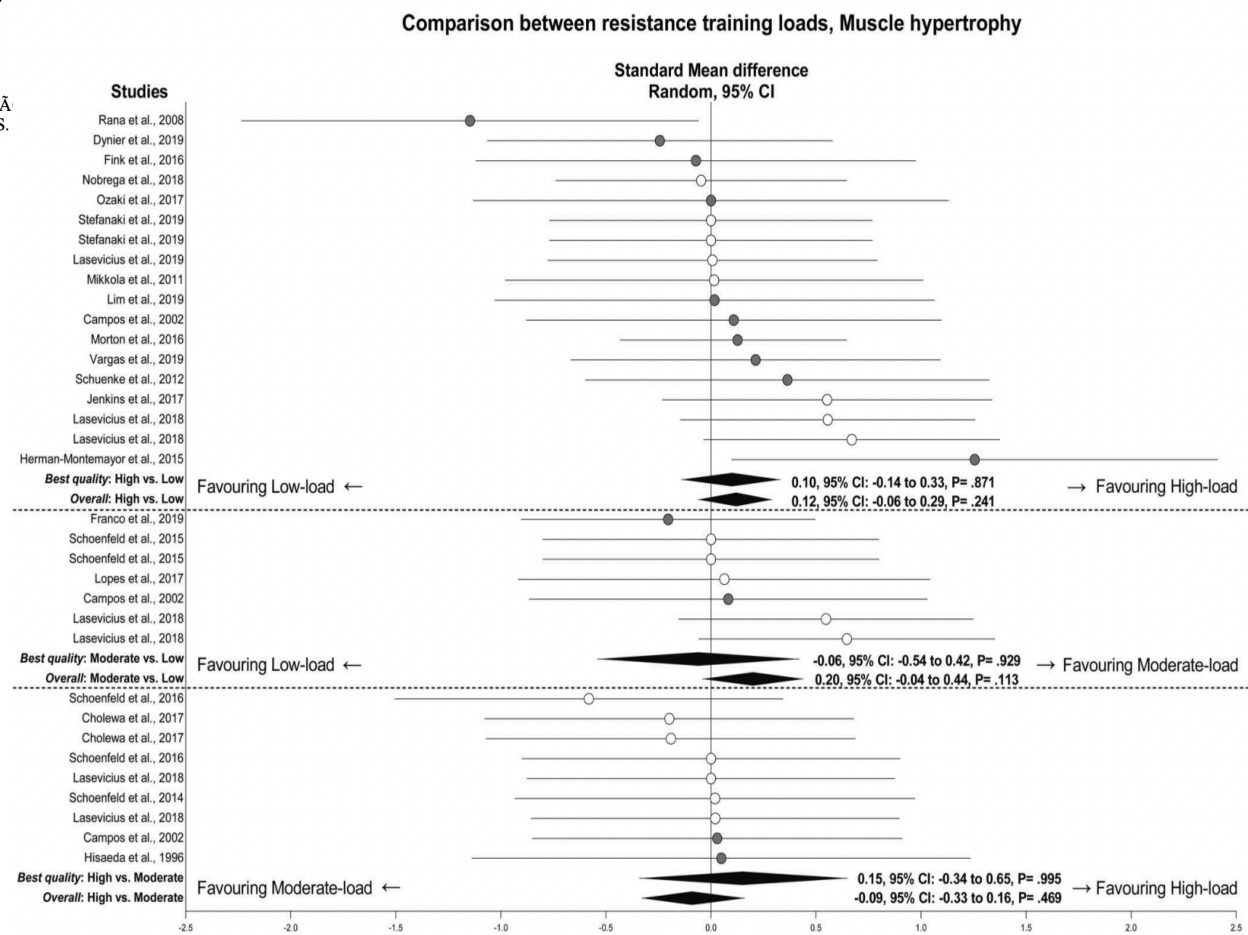


FIGURE 3—SMD effects between low-, moderate-, and high-load resistance training performed until volitional failure on muscle hypertrophy. Overall and subgroup analyses conducted with a network random-effects model. *Gray and white circles* represent study-specific estimates based on risk of bias assessment (low risk, and some concern or high risk of bias, respectively); *diamonds* represent pooled estimates of random-effects meta-analysis.

OPEN

Resistance Training Load Effects on Muscle Hypertrophy and Strength Gain: Systematic Review and Network Meta-analysis

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. Med. Sci. Sports Exerc., Vol. 53, No. 6, pp. 1206–1216, 2021

Carga

Fuerza

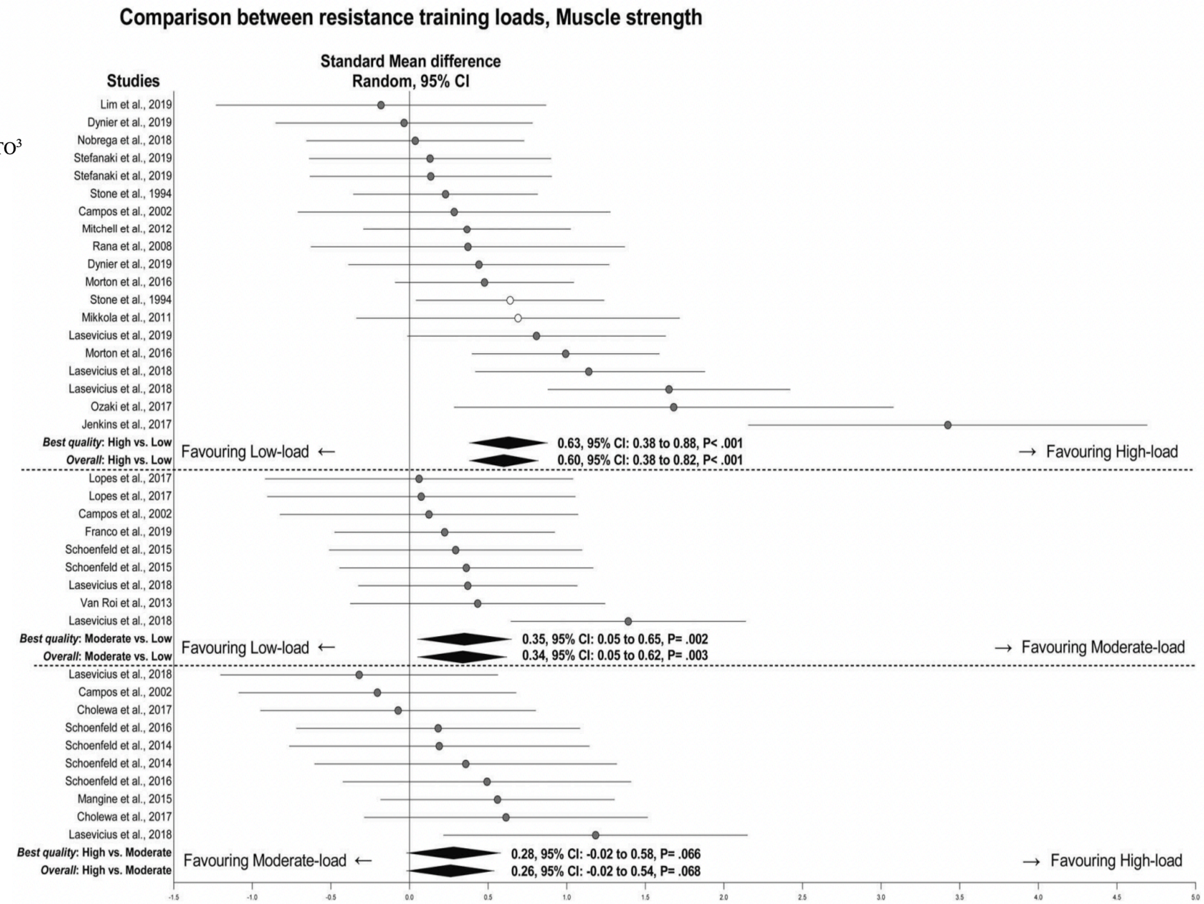


FIGURE 4—SMD effects between low-, moderate-, and high-load resistance training performed until volitional failure on muscle strength. Overall and subgroup analyses conducted with a network random-effects model. *Gray and white circles* represent study-specific estimates based on risk of bias assessment (low risk, and some concern or high risk of bias, respectively); *diamonds* represent pooled estimates of random-effects meta-analysis.

Conclusions: Although muscle hypertrophy improvements seem to be load independent, increases in muscle strength are superior in high-load RT programs. Untrained participants exhibit greater muscle hypertrophy, whereas undertaking more RT sessions provides superior gains in those with previous training experience

Journal of Strength and Conditioning Research, 1999, 13(4), 353–359

Equiparando la carga

The Effects of 4 and 10 Repetition Maximum Weight-Training Protocols on Neuromuscular Adaptations in Untrained Men

JAMES L. CHESTNUT AND DAVID DOCHERTY

School of Physical Education, University of Victoria, Victoria, British Columbia, Canada.

8*4RM*85% = 2720

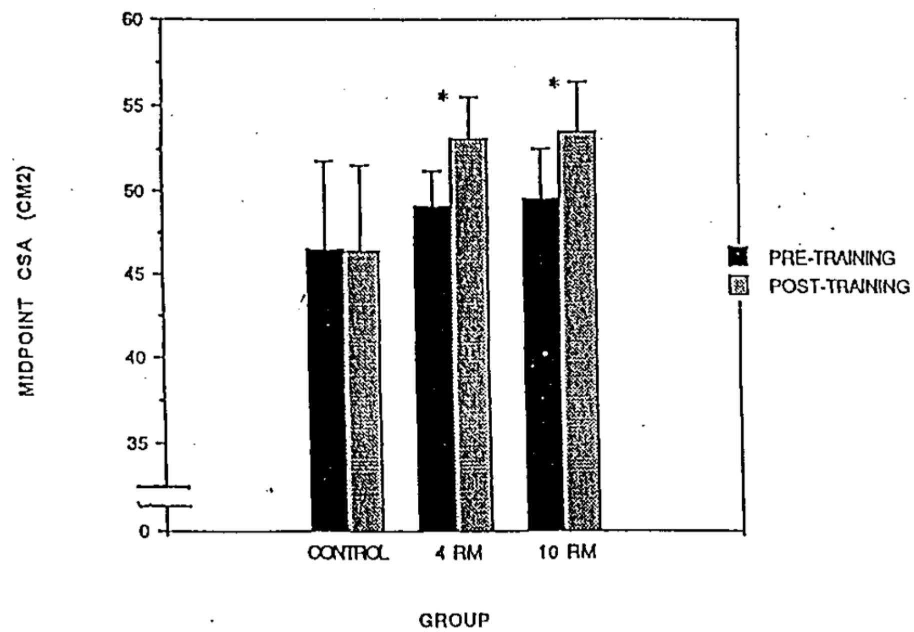
4*10RM*70% = 2800

3*sem*10 sem

Table 1. Pretraining and posttraining relaxed-arm girth, flexed-arm girth, and sum of skinfolds (SOS) values for control (n = 5), 4RM (n = 10), and 10RM (n = 9) groups (mean ± *SE*).

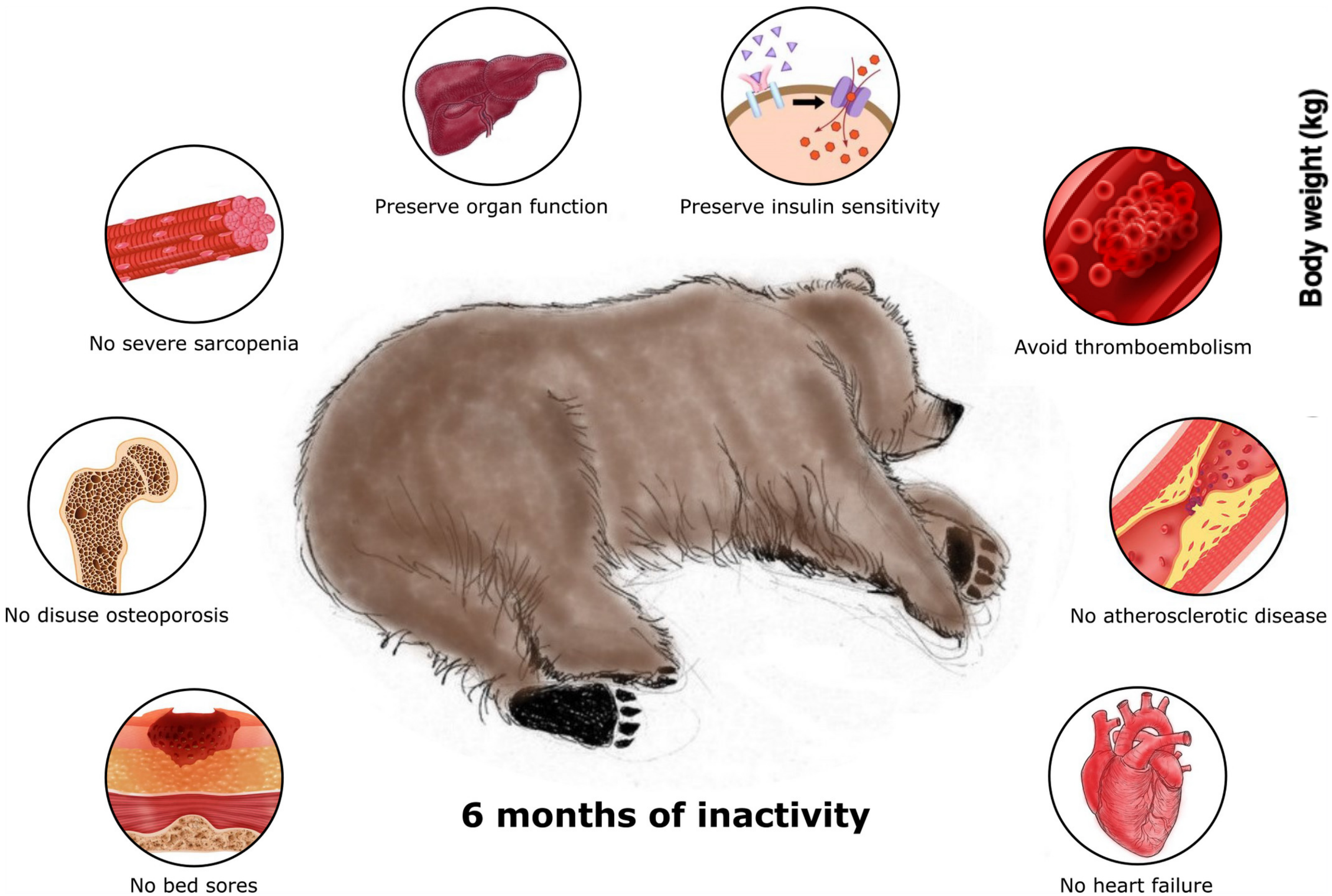
Group	Relaxed-Arm Girth (cm)	Flexed-Arm Girth (cm)	SOS (cm)
Control			
pretraining	28.5 ± 1.9	30.3 ± 1.6	1.3 ± 0.3
posttraining	28.5 ± 2.1	30.6 ± 1.7	1.3 ± 0.3
4RM			
pretraining	31.2 ± 0.9	33.2 ± 1.0	1.4 ± 0.1
posttraining	31.5 ± 1.0	33.9 ± 1.1*	1.3 ± 0.2
10RM			
pretraining	31.1 ± 1.0	32.8 ± 0.9	1.3 ± 0.2
posttraining	31.8 ± 0.9	33.6 ± 0.9*	1.3 ± 0.2

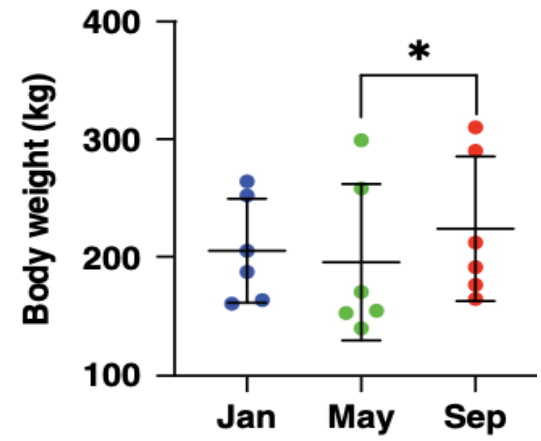
* Significant difference between pretraining and posttraining values ($p < 0.05$).



A igual volumen se producen adaptaciones similares

Se puede mantener la masa muscular si sólo duermo?


Preserve organ function
Preserve insulin sensitivity
No severe sarcopenia
Avoid thromboembolism
No disuse osteoporosis
No atherosclerotic disease
No bed sores
No heart failure
6 months of inactivity

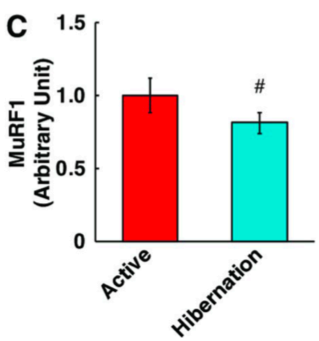

Body weight (kg)
400
300
200
100
*
Jan
May
Sep

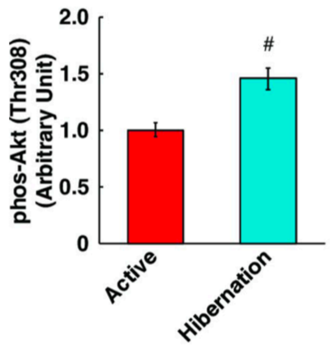
RESEARCH ARTICLE

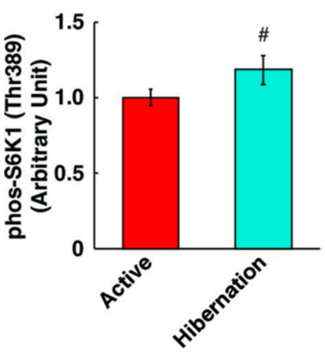
Supplementing cultured human myotubes with hibernating bear serum results in increased protein content by modulating Ak FOXO3a signaling

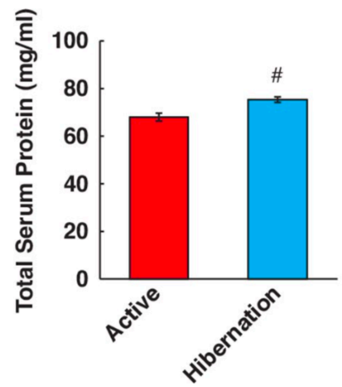
Mitsunori Miyazaki[1,2]*, **Michito Shimozuru**[3], **Toshio Tsubota**[3]

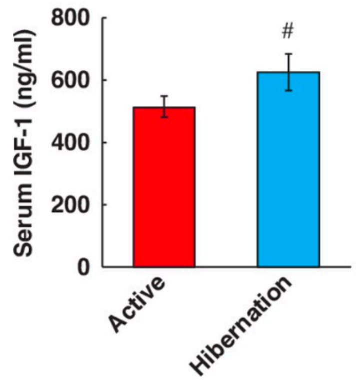
PLOS ONE | https://doi.org/10.1371/journal.pone.0263085 January 25, 2022

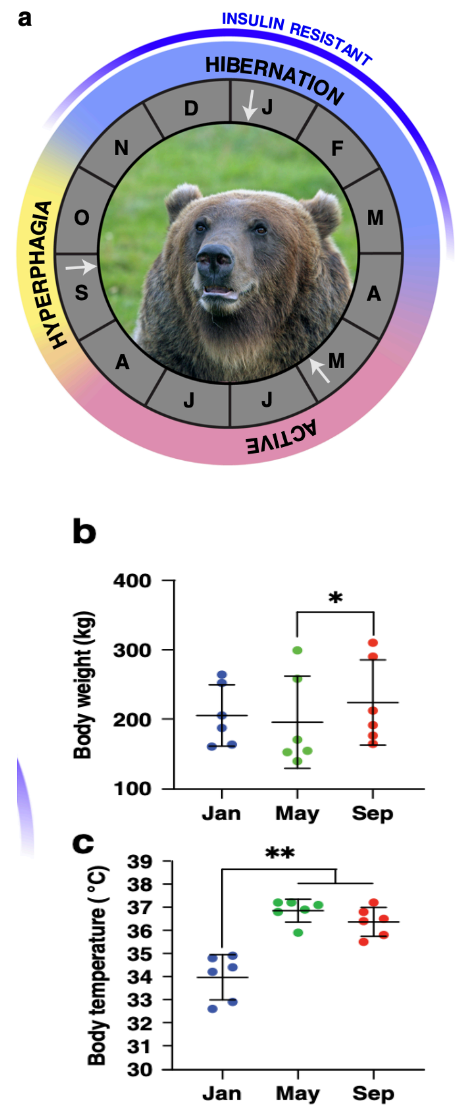












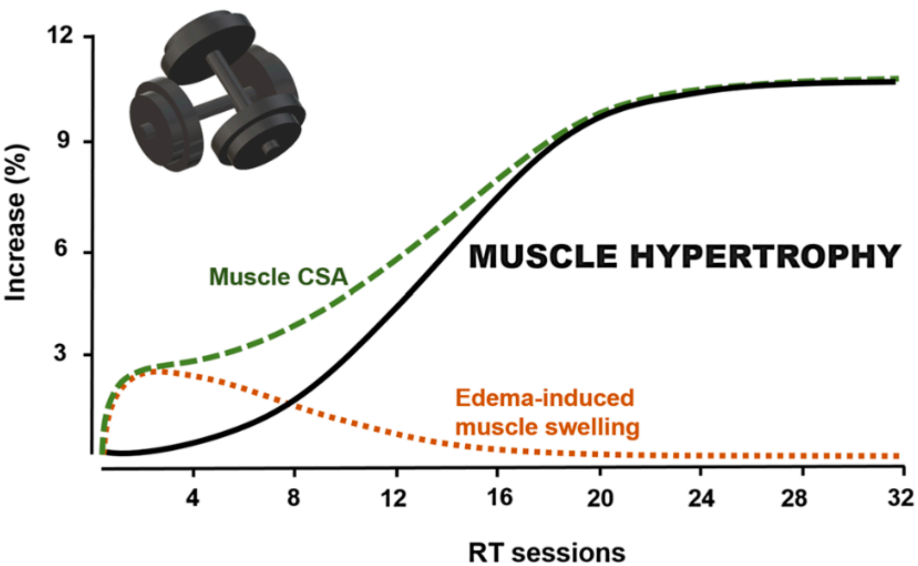
Entendiendo la temporalidad de la hipertrofia muscular

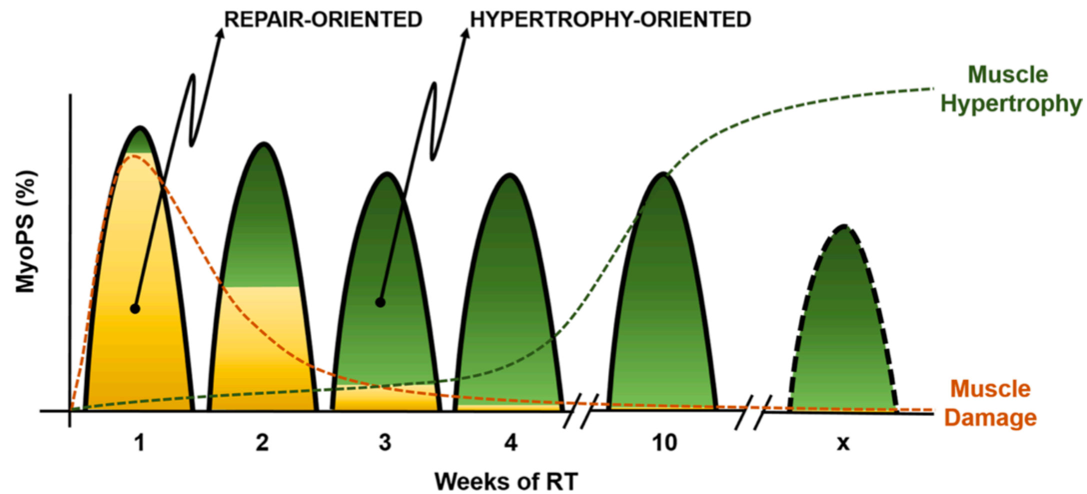
European Journal of Applied Physiology (2018) 118:485–500
https://doi.org/10.1007/s00421-017-3792-9

INVITED REVIEW

The development of skeletal muscle hypertrophy through resistance training: the role of muscle damage and muscle protein synthesis

Felipe Damas[1,2] · Cleiton A. Libardi[2] · Carlos Ugrinowitsch[1]





Orientación de la carga e hipertrofia


2007 AT&T USA OUTDOOR CHAMPIONSHIPS
Abdirahman
INDIANAPOLIS, IN
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INDIANAPOLIS, IN
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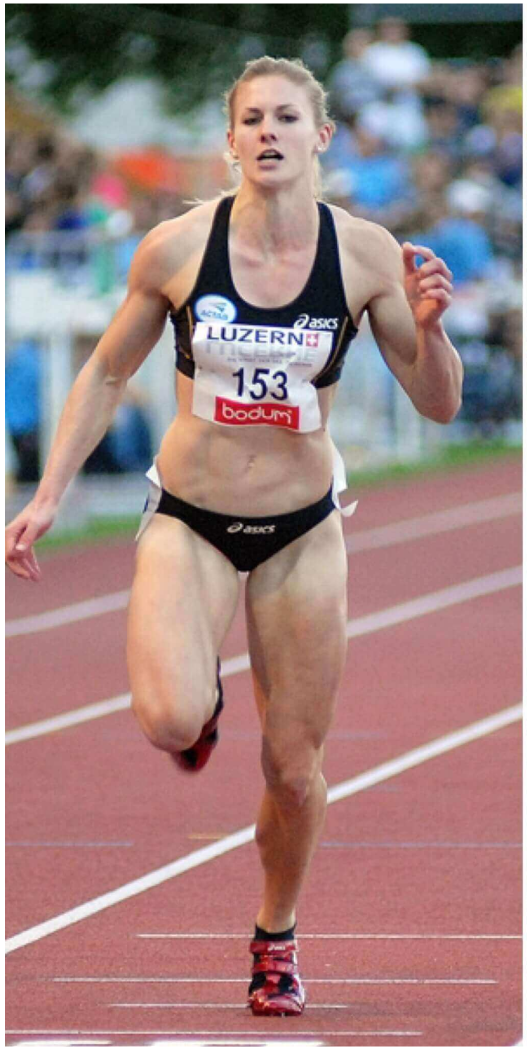
asics
LUZERN
153
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adidas
2
2007 BOSTON
MARATHON

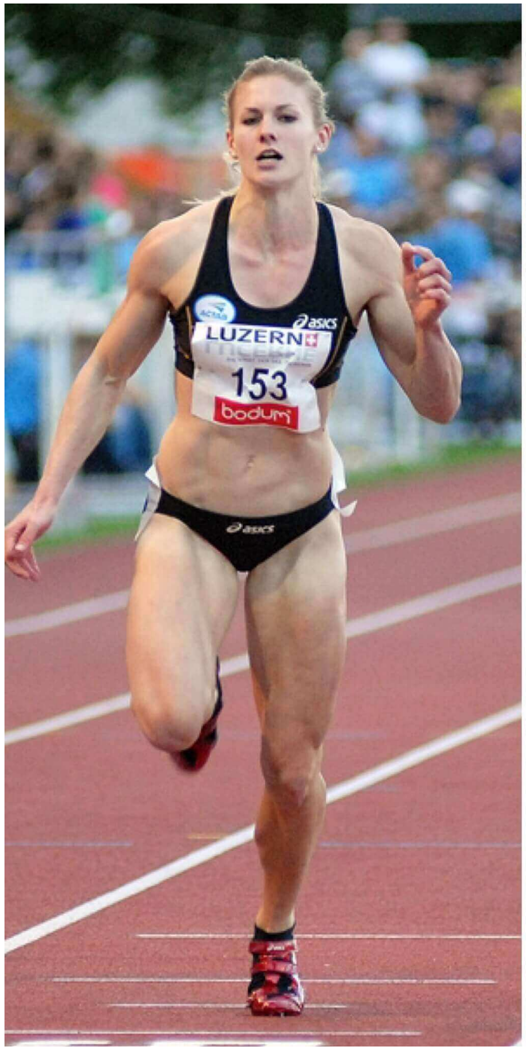
Tipo de entrenamiento

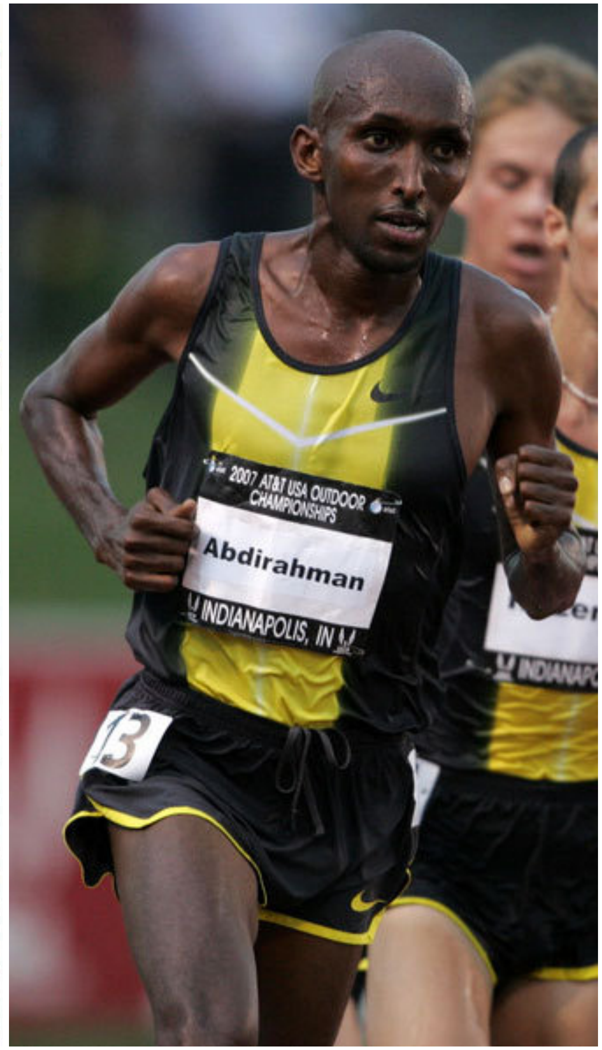
Sprints - Saltos - rebotes
Arrastres
Sentadillas c/s salto
Ejercicios derivados de la Halterofilia

Aeróbicos

Tipo de combustible

Fosfágeno - Glicógeno





Tipo de entrenamiento

Carrera continua - intervalos
1/2 sentadilla - rebotes

Pesas
estímulos en baja cantidad

Tipo de combustible

Glicógeno - Glucosa
Ac. Grasos

Y si se combinan estos entrenamientos?

Tipo de entrenamiento

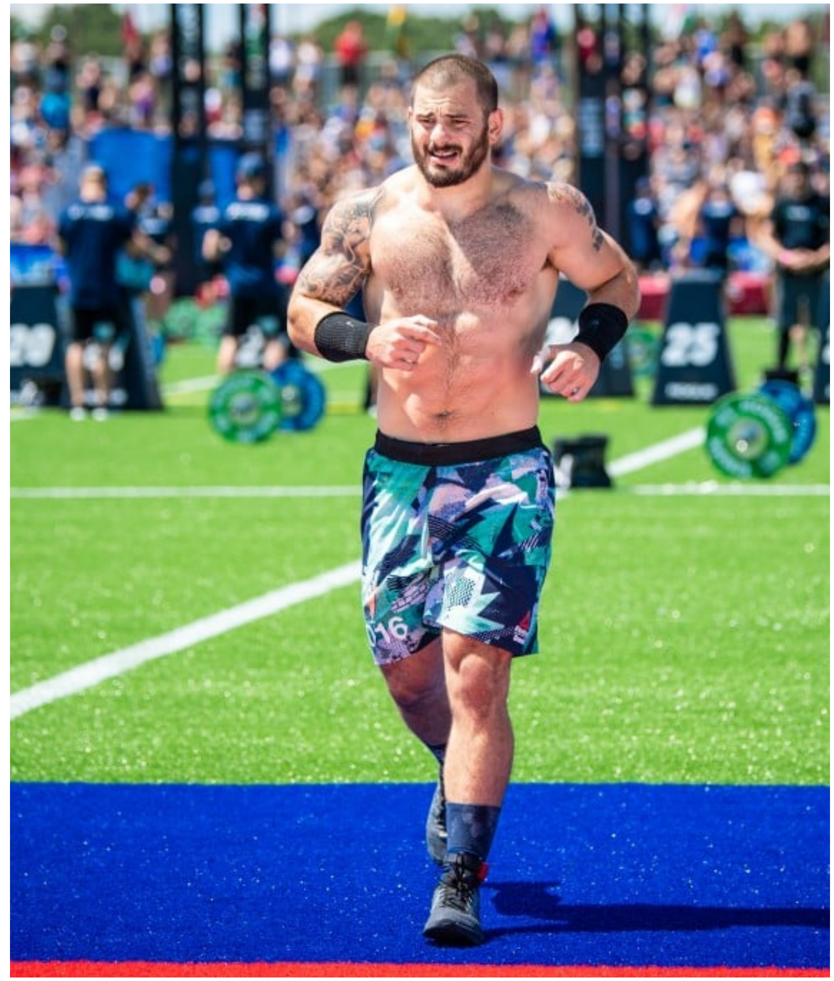
Sprints - Saltos -
Arrastres - dominadas
Sentadillas
Ejercicios derivados
de la Halterofilia

Al Fallo¡¡¡¡

Tipo de combustible

Fosfágeno - Glicógeno - Glucosa
Ac. Grasos

Aeróbicos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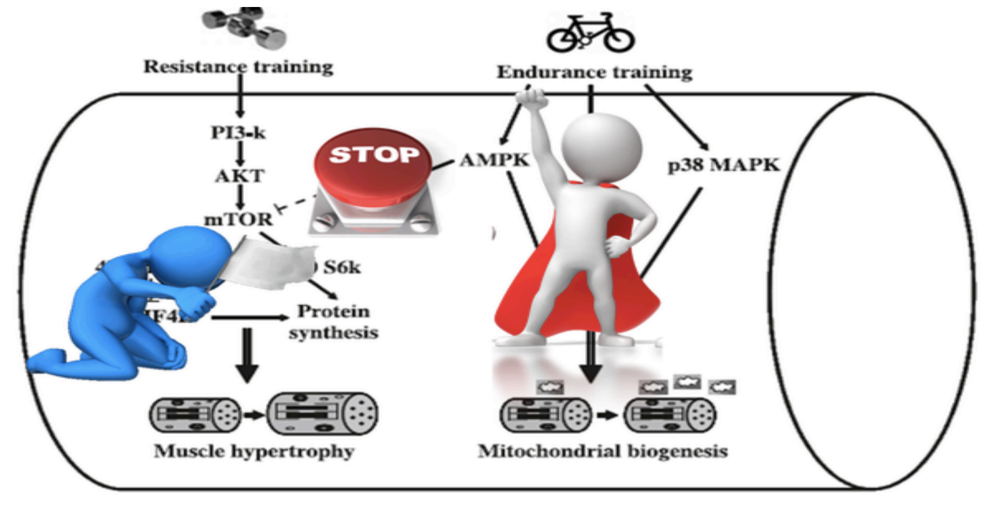
Entonces, el efecto de interferencia existe o no con el entrenamiento concurrente?

Definición

- Es el entrenamiento en forma secuencial de diferentes capacidades biomotoras.
- En general antagónicas
  - Entrenamiento aeróbico y de fuerza.

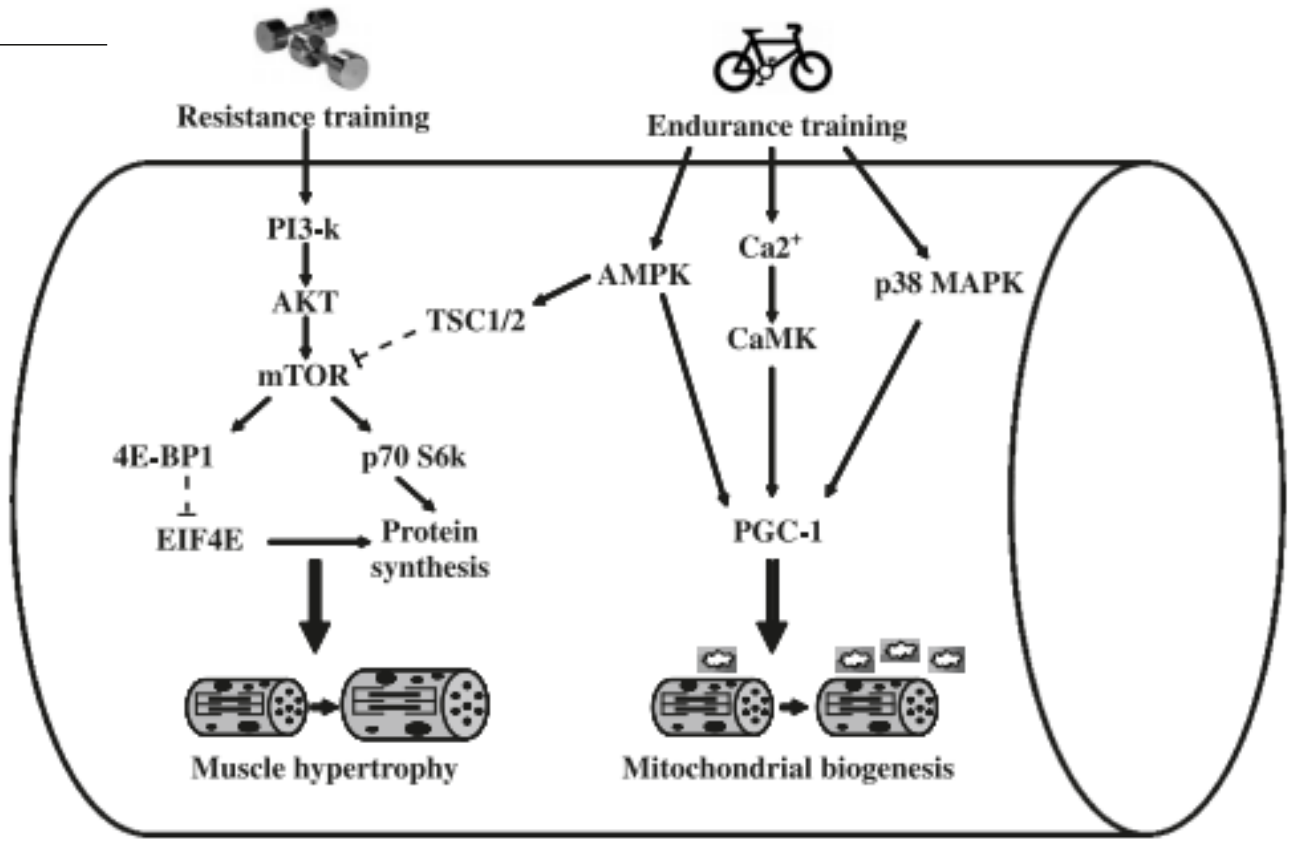
Concurrencia



REVIEW / SYNTHÈSE

Molecular responses to strength and endurance training: Are they incompatible?[1]

John A. Hawley



Hawley, 2009


SPORTS PERFORMANCE

Interference of Strength Development by Simultaneously Training for Strength and Endurance

Robert C. Hickson

University of Illinois at Chicago Circle, Department of Physical Education, Box 4348, Chicago, Il 60680, USA

Grupo Fuerza (S) = 8 sujetos X edad 22 años, 7H; 1M
Grupo Resistencia (E) = 8 sujetos X edad 25, 5H; 3M
Grupo concurrente (S+E) = 7 sujetos X edad 5H; 2M

Grupo S = 5 veces/ semana por 10 semanas
3 días
- Sentadillas 3*5 rep
- Flex. rodillas 3*5 rep
- Ext. rodillas 3*5 rep

2 días
- leg press 3*5 rep
- pantorrillas 3*20 rep

Grupo E = 6 veces/sem
3 días
- interval training 6*5’ cercano al VO2 máx.

3 días
- aeróbico continuo 30’/día 1ª sem, 35’/día 2ª sem y 40’/día en adelante. Intensidad máxima.

Grupo S+E = ambos entrenamientos con separación de 2 h

Eur J Appl Physiol 45: 255–263, 1980.

Interference of Strength Development by Simultaneously Training for Strength and Endurance

Robert C. Hickson

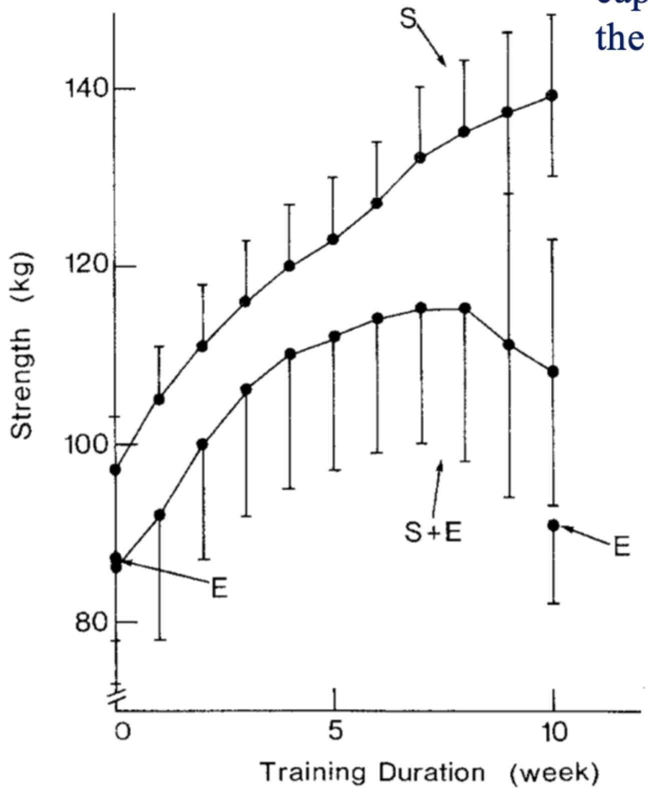
University of Illinois at Chicago Circle, Department of Physical Education,
Box 4348, Chicago, Il 60680, USA

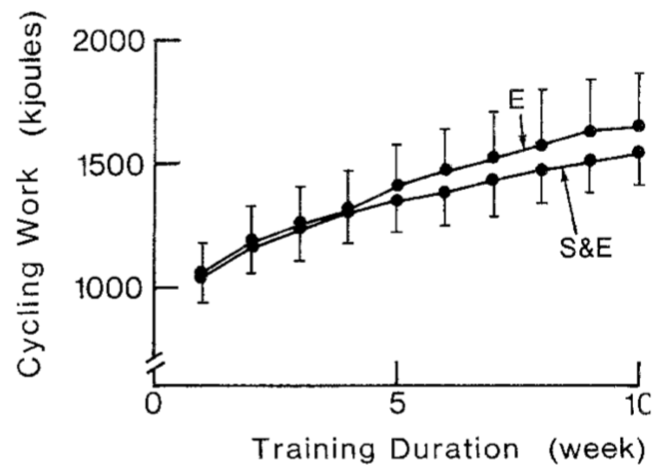
Table 1. Effects of the three types of training programs on body weight, thigh girth, and percent fat

Group	Body weight (kg)		Thigh girth[a] (cm)		Percent fat	
	Before training	After training	Before training	After training	Before training	After training
Strength (8)	75.8 ± 3.4	77.7 ± 3.3[b]	53.3 ± 1.2	55.6 ± 1.1[b]	14.5 ± 1.4	13.7 ± 1.1
Endurance (8)	77.0 ± 4.9	74.8 ± 4.2[c]	54.4 ± 1.5	54.3 ± 1.0	17.8 ± 2.5	14.2 ± 1.6[c]
Strength and Endurance (7)	82.2 ± 7.3	81.4 ± 6.9	54.7 ± 1.4	56.4 ± 1.7[c]	15.3 ± 2.8	13.0 ± 2.2[c]

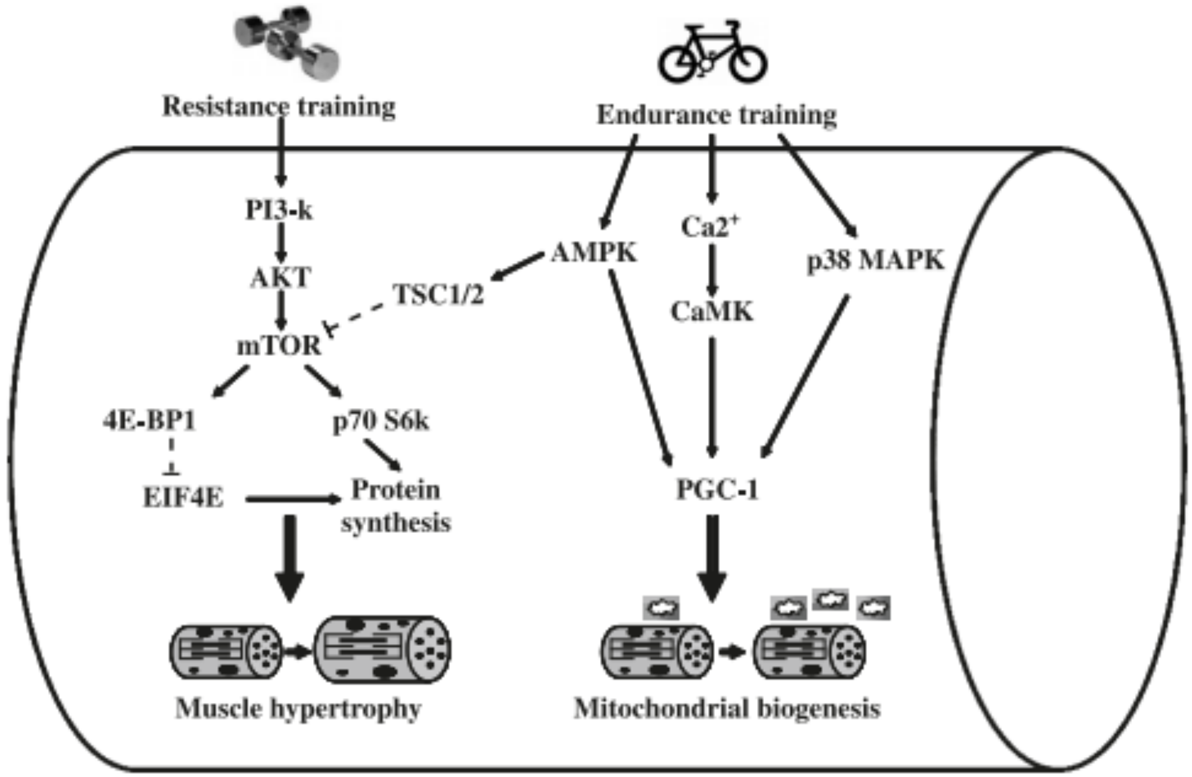
Values are means ± SE. Number of subjects are given in parentheses
[a] Average thigh girth for both legs
[b] Before vs. after Training, $p < 0.01$
[c] Before vs. after Tarining, $p < 0.05$
Percent fat means are for six subjects in the S and E group

These findings demonstrate that simultaneously training for S and E will result in a reduced capacity to develop strength, but will not affect the magnitude of increase in VO2 max.





El entrenamiento concurrente resulta en una reducida capacidad para desarrollar fuerza, pero no afecta la magnitud de incremento en VO2máx



Modelo propuesto de interferencia a hipertrofia. Es cierto?

Hawley, 2009

J Appl Physiol 114: 81–89, 2013.
First published October 25, 2012; doi:10.1152/japplphysiol.01013.2012.

Aerobic exercise does not compromise muscle hypertrophy response to short-term resistance training

Tommy R. Lundberg,[1] Rodrigo Fernandez-Gonzalo,[2] Thomas Gustafsson,[3] and Per A. Tesch[1,2]

[1]*Department of Health Sciences, Mid Sweden University, Östersund, Sweden;* [2]*Department of Physiology and Pharmacology, Karolinska Institutet, Stockholm, Sweden; and* [3]*Department of Laboratory Medicine, Section for Clinical Physiology, Karolinska Institutet, Karolinska University Hospital, Stockholm, Sweden*

Submitted 17 August 2012; accepted in final form 24 October 2012

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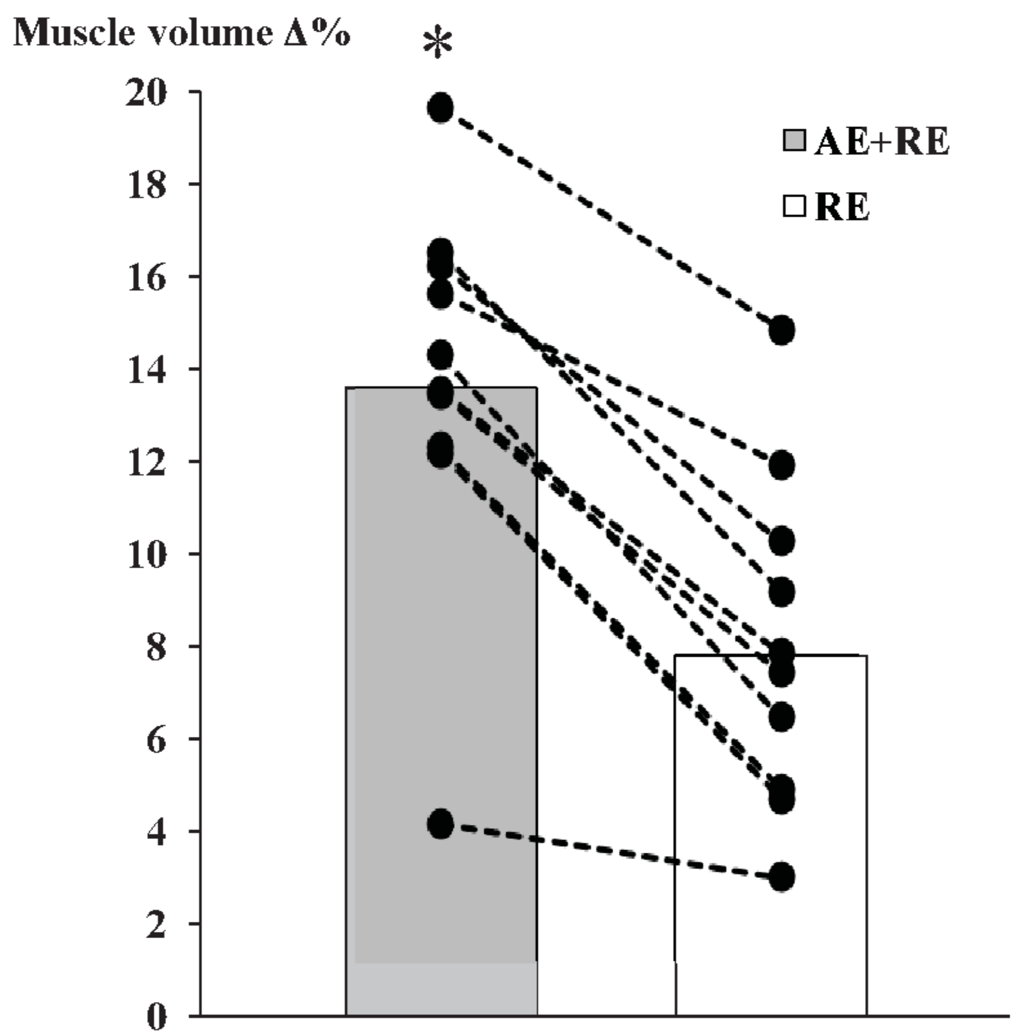
Submitted 17 August 2012; accepted in final form 24 October 2012

Table 1. *Selected outcome measures pre- and postresistance training with (AE+RE) or without (RE) concurrent aerobic exercise*

	AE+RE			RE		
	PRE	POST	Δ%	PRE	POST	Δ%
Endurance performance, s [b,c]	590 ± 104	752 ± 129*	29	553 ± 98	659 ± 109*	19
W_{max}, W [b,c]	50 ± 12	72 ± 19*	44	49 ± 12	62 ± 15*	27
Peak heart rate at W_{max}, beats/min [b,c]	158 ± 18	169 ± 12	7	153 ± 17	161 ± 17	5
Lactate 3 min post W_{max}, mmol/l [b,c]	6.7 ± 1.5	8.0 ± 1.1*	19	6.1 ± 1.0	7.2 ± 1.2*	18
Flywheel mean peak power, W [c]	400 ± 137	514 ± 129*	29	406 ± 120	502 ± 126*	24
Flywheel mean peak torque, Nm [c]	218 ± 31	279 ± 59*	28	217 ± 35	280 ± 61*	29
Maximal isometric torque, Nm [c]	287 ± 53	312 ± 86	9	276 ± 49	307 ± 73	11
QF muscle volume, cm^3 [a,b,c]	1,147 ± 249	1,303 ± 276*†	14	1,111 ± 262	1,198 ± 273*	8
QF mean CSA, cm^2 [a,b,c]	79 ± 10	90 ± 10*†	14	78 ± 12	84 ± 12*	8
QF greatest CSA, cm^2 [a,b,c]	89 ± 11	101 ± 12*†	13	87 ± 13	94 ± 14*	8
Normalized torque, Nm/cm^2 [c]	2.77 ± 0.37	3.10 ± 0.52*	12	2.81 ± 0.36	3.36 ± 0.69*	19
Normalized power, W/cm^2 [c]	5.03 ± 1.16	5.67 ± 1.16*	13	5.22 ± 0.98	6.00 ± 1.29*	15
QF signal intensity, MGV [a,c]	52 ± 7	58 ± 8*	12	52 ± 7	52 ± 9	0
VL signal intensity, MGV [a,b,c]	53 ± 8	58 ± 8*†	9	52 ± 8	51 ± 8	−2
BF signal intensity, MGV	40 ± 7	41 ± 6	2	41 ± 10	40 ± 10	−2

Values are means ± SD. Significant effects ($P < 0.05$); a, interaction; b, leg; c, time. Significant post hoc differences ($P < 0.05$): *within leg vs. PRE; †vs. RE at POST. W_{max}, maximal workload; CSA, cross-sectional area; MGV, mean gray value; QF, quadricep femoris; VL, vastus lateralis; BF, biceps femoris.

El aumento en el volumen muscular fue mayor en la pierna que realizó el entrenamiento combinado



Y entonces, AMPK no produce la interferencia?

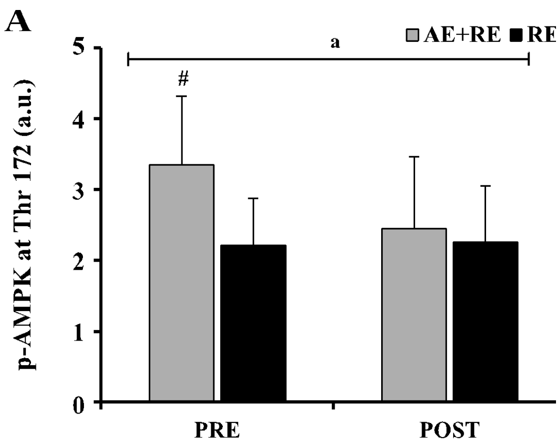
45 min AE + 4*7 máx ext. Rodillas
15 min entre AE y RE

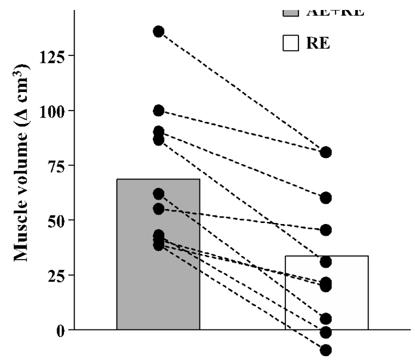
First published January 9, 2014; doi:10.1152/japplphysiol.01082.201

Exercise-induced AMPK activation does not interfere with muscle hypertrophy in response to resistance training in men

Tommy R. Lundberg,[1] Rodrigo Fernandez-Gonzalo,[2,3] and Per A. Tesch[2]
[1]Department of Health Sciences, Mid Sweden University, Östersund, Sweden; [2]Department of Physiology and Pharmacology, Karolinska Institutet, Stockholm, Sweden; and [3]Department of Laboratory Medicine, Section for Clinical Physiology, Karolinska Institutet, Karolinska University Hospital, Stockholm, Sweden

Submitted 26 September 2013; accepted in final form 8 January 2014





3. Individual and mean increase in quadriceps muscle volume after ...ance training with (AE + RE) or without (RE) concurrent aerobic ...ise. *Greater increase after AE + RE.

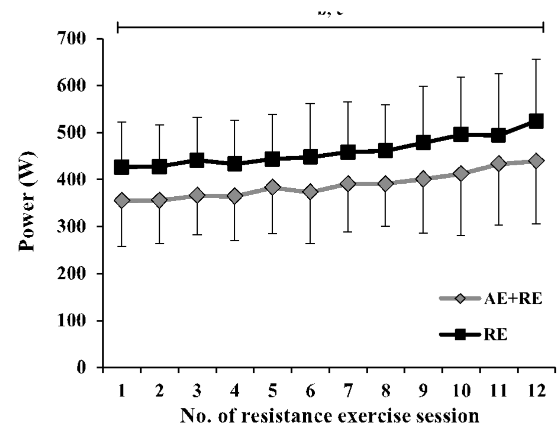


Fig. 2. Peak power measured in the flywheel ergometer during 12 resistan... exercise sessions with (AE + RE) or without (RE) preceding aerobic exercis... Means ± SD. Significant effect ($P < 0.05$): b = leg; c = time.

A pesar de entrenar con elevados niveles de AMPK, el entrenamiento concurrente resultó en mayores ganancias de masa muscular, pero las potencias generadas durante las sesiones de entrenamiento fueron menores

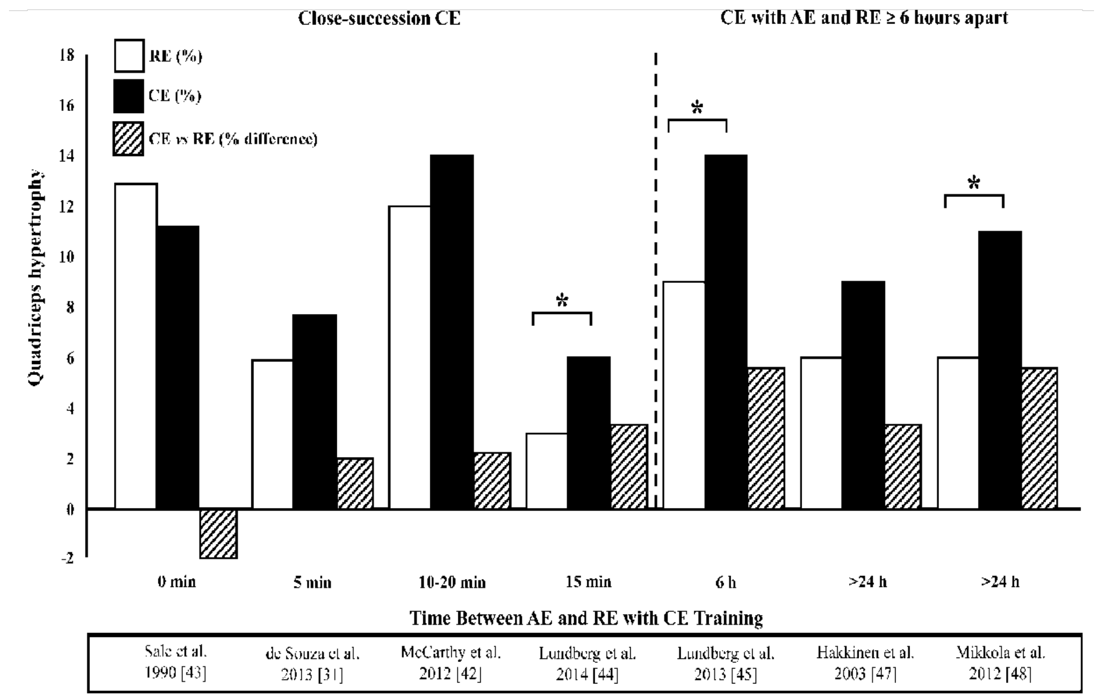
Sports Med
DOI 10.1007/s40279-016-0496-y

CURRENT OPINION

Skeletal Muscle Hypertrophy with Concurrent Exercise Training: Contrary Evidence for an Interference Effect

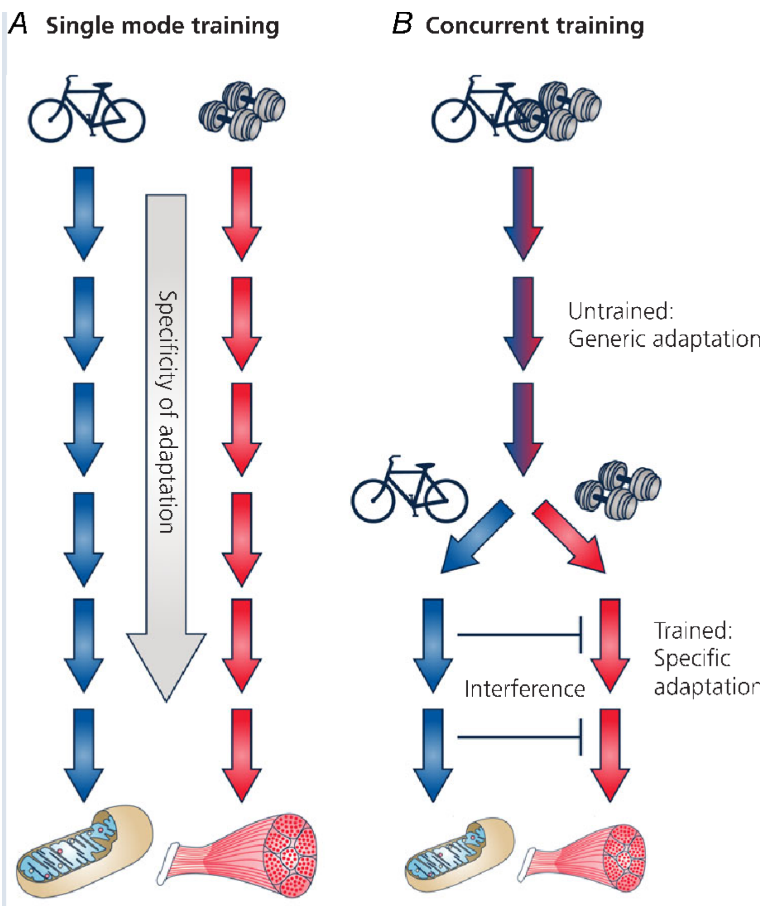
Kevin A. Murach[1] · James R. Bagley[2]

- Ejercicio aeróbico puede inducir hipertrofia.
- Ejercicio concurrente puede aumentar la respuesta hipertrófica al ejercicio con sobrecarga
- La respuesta hipertrófica máxima puede ser alcanzada:
  - Separando las sesiones 6-24 h.
  - Adoptando estrategias que minimicen el volumen de ejercicio (intervalos vs continuo).
  - Favorecer bicicleta a trote.
- El entrenamiento concurrente puede afectar la función en cuanto al desarrollo de potencia.



Entrenamiento concurrente

La interferencia ocurre en personas con diferente nivel de rendimiento?



J Physiol 595.9 (2017) pp 2883–2896

SYMPOSIUM REVIEW

Concurrent exercise training: do opposites distract?

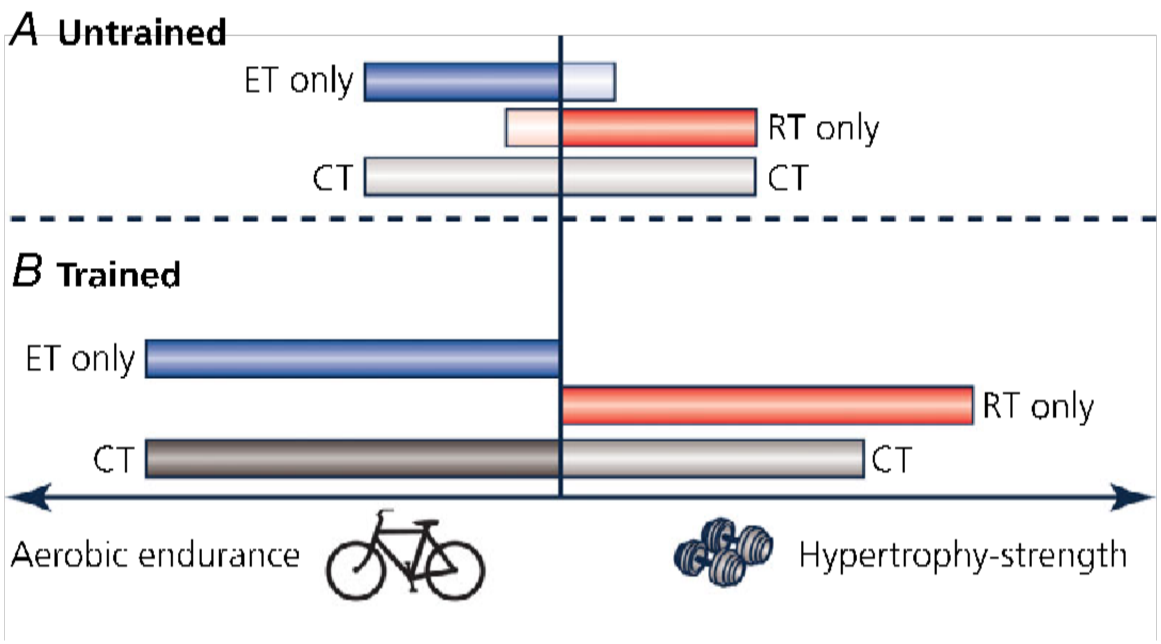
Vernon G. Coffey[1] and John A. Hawley[2,3]

J Physiol 595.9 (2017) pp 2883–2896

SYMPOSIUM REVIEW

Concurrent exercise training: do opposites distract?

Vernon G. Coffey[1] and John A. Hawley[2,3]



No existiría interferencia para sujetos no entrenados. En cambio para sujetos entrenados, la interferencia del entrenamiento concurrente afectaría a la fuerza-hipertrofia y no al componente aeróbico

Sports Medicine (2022) 52:601–612
https://doi.org/10.1007/s40279-021-01587-7

SYSTEMATIC REVIEW

Compatibility of Concurrent Aerobic and Strength Training for Skeletal Muscle Size and Function: An Updated Systematic Review and Meta-Analysis

Moritz Schumann[1] · Joshua F. Feuerbacher[1] · Marvin Sünkeler[1] · Nils Freitag[1,2] · Bent R. Rønnestad[3] · Kenji Doma[4] · Tommy R. Lundberg[5,6]

Key Points

Concurrent aerobic and strength training is recommended to improve physical fitness and health; however, the compatibility of these two distinct training modes remains unclear.

In this meta-analysis, we report that concurrent training does not interfere with adaptations in maximal strength and muscle hypertrophy, regardless of the type of aerobic training (cycling vs. running), frequency of concurrent training (> 5 vs. < 5 weekly sessions), training status (untrained vs. active), mean age (< 40 vs. > 40 years), and training modality (same session vs. same day vs. different day training).

However, concurrent training may attenuate gains in explosive strength, which is exacerbated when aerobic and strength training are performed within the same training session.

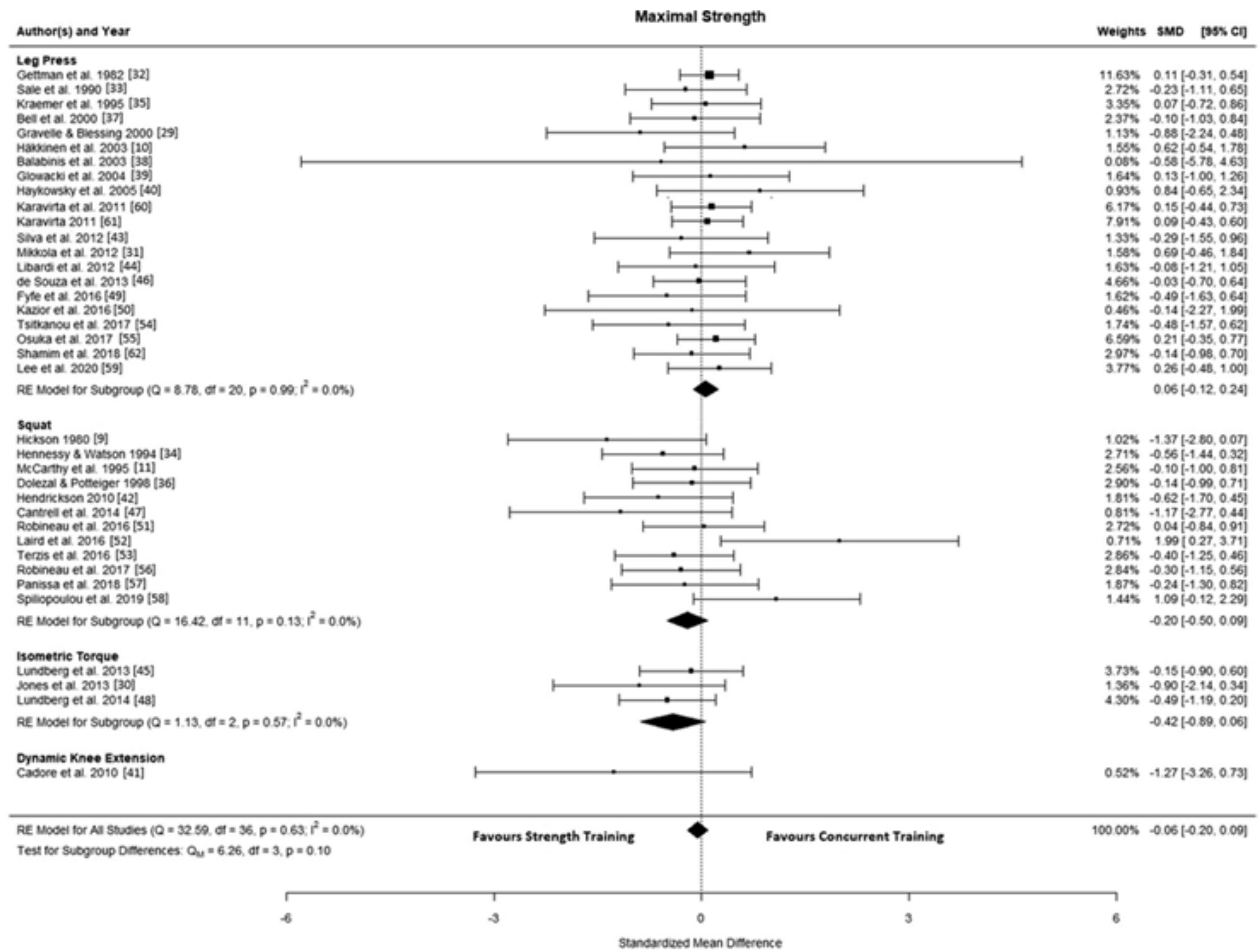


Fig. 2 Forest plot of studies comparing differences in maximal strength. *CI* confidence interval, *RE* random effects, *SMD* standardised mean difference

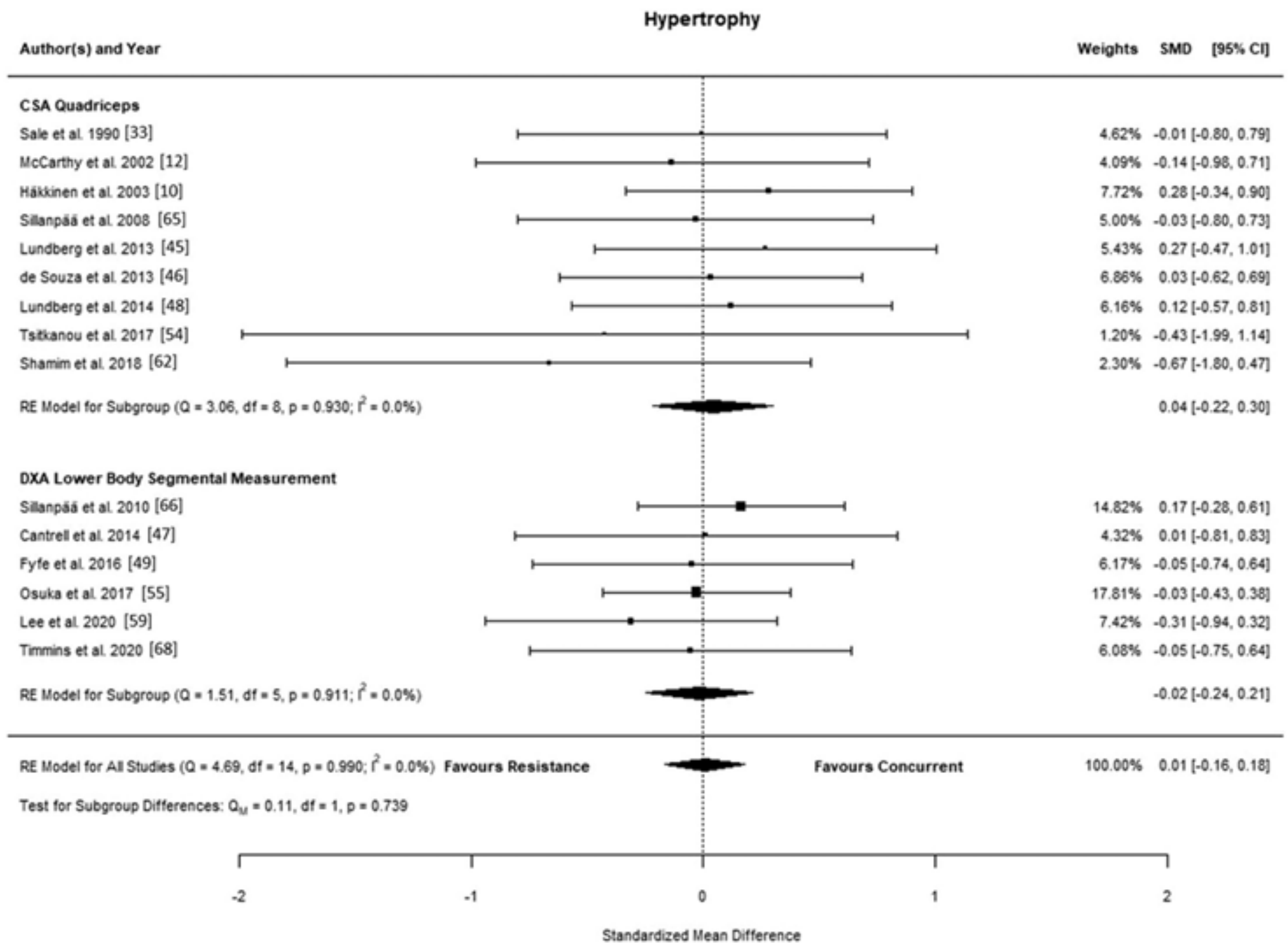


Fig. 4 Forest plot of studies comparing differences in muscle hypertrophy. *CI* confidence interval, *CSA* cross-sectional area, *DXA* dual energy X-ray absorptiometry, *RE* random effects, *SMD* standardised mean difference

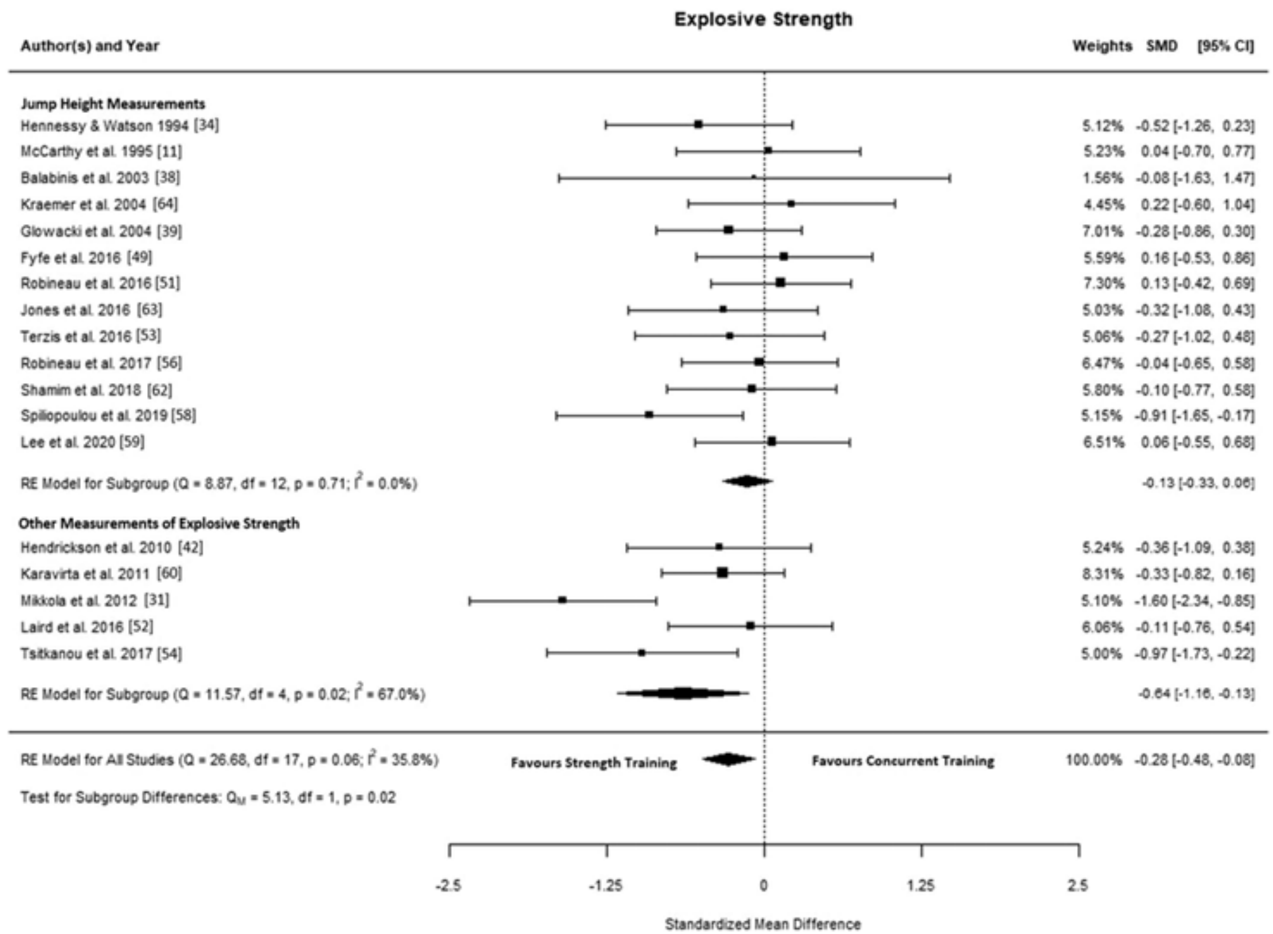


Fig. 3 Forest plot of studies comparing differences in explosive strength. *CI* confidence interval, *RE* random effects, *SMD* standardised mean difference

Y el orden de los ejercicios?

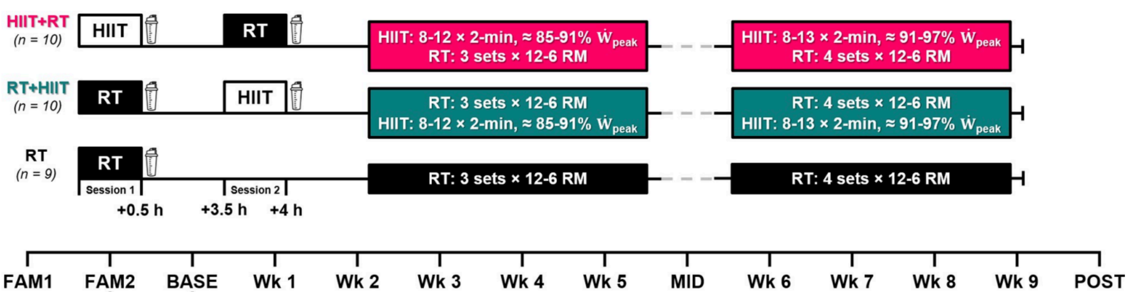
Y el orden de los ejercicios?

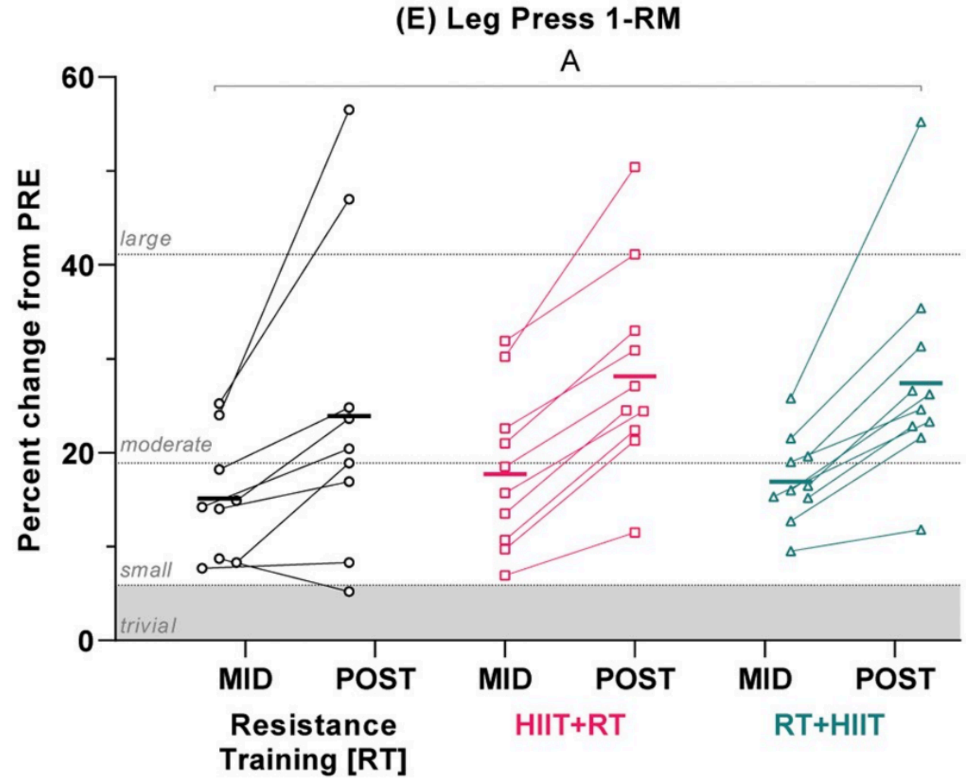
RESEARCH ARTICLE

Order of same-day concurrent training influences some indices of power development, but not strength, lean mass, or aerobic fitness in healthy, moderately-active men after 9 weeks of training

Matthew J. -C. Lee[1]*, James K. Ballantyne[1], Javier Chagolla[1], William G. Hopkins[1], Jackson J. Fyfe[2], Stuart M. Phillips[3], David J. Bishop[1,4], Jonathan D. Bartlett[1]

1 Institute for Health and Sport, Victoria University, Melbourne, Australia, **2** Centre for Sport Research, School of Exercise and Nutrition Sciences, Deakin University, Australia, **3** Department of Kinesiology, McMaster University, Hamilton, Ontario, Canada, **4** School of Medicine & Health Sciences, Edith Cowan University, Joonalup, Australia





Leg Press 1-RM	**RT**	23.9 ± *12.4*
	HIIT+RT	28.1 ± *8.3*
	RT+HIIT	27.4 ± *7.9*

Y el orden de los ejercicios?

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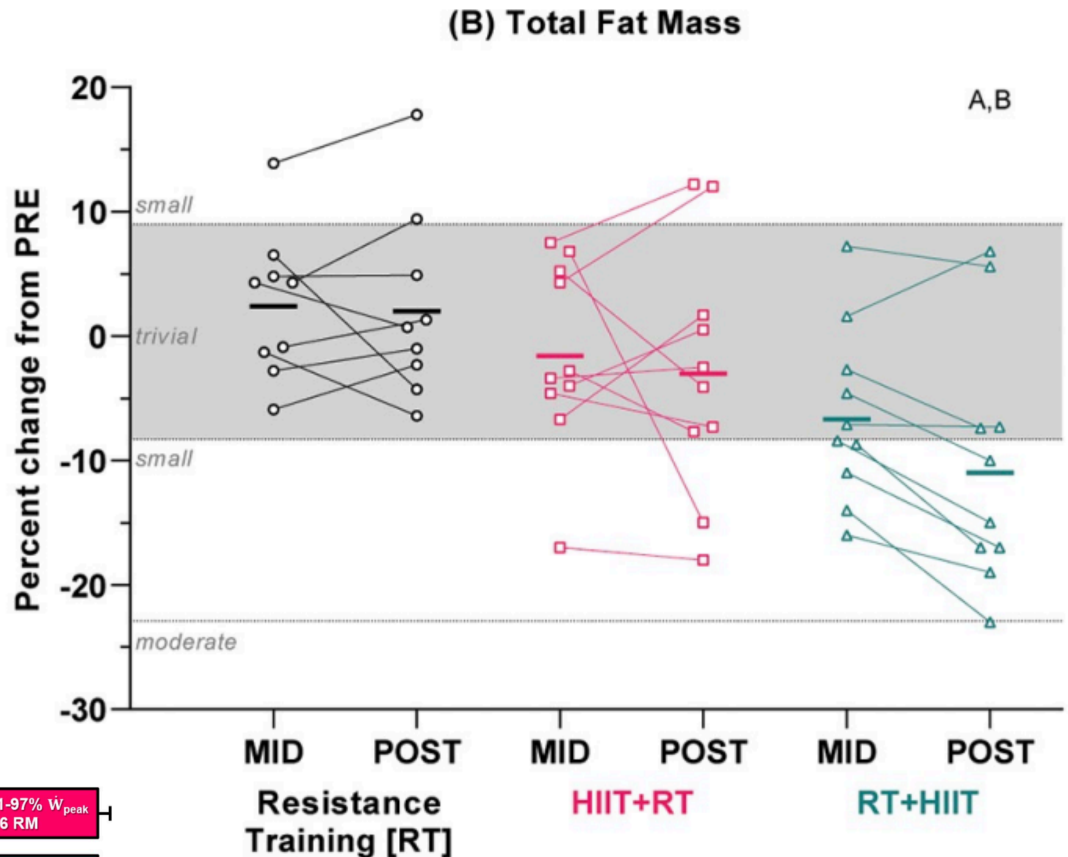

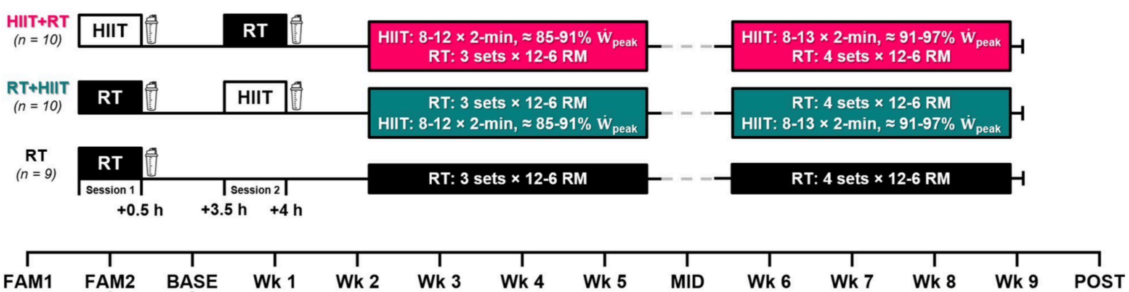

Total Fat Mass (TBLH)	RT	2.0 ± *6.3*
	HIIT+RT	-3.0 ± *11.0*
	RT+HIIT	-11.0 ± *11.7*

Y el orden de los ejercicios?

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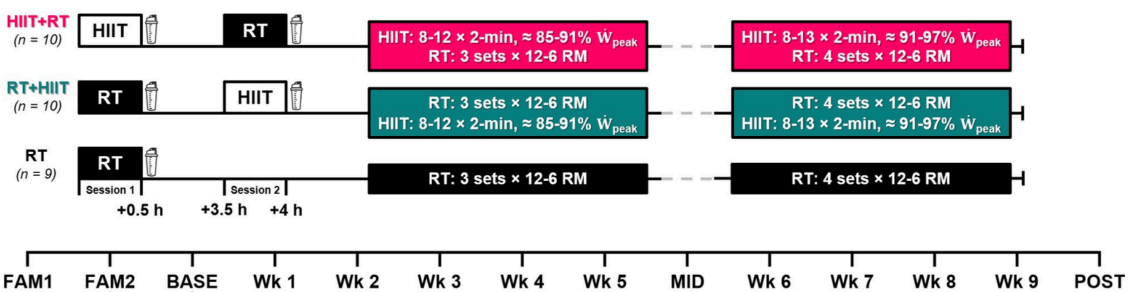

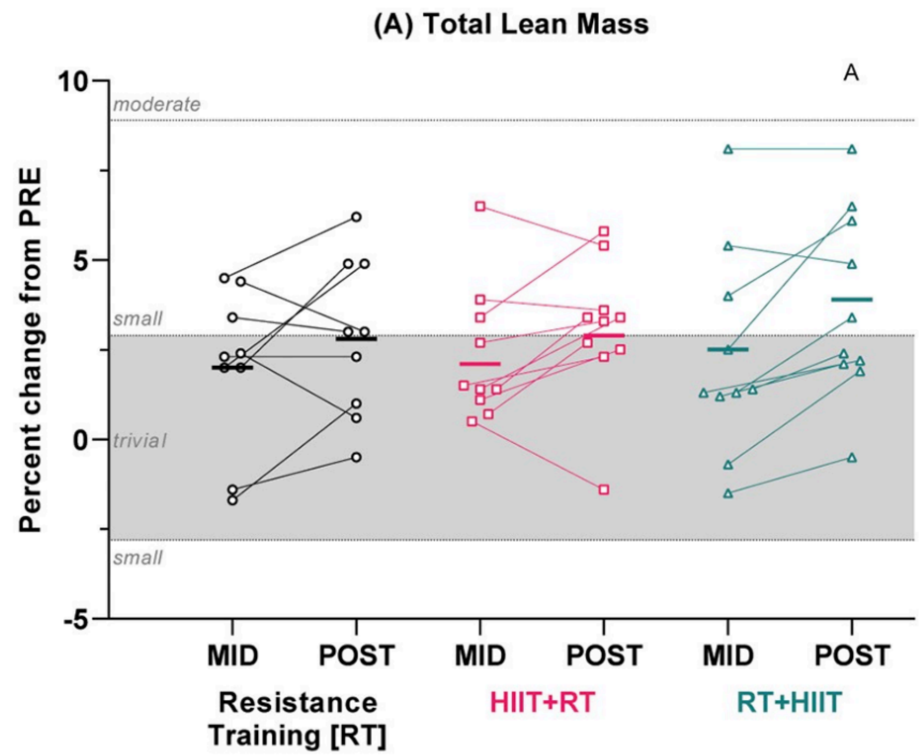

Total Lean Mass (TBLH)	RT	2.8 ± *2.3*
	HIIT+RT	2.9 ± *1.4*
	RT+HIIT	3.9 ± *1.5*

Y el orden de los ejercicios?

RESEARCH ARTICLE

Order of same-day concurrent training influences some indices of power development, but not strength, lean mass, or aerobic fitness in healthy, moderately-active men after 9 weeks of training

Matthew J. -C. Lee[1]*, James K. Ballantyne[1], Javier Chagolla[1], William G. Hopkins[1], Jackson J. Fyfe[2], Stuart M. Phillips[3], David J. Bishop[1,4], Jonathan D. Bartlett[1]

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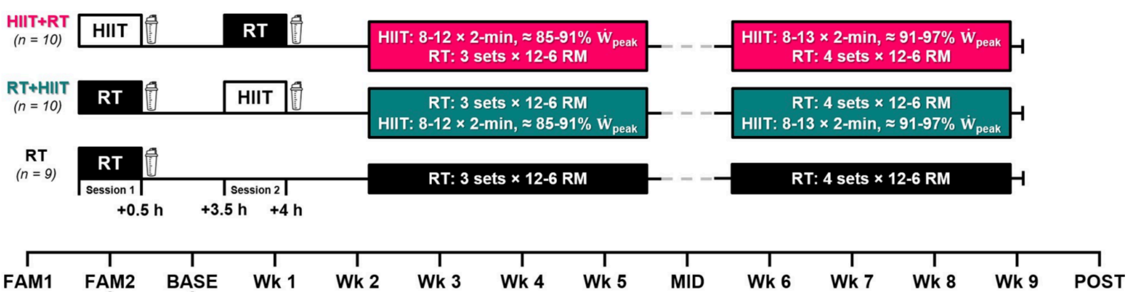

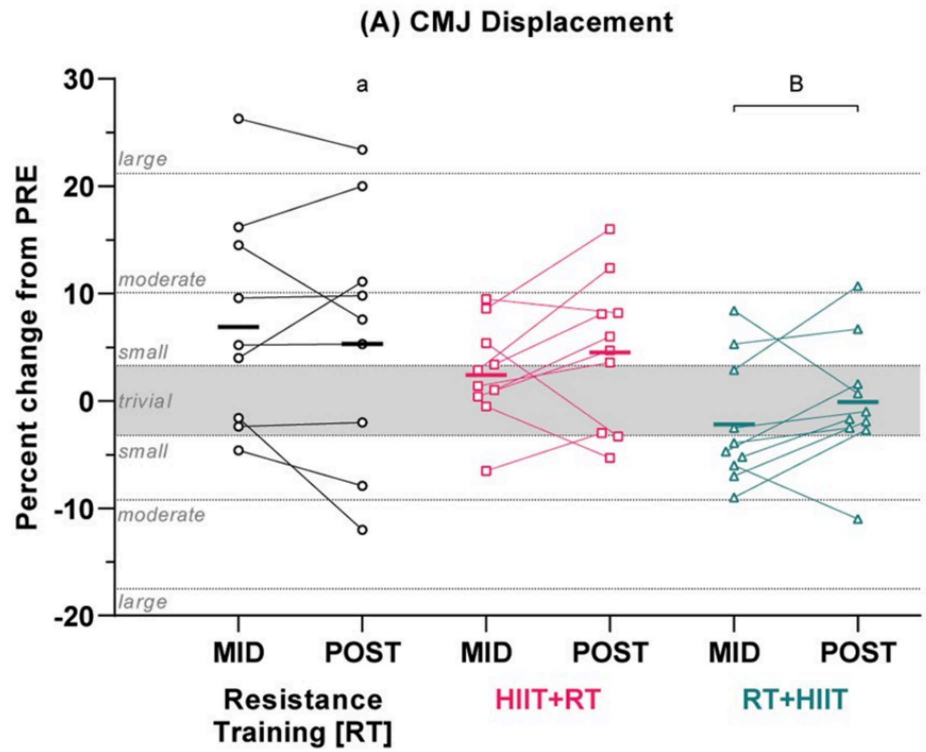

CMJ Height	RT	5.3 ± *6.3*
	HIIT+RT	4.5 ± *6.3*
	RT+HIIT	-0.1 ± *4.8*

COMPARACIÓN DE LOS EFECTOS DE DOS SECUENCIAS DE ENTRENAMIENTO CONCURRENTE SOBRE LA COMPOSICIÓN CORPORAL Y CONDICIÓN FÍSICA DE MUJERES NO ENTRENADAS.

Por

FELIPE MANQUI MONSALVES

Tabla . Cambio de las variables de la composición corporal post 6 semanas de entrenamiento.

	GFA (n = 10)				GAF (n = 11)			
Variables	PRE	POST	Δ%	p value	PRE	POST	Δ %	p value
MG (%)	40.05 ± 3.8	37.62 ± 3.4	-6	0.005	42.5 ± 3.9	40 ± 4.4	-6	0.002
MLG (%)	59.94 ± 3.8	62.37 ± 3.4	4%	0.005	57.46 ± 3.90	60.0 ± 4.46	4	0.002

MG, masa grasa; MLG, masa libre de grasa. Efecto tiempo. Promedio ± desviación estándar y porcentajes de cambios.

Se concluye que el orden de la secuencia de entrenamiento no es determinante para generar cambios en la composición corporal y condición física de mujeres no entrenadas y este factor no contribuye en la aparición del denominado efecto de interferencia del EC.

Tesis presentada en la Escuela de Kinesiología de la Universidad Finis Terrae para obtener el grado de Magister en ciencias de la salud y el deporte, mención entrenamiento deportivo.

Datos no publicados

En resumen

- El músculo es un tejido con alta plasticidad y que responde positivamente al entrenamiento.
- El anabolismo muscular depende de una coordinada interacción entre factores celulares, hormonales y vías de señalización.
- La hipertrofia permanente implica aumentos en el contenido proteico tanto sarcomérico como sarcoplasmático.

En resumen

- Entre los factores a considerar al momento del entrenamiento con orientación hipertrófica está:
  - Frecuencia de entrenamiento. 2-3 veces por semana
  - Cantidad de series. 2-3 series por ejercicio
  - Cantidad de repeticiones. Hasta el fallo con una duración de hasta 4 s por repetición
  - Carga. La necesaria para obtener 6 - 15 RM
  - El efecto de interferencia no se sustenta con la evidencia científica para la hipertrofia muscular. Sin embargo, la fuerza explosiva podría verse afectada

LaFlorida
CORPORACIÓN DEL DEPORTE

Fisiología del entrenamiento de la fuerza y la hipertrofia

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