FUERZA EN FUTBOLISTAS Y EFECTOS DE LA REALIZACIÓN DE DIFERENTES GRADOS DE ESFUERZO DENTRO DE LA SERIE

Osuna

Abril de 2017

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1. INTRODUCCIÓN

- ***Tener una buena condición física es un aspecto clave para obtener un alto rendimiento durante un partido*** (Hoff et al., 2004; Stolen et al., 2005)

  - ✓ ***Acciones de alta velocidad: 1-11% de distancia total cubierta*** (Stolen et al., 2005; Hoff et al., 2004).
  - ✓ ***>80% Goles precedidos por sprint, salto o cambio de dirección del que mete el gol o del asistente*** (Faude et al., 2013).
  - ✓ ***Evolución en el futbol marcada por el aumento del número y los metros recorridos a alta velocidad y del número de acciones de alta velocidad*** (Barnes et al.,

¡ENTRENAMIENTO DE FUERZA!

FUERZA POR UNIDAD DE TIEMPO

1. INTRODUCCIÓN

El entrenamiento de Fuerza debe basarse en…

BIOMECÁNICA

FISIOLOGÍA

SENTIDO COMUN

1. INTRODUCCIÓN

- ***Estudios previos:***

  - ✓ ***Ento. de Fza*** (Chelly et al., 2009; Christou et al., 2006; Maio Alves et al., 2010)
  - ✓ ***Ento. de Fza combinado con ejercicios pliométricos*** (Faude et al., 2013; Kotzamanidis et al., 2005; Moore et al., 2005)

Alta intensidad y máximo o casi máximo número de repeticiones por serie

Alto grado de FATIGA
(Sánchez-Medina & González-Badillo, 2011; Apriantono et al., 2006)

OBJETIVO → **Máxima ganancia con el menor grado de fatiga**

Effects of Velocity-Based Resistance Training on Young Soccer Players of Different Ages

Juan J. González-Badillo,[1] Fernando Pareja-Blanco,[1] David Rodríguez-Rosell,[1] José L. Abad-Herencia,[1] Juan J. del Ojo-López,[1] and Luis Sánchez-Medina[2]

[1]*Physical and Athletic Performance Research Center, Faculty of Sport, Pablo de Olavide University, Seville, Spain; and* [2]*Studies, Research and Sports Medicine Center, Government of Navarre, Pamplona, Spain*

Table 2. Resistance training program.*†

Weeks	Pretest	1	2	3	4	5	6	7
SQ (%V1LOAD)		2 × 8 (80%)	3 × 8 (80%)	3 × 6 (90%)	3 × 8 (90%)	2 × 6 (100%)	3 × 6 (100%)	Control test
CMJ↓ (%load-20 cm)		3 × 6 (40%)	3 × 6 (50%)	3 × 6 (60%)	3 × 6 (60%)	3 × 6 (70%)	3 × 6 (70%)	
JB		3 × 5	3 × 5	3 × 5	3 × 5	3 × 5	3 × 5	
Sled towing								
SPTJ (steps)		3 × (2 × 6)	3 × (2 × 6)	3 × (2 × 6)	3 × (2 × 8)	3 × (2 × 8)	3 × (2 × 8)	
COD		3 × 10″	3 × 10″	4 × 10″	4 × 10″	5 × 10″	3 × 10″	
Sprint		3 × 20 m	4 × 20 m	3 × 20 m	4 × 20 m	4 × 20 m	3 × 20 m	

Weeks	8	9	10	11	12	13	14	15
SQ (%V1LOAD)	3 × 6 (85%)	3 × 6 (85%)	3 × 6 (95%)	3 × 6 (95%)	3 × 6 (95%)	3 × 4 (105%)	3 × 4 (105%)	Control test
CMJ↓ (%load-20 cm)	3 × 4 (40%)	3 × 4 (50%)	3 × 4 (60%)	3 × 4 (60%)	3 × 4 (70%)	3 × 4 (70%)	3 × 4 (70%)	
JB	3 × 5	3 × 5	3 × 5	3 × 5	3 × 5	3 × 5	3 × 5	
Sled towing	4 × 20 m	4 × 20 m	4 × 20 m	4 × 20 m	4 × 20 m	4 × 20 m	4 × 20 m	
SPTJ (steps)	3 × (2 × 8)	3 × (2 × 8)	3 × (2 × 8)	3 × (2 × 8)	3 × (2 × 8)	3 × (2 × 8)	3 × (2 × 8)	
COD	4 × 10″	4 × 10″	4 × 10″	4 × 10″	4 × 10″	4 × 10″	4 × 10″	
Sprint	3 × 20 m	3 × 20 m	3 × 20 m	3 × 20 m	3 × 20 m	3 × 20 m	3 × 20 m	

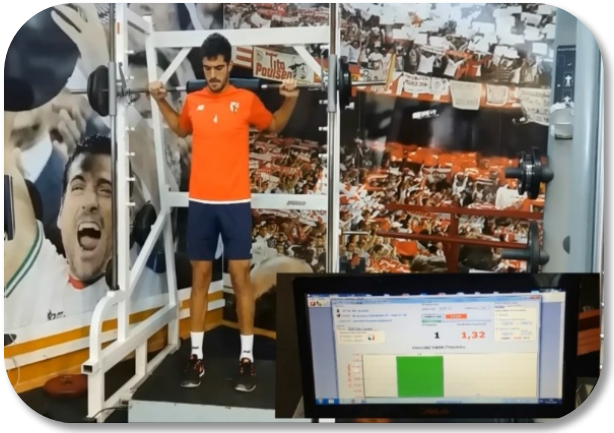
Weeks	16	17	18	19	20	21	22	23	24	25	26	Posttest
SQ (% V1LOAD)	2 × 8 (90%)	3 × 8 (90%)	3 × 6 (95%)	3 × 6 (95%)	4 × 6 (95%)	4 × 6 (95%)	3 × 6 (100%)	4 × 6 (100%)	3 × 4 (105%)	3 × 4 (105%)	3 × 4 (105%)	
CMJ↓ (%load-20 cm)	3 × 5 (60%)	4 × 5 (60%)	4 × 5 (60%)	4 × 5 (60%)								
HJ	3 × 4 × 2	4 × 4 × 2	4 × 4 × 2	2 × 4 × 3	2 × 4 × 3	3 × 4 × 3	4 × 4 × 3	2 × 4 × 3	3 × 5 × 3	3 × 5 × 3	3 × 5 × 3	
Sled towing					4 × 25 m	4 × 25 m	5 × 25 m	5 × 25 m	5 × 25 m	4 × 20 m	4 × 20 m	
SPTJ (steps)	3 × (2 × 8)	4 × (2 × 8)	4 × (2 × 8)	4 × (2 × 8)	4 × (2 × 8)	4 × (2 × 8)	4 × (2 × 8)	4 × (2 × 8)	4 × (2 × 8)	4 × (2 × 8)	3 × (2 × 8)	
COD	3 × 10″	4 × 10″	5 × 10″	5 × 10″	5 × 10″	5 × 10″	5 × 10″	5 × 10″	5 × 10″	4 × 10″	3 × 10″	
Sprint	4 × 20 m	4 × 20 m	5 × 20 m	5 × 20 m	3 × 20 m	3 × 20 m	3 × 20 m	3 × 20 m	3 × 20 m	3 × 20 m	3 × 20 m	

*SQ = squat; CMJ↓ = countermovement jump with load; HJ = hurdle jumps; %V1LOAD = percentage of the load that elicited ~1 m·s^{-1} in the squat test; %load-20 cm = percent of the load with which the players jumped ~20 cm in the loaded countermovement jump exercise; JB = jump to box; SPTJ = step phase triple jumps; COD = acceleration with changes of direction sprint.

†The squat exercise was performed twice per week, and the rest of exercises were performed once a week.

FERNANDO PAREJA BLANCO CENTRO DE INVESTIGACIÓN EN RENDIMIENTO FÍSICO Y DEPORTIVO Universidad Pablo de Olavide (Sevilla)

PROPUESTA METODOLOGICA



Effects of Velocity-Based Resistance Training on Young Soccer Players of Different Ages

Juan J. González-Badillo,[1] Fernando Pareja-Blanco,[1] David Rodríguez-Rosell,[1] José L. Abad-Herencia,[1] Juan J. del Ojo-López,[1] and Luis Sánchez-Medina[2]

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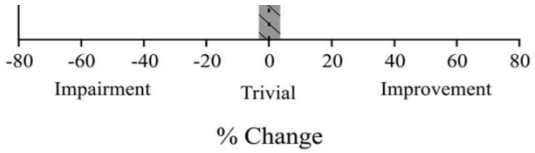
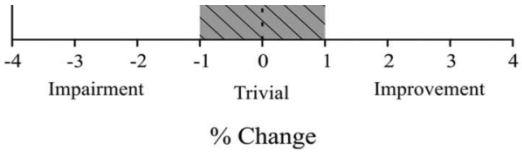
Table 3. Changes in selected neuromuscular performance variables from T1 to T2 for each group, mean (±*SD*).*

			Changes observed for T2 vs. T1		
	T1	T2	*p* value within groups	Standarized (Cohen) differences (90% CI)	Percent changes of better/trivial/worse effect
CMJ-U16 (cm)	35.4 ± 3.9	39.1 ± 4.9	0.000	0.91 (0.70 to 1.11)	100/0/0 most likely
CMJ-U18 (cm)	38.4 ± 3.0	41.3 ± 4.5	0.000	0.90 (0.45 to 1.35)	99/1/0 very likely
CMJ-U21 (cm)	37.1 ± 3.7	38.1 ± 3.5	0.36	0.18 (−0.14 to 0.50)	45/52/3 possibly
T20-U16 (s)	2.99 ± 0.10	2.97 ± 0.09	0.14	0.23 (0.08 to 0.38)	62/38/0 possibly
T20-U18 (s)	2.96 ± 0.10	2.92 ± 0.10	0.02	0.37 (0.11 to 0.63)	87/13/0 likely
T20-U21 (s)	2.97 ± 0.09	2.96 ± 0.10	0.36	0.18 (−0.32 to 0.68)	47/43/10 unclear
V1LOAD-U16 (kg)	41.7 ± 9.3	69.9 ± 12.5	0.000	2.86 (2.60 to 3.12)	100/0/0 most likely
V1LOAD-U18 (kg)	51.6 ± 10.7	66.6 ± 10.1	0.000	1.31 (1.10 to 1.53)	100/0/0 most likely
V1LOAD-U21 (kg)	53.1 ± 4.9	65.9 ± 2.2	0.000	2.38 (1.96 to 2.79)	100/0/0 most likely
MAS-U16 (km·h^{-1})	15.9 ± 0.7	16.2 ± 0.8	0.02	0.52 (0.20 to 0.84)	95/5/0 likely
MAS-U18 (km·h^{-1})	15.8 ± 1.0	16.0 ± 0.8	0.12	0.24 (−0.03 to 0.51)	60/40/0 possibly
MAS-U21 (km·h^{-1})	15.9 ± 0.7	15.9 ± 0.8	0.91	0.03 (−0.48 to 0.54)	28/50/22 unclear





Effects of Combined Resistance Training and Plyometrics on Physical Performance in Young Soccer Players

Authors: F. Franco-Márquez[1], D. Rodríguez-Rosell[2], J. M. González-Suárez[1], F. Pareja-Blanco[2], R. Mora-Custodio[3], J. M. Yañez-García[2], J. J. González-Badillo[2]

Group	Age (years)	Mass (kg)	Height (m)	BMI ($kg \cdot m^{-2}$)	MO	PAS (%)
CG	14.7±0.5	63.5±6.9	1.70±0.06	21.9±1.7	1.00±0.48	95.3±2.0
STG	14.7±0.5	60.3±6.6	1.71±0.05	20.7±1.6	1.04±0.45	95.4±1.7

CG: Control group; STG: Strength training group; BMI: Body mass index; MO: Maturity offset; PAS: Predicted adult stature

	Sessions											
Exercises	1	2	3	4	5	6	7	8	9	10	11	12
FS (S×R) ($m \cdot s^{-1}$)	2×8 (1.20)	3×8 (1.20)	3×8 (1.20)	3×6 (1.12)	3×6 (1.12)	3×8 (1.12)	2×6 (1.06)	3×6 (1.06)	3×6 (1.06)	2×4 (1.00)	3×4 (1.00)	3×4 (1.00)
CMJ		3×5		3×5		3×5		3×5		3×5		3×5
SPTJ (S×J)	6×8	6×6	6×8	6×6	6×10	6×6	6×10	6×6	6×12	6×6	6×12	6×6
COD (R×T)	3×10 s		3×10 s		4×10 s		4×10 s		5×10 s		3×10 s	
Sprint (R×D)		3×20 m		4×20 m		3×20 m		4×20 m		4×20 m		3×20 m

FS: full squat; CMJ: countermovement jump; SPTJ: step phase triple jump; COD: changes of direction; S×R: sets×repetitions; S×J: sets×number of jumps; R×T: repetitions×duration. R×D: repetitions×distance

Effects of Combined Resistance Training and Plyometrics on Physical Performance in Young Soccer Players

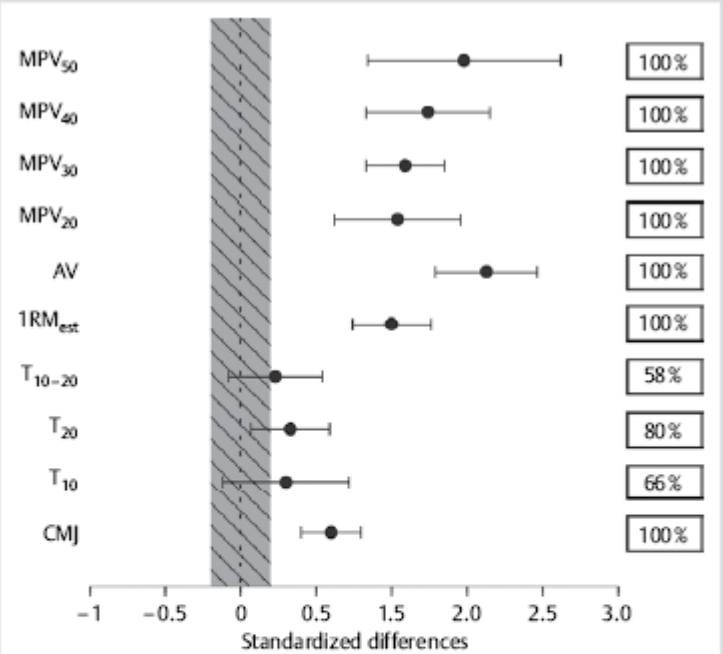


Fig. 1 Differences scores (90% confidence intervals) for changes from pre- to post-test in 10 m (T_{10}), 10–20 m (T_{10-20}) and 20 m (T_{20}) sprint time, countermovement jump performance (CMJ), estimate one repetition maximum ($1RM_{est}$), average velocity attained against all absolute loads common to pre- and post-tests (AV) and velocity developed against different absolute loads ($MPV_{20, 30, 40 \text{ and } 50}$) when comparing the STG and CG. Gray areas represent trivial differences. The probability of the effect being practically relevant in favor of STG compared to CG is additionally given in the boxes.

CONCLUSIONES

- Entrenamiento de fuerza de **baja carga y bajo volumen y desplazando la carga a la máxima velocidad** combinado con entrenamiento pliométrico, además del entrenamiento técnico-táctico produce importantes ganancias de fuerza, capacidad de salto y aceleración.

- El mejor entrenamiento de fuerza es aquel que produzca **mayores ganancias con la mínima fatiga**, ya que debemos evitar interferencias con el entrenamiento específico

Velocity Loss as an Indicator of Neuromuscular F

Journal of Strength and Conditioning Research, 2007, 21(3), 841–847

Increased Number of Forced Repetitions Does

Research Quarterly for Exercise and Sport

Vol. 67, Supplement to No.3, pp. 65-69

How Much Is Too Much? Performance Aspects of Overtraining

Harm Kuipers

The primary goal of athletic training is to enhance performance as much as possible. This is accomplished via a training program, which should eventually lead to peaking at the right moment. To push the performance capacity to its upper limit, relatively high amounts of intensive exercise have to be done. Therefore, the athlete is continuously challenging the delicate balance between training and overtraining. The

who was a world class speed skater from 1972-1975. The training characteristics and competitive results were accurately recorded daily for several years. The training consisted of a rather consistent mix of endurance exercise and intermittent exercise at near competitive intensity. In retrospect, it was observed that when the total training duration was beyond 15 hours a week there was a consistent decrement in competitive performance

(IDIBA

Fatigue is not a necessary stimulus for strength gains during resistance training

J P Folland, C S Irish, J C Roberts, J E Tarr, D A Jones

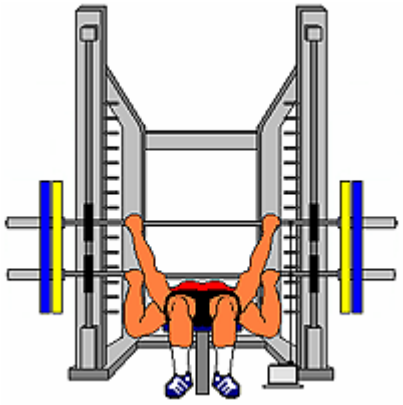
Br J Sports Med 2002;**36**:370–374

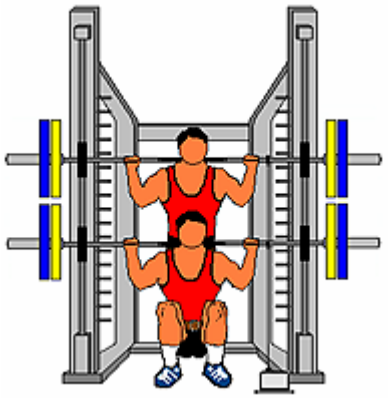
ACUTE AND DELAYED RESPONSE TO RESISTANCE EXERCISE LEADING OR NOT TO MUSCLE FAILURE

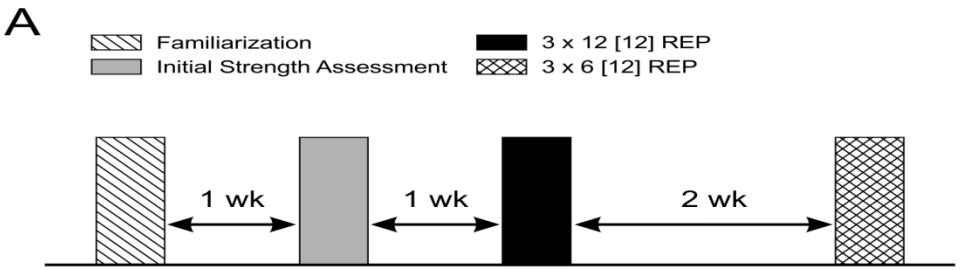
AUTHORS: Fernando Pareja-Blanco[1], David Rodríguez-Rosell[1], Luis Sánchez-Medina[2], Juan Ribas-Serna[3], Covadonga López-López[4], Ricardo Mora-Custodio[1], Juan Manuel Yáñez-García[1], Juan José González-Badillo[1]

Pareja-Blanco et al, (2016)

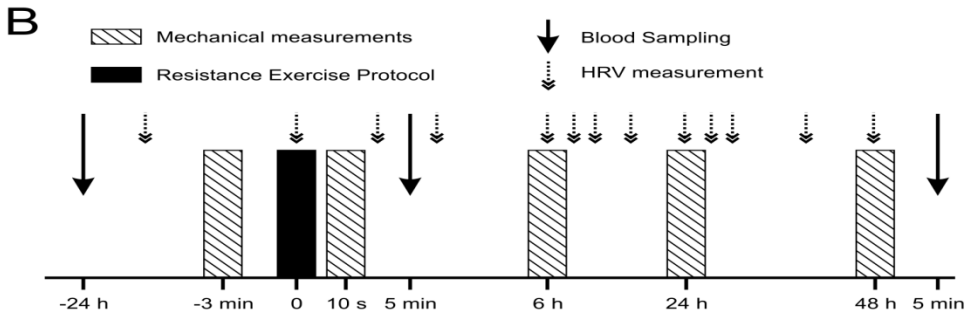
- 3 x 6(12) vs. 3 x 12(12)







10 hombres con experiencia en entrenamiento de fuerza



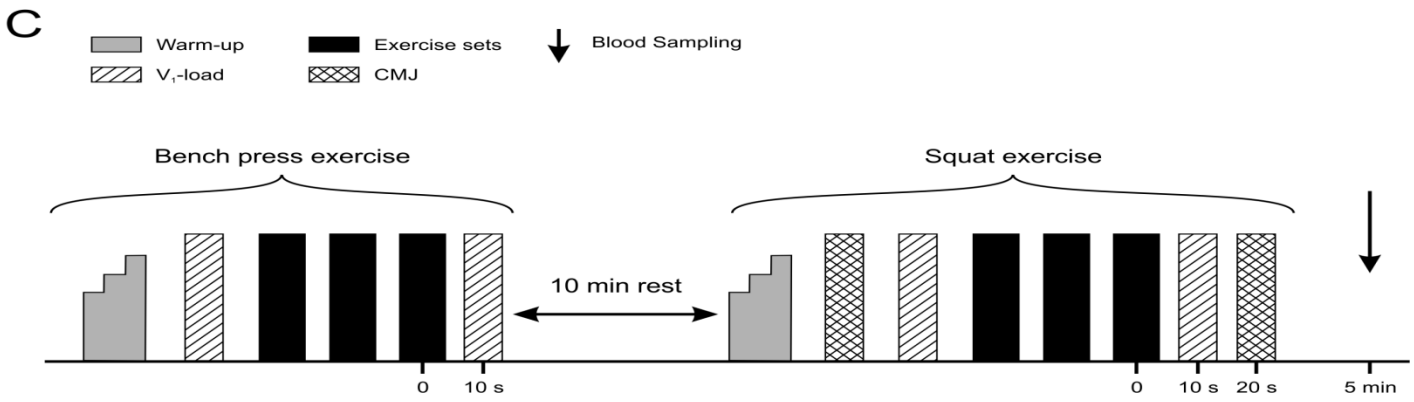
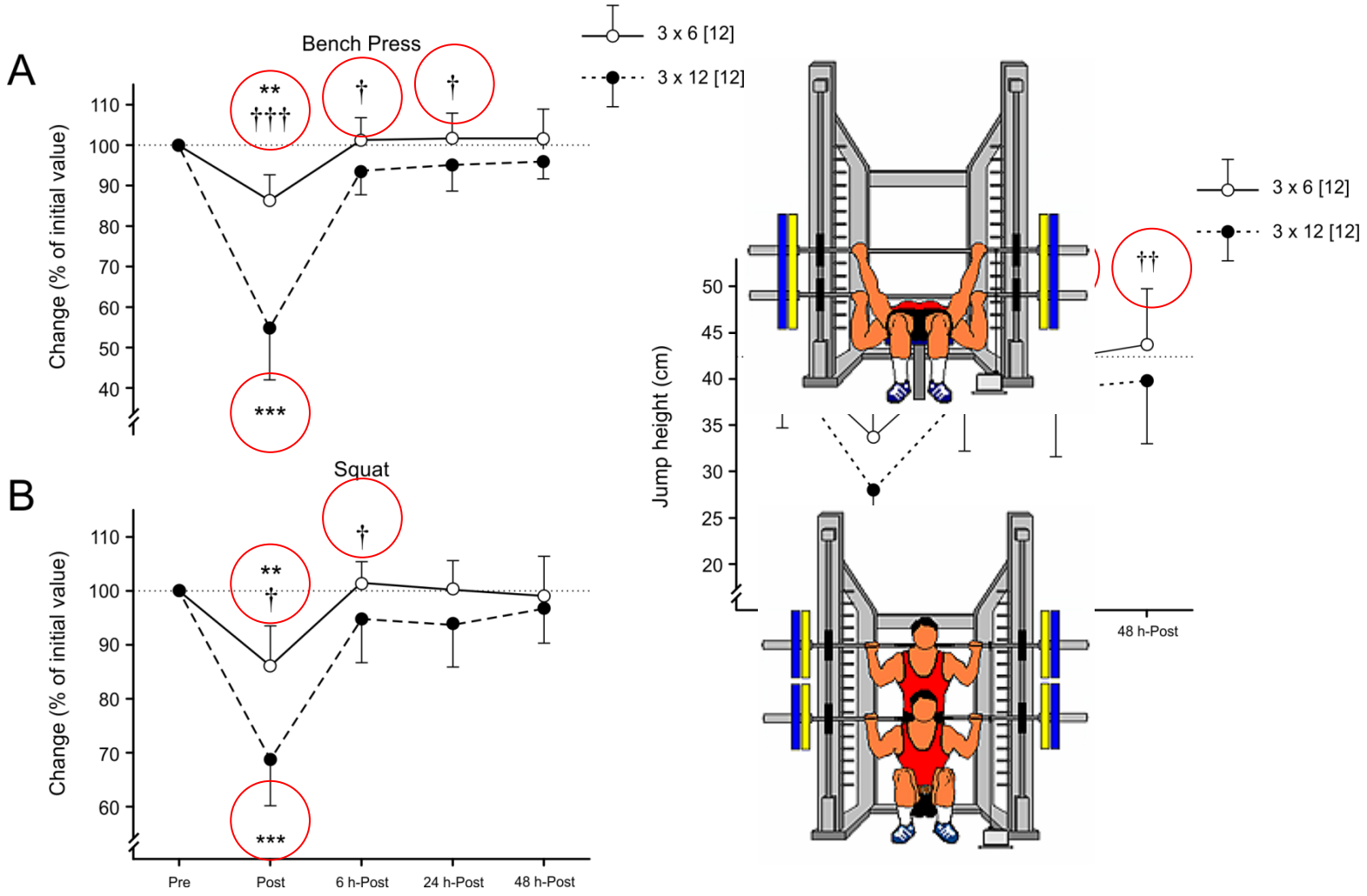


TABLE 1. Descriptive characteristics of each resistance exercise protocol.

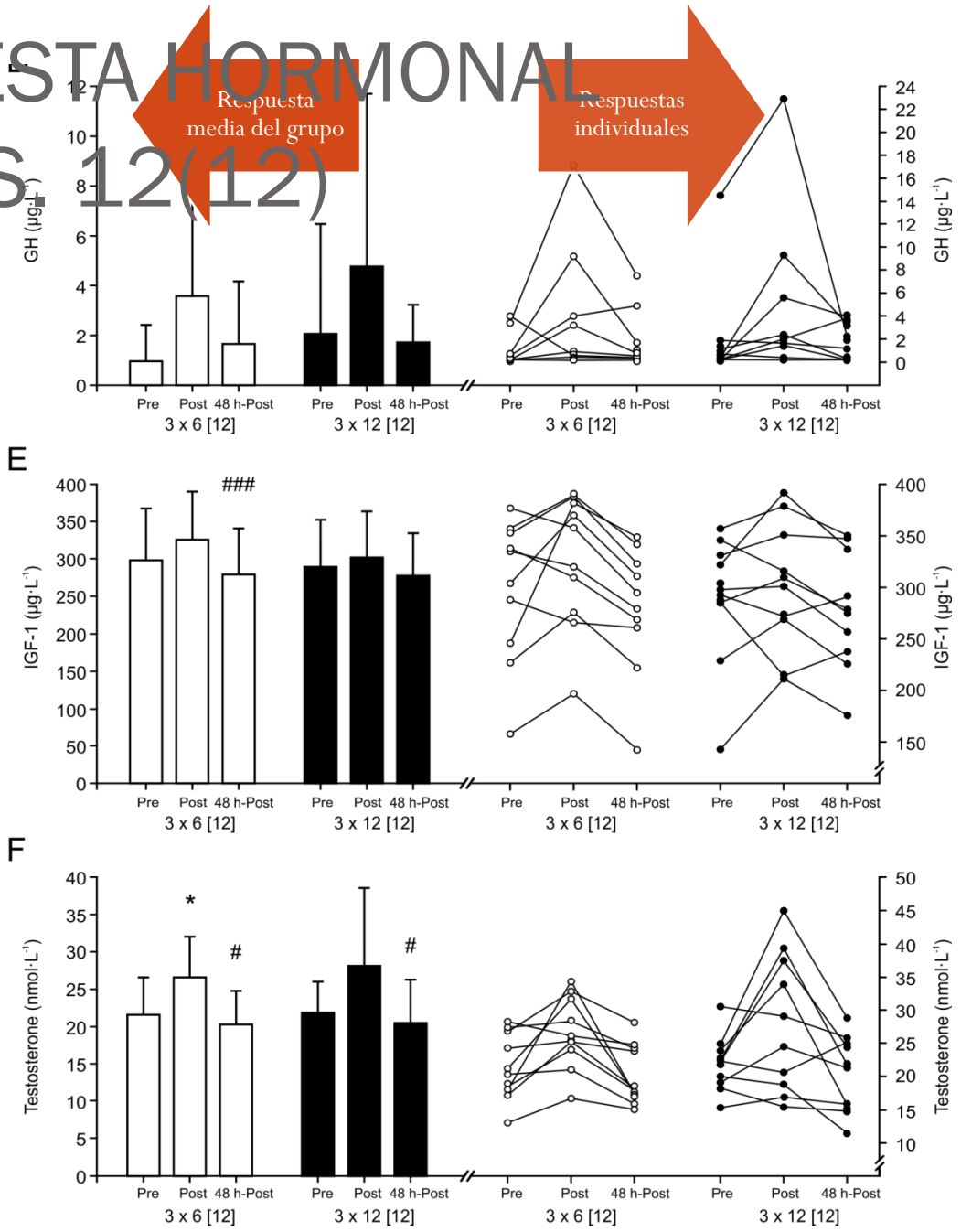
	SQUAT			BENCH PRESS		
	3x6[12]	3x12[12]	P-value	3x6[12]	3x12[12]	P-value
Reps	6.0 ± 0.0	11.2 ± 0.9	<0.001	6.0 ± 0.0	10.5 ± 1.3	<0.001
Fastest-V ($m \cdot s^{-1}$)	0.85 ± 0.03	0.84 ± 0.03	0.47	0.65 ± 0.03	0.63 ± 0.05	0.21
Slowest-V ($m \cdot s^{-1}$)	0.63 ± 0.07	0.38 ± 0.07	<0.001	0.44 ± 0.05	0.15 ± 0.05	<0.001
Mean-V ($m \cdot s^{-1}$)	0.75 ± 0.04	0.63 ± 0.07	0.001	0.55 ± 0.03	0.42 ± 0.04	<0.001
MeanLoss-V (%)	20.3 ± 6.1	43.8 ± 6.7	<0.001	26.4 ± 6.7	65.0 ± 5.7	<0.001
MaxLoss-V (%)	25.9 ± 8.5	54.7 ± 7.4	<0.001	33.4 ± 7.5	76.5 ± 7.3	<0.001

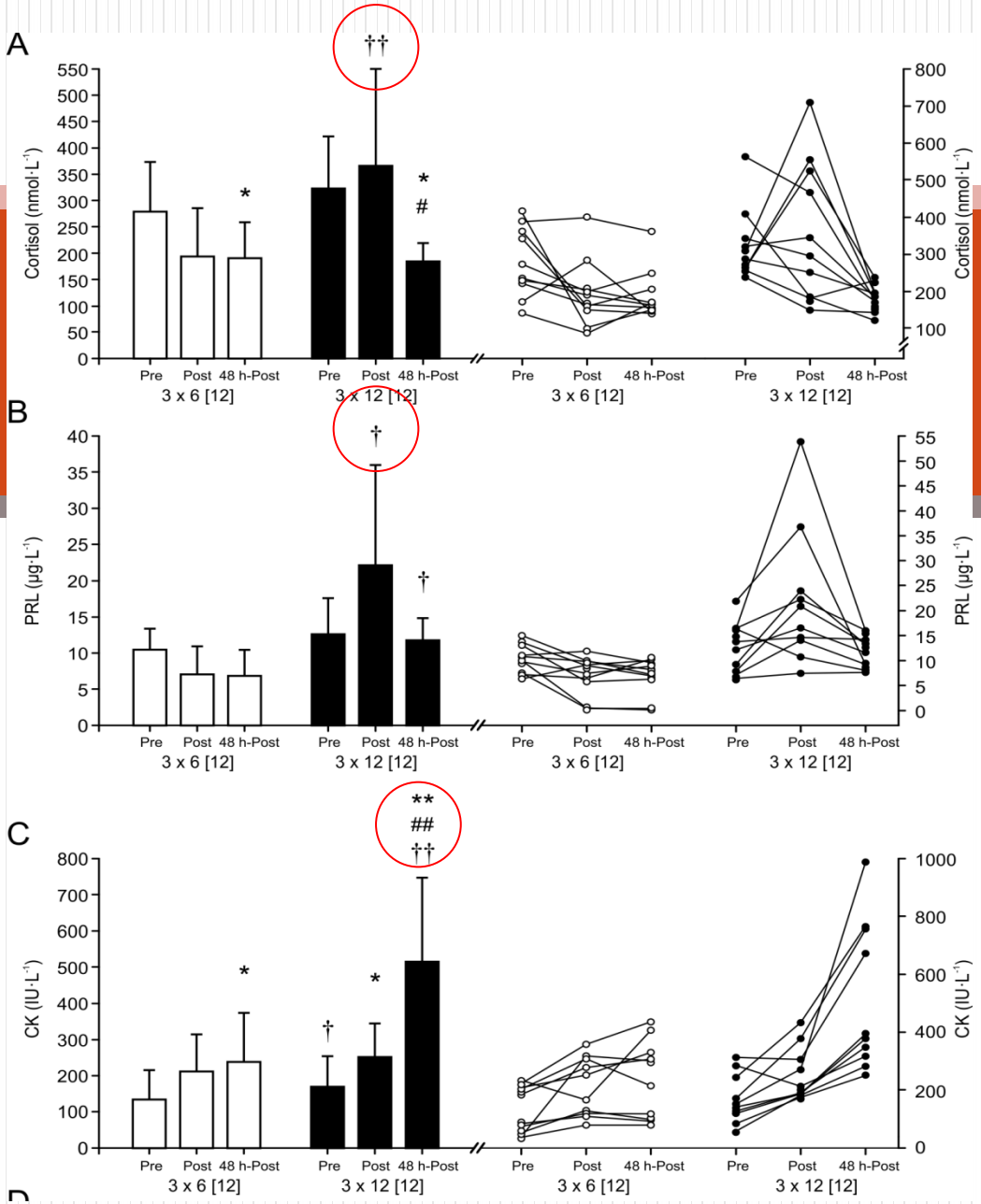
Data are mean ± SD, n = 10.
Reps: repetitions performed in each set.
Fastest-V: highest velocity measured in the three sets.
Slowest-V: lowest velocity measured in the three sets.
Mean-V: mean velocity of all repetitions during the three sets.
MeanLoss-V: mean percent loss in velocity from the fastest to the slowest repetition over the three sets.
MaxLoss-V: maximum percent loss in velocity from the fastest to the slowest repetition over the three sets.
Velocities correspond to the mean concentric propulsive velocity of each repetition.

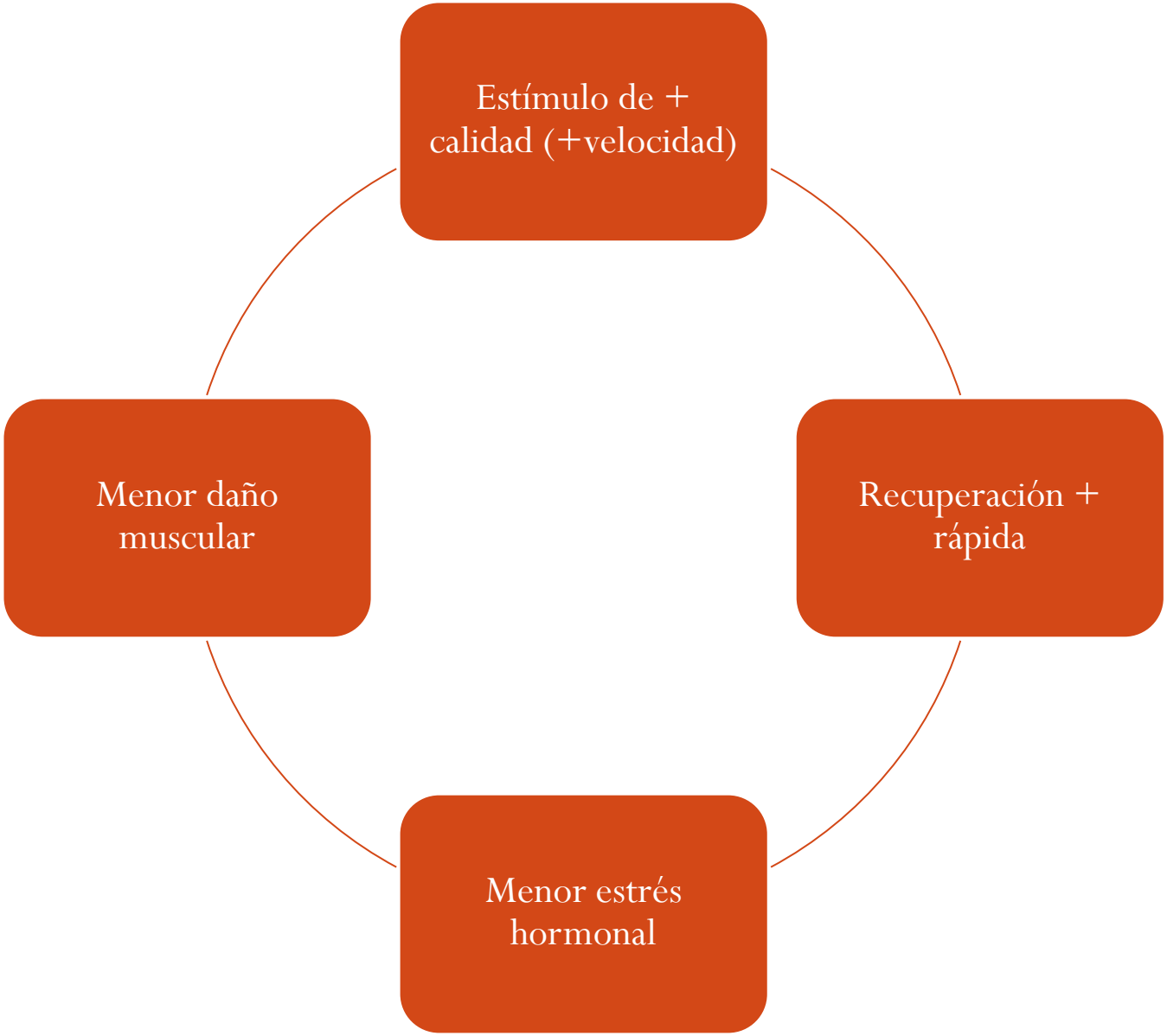
VARIABLES MECÁNICAS
6(12) VS. 12(12)



RESPUESTA HORMONAL 6(12) VS 12(12)




A
Cortisol (nmol·L⁻¹)
B
PRL (µg·L⁻¹)
C
CK (IU·L⁻¹)
Pre
Post
48 h-Post
3 x 6 [12]
3 x 12 [12]


Estímulo de + calidad (+velocidad)
Recuperación + rápida
Menor estrés hormonal
Menor daño muscular

Efectos del Carácter del Esfuerzo

• Existe un número aproximado de **repeticiones por serie que se puede hacer con cada % 1RM**.

Esto nos da una orientación sobre el porcentaje con el trabajamos cuando estimamos que podemos hacer un nº determinado de rep/serie.

% 1RM	**Rep. realizables**
100%	1
95%	1-2
90%	2-4
85%	5-6
80%	7-8
75%	9-11
70%	11-13
65%	13-15
60%	14-17

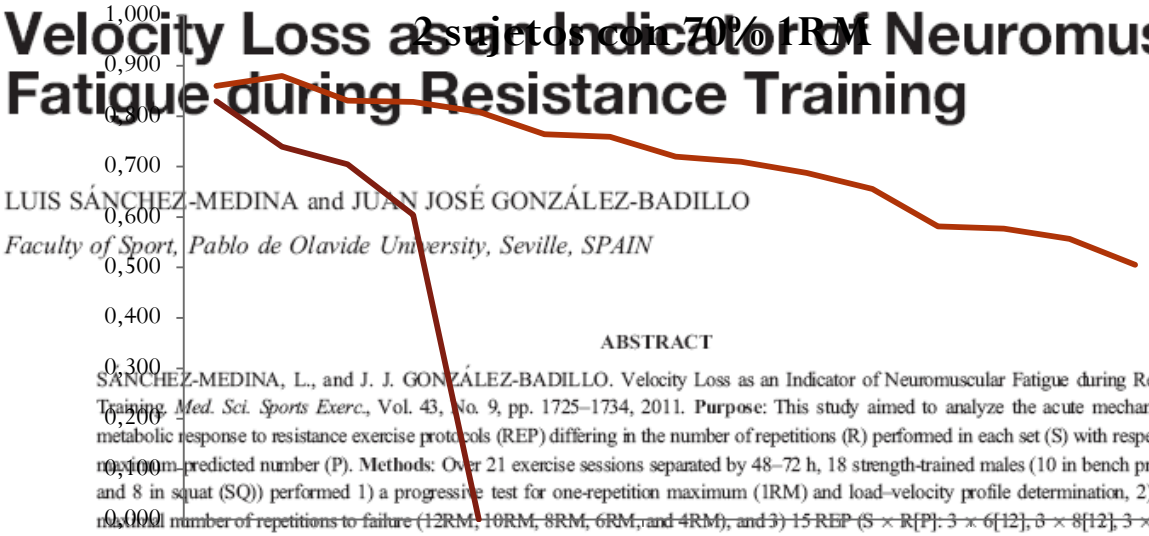
Brzycki (1993)

PROBLEMA:

No todo el mundo realiza el mismo número de

2 sujetos con 70% 1 RM

le



Velocity Loss as an Indicator of Neuromuscular Fatigue during Resistance Training

LUIS SÁNCHEZ-MEDINA and JUAN JOSÉ GONZÁLEZ-BADILLO

Faculty of Sport, Pablo de Olavide University, Seville, SPAIN

ABSTRACT

SÁNCHEZ-MEDINA, L., and J. J. GONZÁLEZ-BADILLO. Velocity Loss as an Indicator of Neuromuscular Fatigue during Resistance Training. *Med. Sci. Sports Exerc.*, Vol. 43, No. 9, pp. 1725–1734, 2011. **Purpose**: This study aimed to analyze the acute mechanical and metabolic response to resistance exercise protocols (REP) differing in the number of repetitions (R) performed in each set (S) with respect to the maximum–predicted number (P). **Methods**: Over 21 exercise sessions separated by 48–72 h, 18 strength-trained males (10 in bench press (BP) and 8 in squat (SQ)) performed 1) a progressive test for one-repetition maximum (1RM) and load–velocity profile determination, 2) tests of maximal number of repetitions to failure (12RM, 10RM, 8RM, 6RM, and 4RM), and 3) 15 REP (S × R[P]: 3 × 6[12], 3 × 8[12], 3 × 10[12], 3 × 12[12], 3 × 6[10], 3 × 8[10], 3 × 10[10], 3 × 4[8], 3 × 6[8], 3 × 8[8], 3 × 3[6], 3 × 4[6], 3 × 6[6], 3 × 12[4], 3 × 4[4]), with 5-min interset rests. Kinematic data were registered by a linear velocity transducer. Blood lactate and ammonia were measured before and after exercise. **Results**: Mean repetition velocity loss after three sets, loss of velocity pre-post exercise against the 1-m·s^{-1} load, and countermovement jump height loss (SQ group) were significant for all REP and were highly correlated to each other (r = 0.91–0.97). Velocity loss was significantly greater for BP compared with SQ and strongly correlated to peak postexercise lactate (r = 0.93–0.97) for both SQ and BP. Unlike lactate, ammonia showed a curvilinear response to loss of velocity, only increasing above resting levels when R was at least two repetitions higher than 50% of P. **Conclusions**: Velocity loss and metabolic stress clearly differs when manipulating the number of repetitions actually performed in each training set. The high correlations found between mechanical (velocity and countermovement jump height losses) and metabolic (lactate, ammonia) measures of fatigue support the validity of using velocity loss to objectively quantify neuromuscular fatigue during resistance training. **Key Words:** MUSCLE STRENGTH, WEIGHT TRAINING, BLOOD LACTATE, AMMONIA, BENCH PRESS, FULL SQUAT

ina

Pérdida de velocidad dentro de la serie

- Fatiga no es sólo el punto del fallo muscular. Es un proceso que se da desde el inicio de la actividad
- Complejid… …rla en la acción
- Pérdida de… …z-Medina & Gonzalez-…
- Ya que los… …ente número de repeticione… …Gonzalez-Badillo et… …)O DE FATIGA

TABLE 1. Mechanical and metabolic measurements

REP	Loss of MPV over Three Sets (%) SQ	BP
3 × 12[12]	46.5 ± 3.8	***63.3 ± 4.0
3 × 10[12]	37.1 ± 7.7	***51.1 ± 5.5
3 × 8[12]	32.3 ± 7.6	36.5 ± 4.3
3 × 6[12]	20.2 ± 4.3	*24.2 ± 2.3
3 × 10[10]	45.7 ± 7.0	***58.4 ± 4.5
3 × 8[10]	32.3 ± 5.5	***46.1 ± 4.2
3 × 6[10]	22.0 ± 8.0	*29.8 ± 4.5
3 × 8[8]	39.8 ± 4.0	***56.9 ± 3.7
3 × 6[8]	29.4 ± 9.4	*39.0 ± 4.5
3 × 4[8]	21.2 ± 8.6	24.8 ± 2.9
3 × 6[6]	41.9 ± 4.9	***56.8 ± 5.7
3 × 4[6]	28.1 ± 6.1	*33.8 ± 3.6
3 × 3[6]	19.6 ± 7.1	23.7 ± 3.0
3 × 4[4]	32.0 ± 5.1	***49.8 ± 6.6
3 × 2[4]	16.6 ± 4.5	18.9 ± 4.4

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Muscle fatigue increases with the accumulation of repetitions, and if the exercise is not stopped, task failure occurs. However, before task failure oc

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Effects of velocity loss during resistance training on athletic performance, strength gains and muscle adaptations

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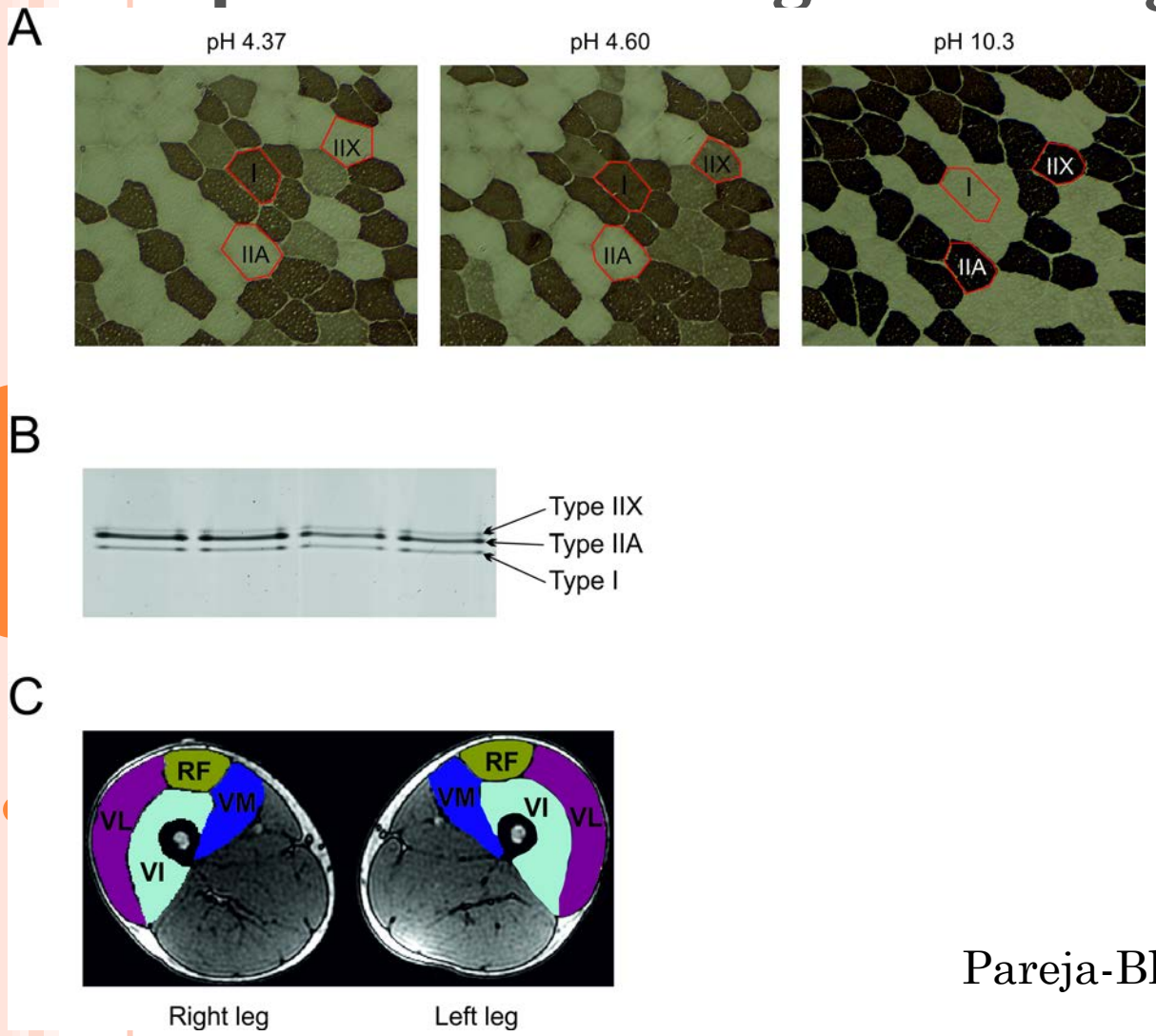
- Proponemos en lugar de programar un número fijo con una carga determinada
- Entrenamiento de fuerza a partir de velocidad de 1º repetición (Gonzalez-Badillo & Sanchez-Medina, 2010); y 2) pérdida de velocidad permitida en la serie (Sanchez-Medina & Gonzalez-Badillo, 2011).
- Objetivo: Analizar efecto de 2 entrenamientos de fuerza que sólo difieren en la pérdida de velocidad en la serie (20% vs. 40%)

Velocity Loss as a critical variable determining the adaptations to strength training



Pareja-Blanco et al. (2016)

Velocity Loss as a critical variable determining the adaptations to strength training

Table 1. Descriptive characteristics of the training program performed by both experimental groups

Scheduled	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8	Session 9
Sets x VL (%)									
VL20	3 x 20%	3 x 20%	3 x 20%	3 x 20%	3 x 20%	3 x 20%	3 x 20%	3 x 20%	3 x 20%
VL40	3 x 20%	3 x 30%	3 x 40%	3 x 50%	3 x 50%	3 x 50%	3 x 35%	3 x 45%	3 x 50%
Target MPV ($m \cdot s^{-1}$)	0.82 (~70% 1RM)	0.82 (~70% 1RM)	0.82 (~70% 1RM)	0.82 (~70% 1RM)	0.82 (~70% 1RM)	0.82 (~70% 1RM)	0.75 (~75% 1RM)	0.75 (~75% 1RM)	0.75 (~75% 1RM)
Actually Performed									
VL (%)									
VL20	22.7 ± 2.6	21.9 ± 3.0	21.4 ± 3.9	19.4 ± 1.6	21.6 ± 2.3	21.2 ± 3.1	21.2 ± 2.8	19.6 ± 2.3	19.9 ± 2.2
VL40	23.3 ± 2.1	31.9 ± 2.6	40.9 ± 2.6	49.7 ± 3.9	48.6 ± 2.2	47.9 ± 7.9	36.7 ± 2.0	45.6 ± 2.7	50.5 ± 2.9
Rep per set									
VL20	5.2 ± 1.0	5.0 ± 1.0	5.0 ± 1.4	5.3 ± 1.2	5.4 ± 1.1	4.4 ± 0.6	3.9 ± 0.6	4.3 ± 1.0	3.9 ± 0.8
VL40	5.3 ± 1.3	6.9 ± 1.8	7.7 ± 1.4	9.4 ± 1.8	9.2 ± 1.1	9.4 ± 2.3	6.1 ± 1.2	7.3 ± 1.4	7.5 ± 1.0

Scheduled	Session 10	Session 11	Session 12	Session 13	Session 14	Session 15	Session 16	
Sets x VL (%)								
VL20	3 x 20%	3 x 20%	3 x 20%	3 x 20%	3 x 15%	3 x 15%	3 x 15%	
VL40	3 x 50%	3 x 35%	3 x 45%	3 x 45%	3 x 30%	3 x 40%	3 x 40%	
Target MPV ($m \cdot s^{-1}$)	0.75 (~75% 1RM)	0.68 (~80% 1RM)	0.68 (~80% 1RM)	0.68 (~80% 1RM)	0.60 (~85% 1RM)	0.60 (~85% 1RM)	0.60 (~85% 1RM)	
Actually Performed								Overall
VL (%)								
VL20	20.6 ± 3.4	23.1 ± 6.2	22.4 ± 4.4	23.2 ± 4.8	15.9 ± 4.1	15.2 ± 3.1	14.3 ± 3.8	20.4 ± 1.5
VL40	50.1 ± 2.3	37.0 ± 3.7	44.7 ± 3.4	45.9 ± 2.9	33.1 ± 5.0	43.8 ± 5.1	43.8 ± 5.5	41.9 ± 1.9
Rep per set								
VL20	3.8 ± 0.4	3.0 ± 0.4	3.3 ± 0.8	3.3 ± 1.0	2.0 ± 0.4	2.1 ± 0.4	1.9 ± 0.8	3.9 ± 0.5
VL40	7.3 ± 1.4	4.6 ± 1.0	5.8 ± 1.8	5.2 ± 1.3	3.3 ± 0.8	3.7 ± 0.6	4.5 ± 0.7	6.5 ± 0.9

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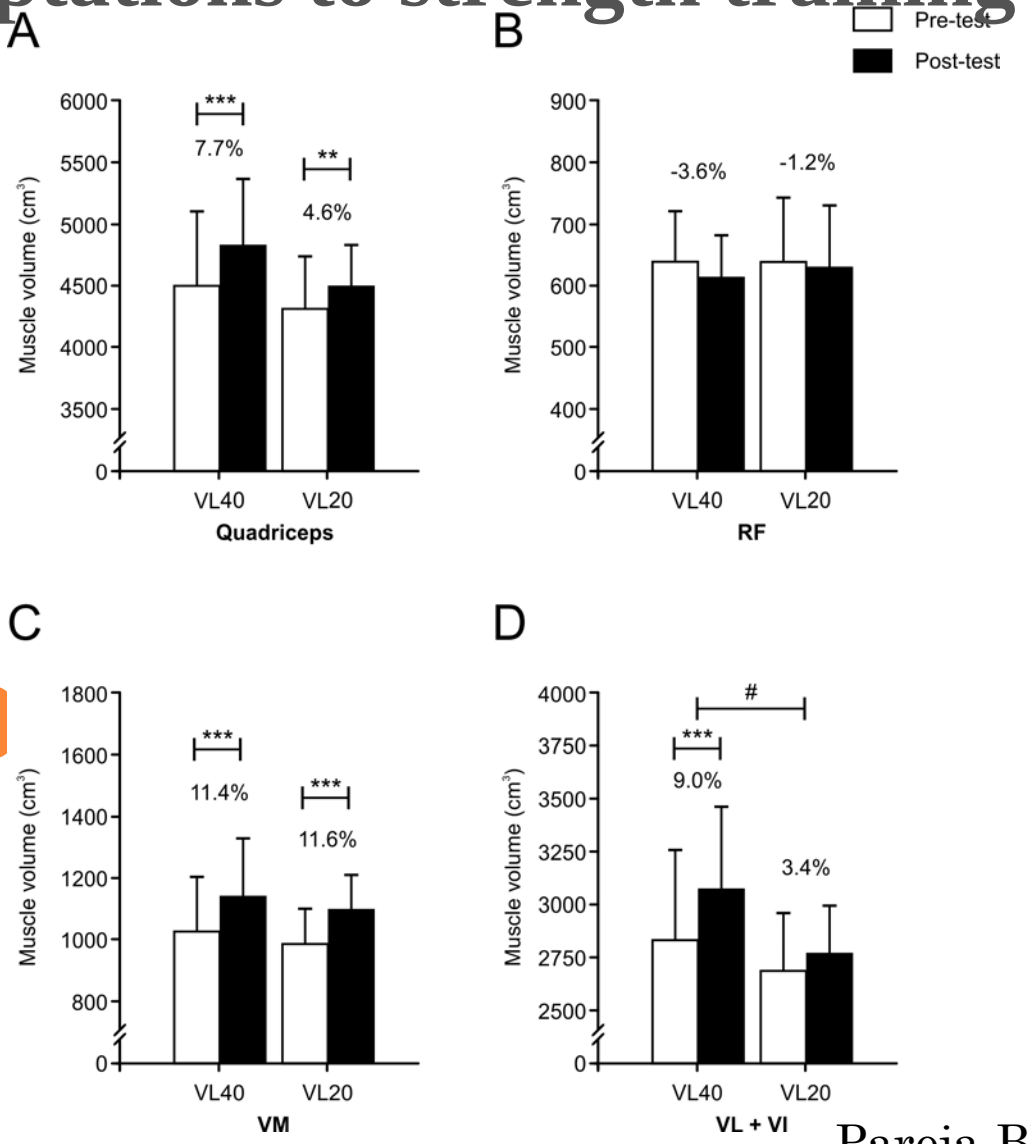
Velocity Loss as a critical variable determining the adaptations to strength training



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Velocity Loss as a critical variable determining the adaptations to strength training

ATPasa analysis	VL40		VL20	
	Pre	Post	Pre	Post
Type I (%)	44.3 ± 10.4	47.5 ± 9.8	45.9 ± 15.7	43.7 ± 13.4
Type IIC (%)	0.1 ± 0.2	0.3 ± 0.6	0.5 ± 1.1	1.6 ± 4.9
Type IIA (%)	36.5 ± 9.7	36.4 ± 7.6	33.6 ± 10.2	38.5 ± 11.0
Type IIAX (%)	11.2 ± 6.1	12.0 ± 6.3	13.7 ± 11.2	10.1 ± 7.6
Type IIX (%)	7.8 ± 7.0	3.8 ± 5.0*	6.3 ± 8.9	6.1 ± 8.2
MHC analysis	**VL40**		**VL20**	
	Pre	Post	Pre	Post
Type I (%)	42.8 ± 7.9	45.5 ± 7.6	40.0 ± 8.6	39.3 ± 9.3
Type IIA (%)	42.6 ± 3.8	47.3 ± 5.9*	42.9 ± 5.4	45.8 ± 8.6
Type IIX (%)	14.6 ± 8.9	7.2 ± 7.6***#	17.0 ± 7.4	14.8 ± 8.2

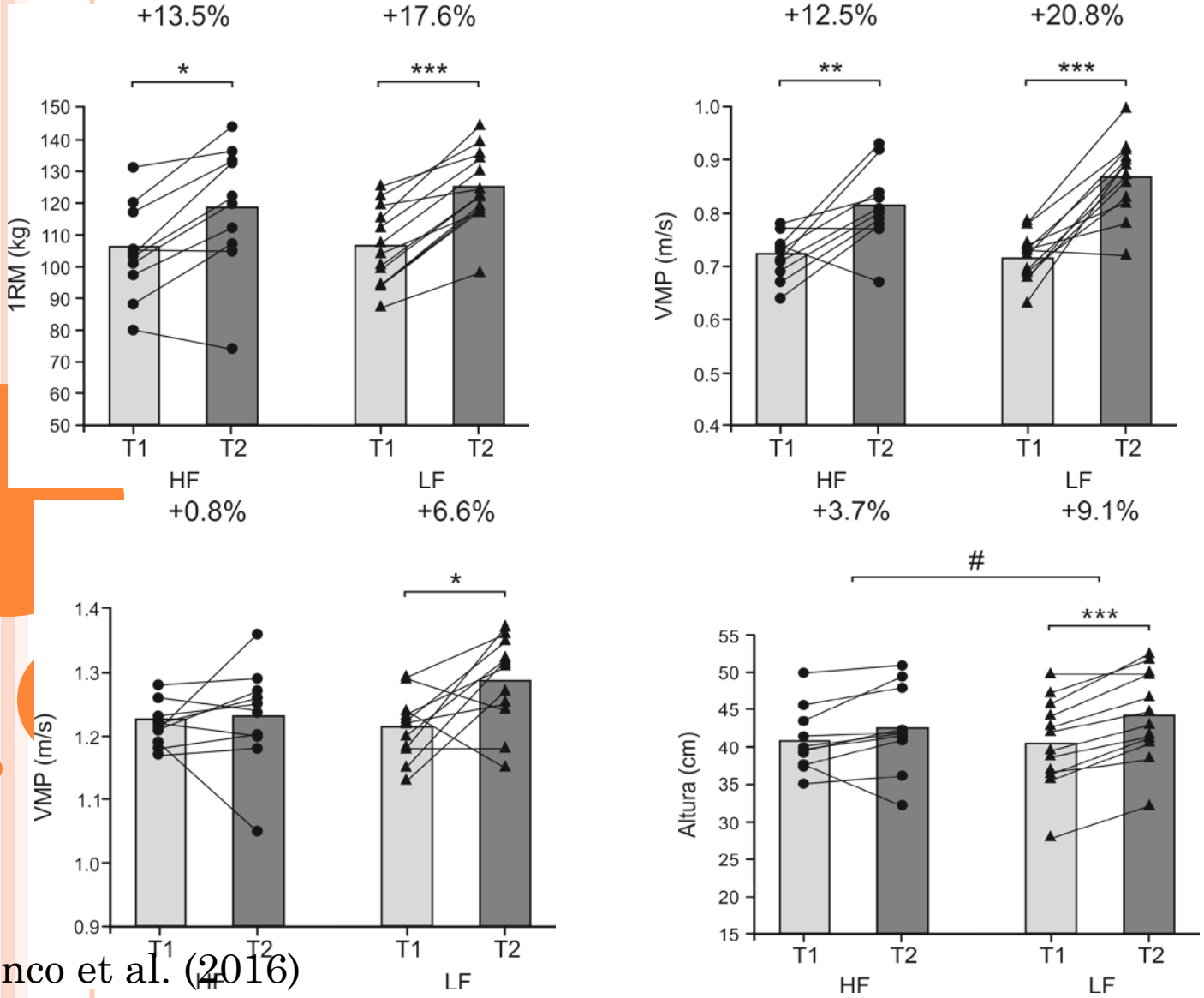
Data are mean ± SD
VL20: Group of 20% velocity loss (n = 12), VL40: Group of 40% velocity loss (n = 10)
Intra-group significant differences from Pre- to Post-training: * P < 0.05, *** P < 0.001
significant group x time interaction: P < 0.05

	VL40			VL20		
	Pre	Post	Δ (%)	Pre	Post	Δ (%)
CSA (μm²)	4935 ± 690	5438 ± 788*	11.0	4800 ± 691	5217 ± 701*	9.8
CSA-I (μm²)	4314 ± 676	4798 ± 804**	11.9	4070 ± 834	4346 ± 873	7.9
CSA-IIA (μm²)	5584 ± 1259	6233 ± 998*	16.9	5708 ± 893	6169 ± 716	9.6
CSA-IIAX (μm²)	4619 ± 1022	5260 ± 962*	19.3	4936 ± 740	5146 ± 744	5.5
CSA-IIX (μm²)	4406 ± 1037	4927 ± 1502	16.4	4130 ± 930	4853 ± 1016	18.3

Data are mean ± SD;
CSA: Cross-sectional area
VL20: Group of 20% velocity loss (n = 12), VL40: Group of 40% velocity loss (n = 10)
Intra-group significant differences from Pre- to Post-training: * P < 0.05, ** P < 0.01

Pareja-Blanco et al. (2016)

Velocity Loss as a critical variable determining the adaptations to strength training



Pareja-Blanco et al. (2016)

"Effects of Velocity Loss During Resistance Training on Performance in Professional Soccer Players" by Pareja-Blanco F, Sánchez-Medina L, Suárez-Arrones L, González-Badillo JJ
International Journal of Sports Physiology and Performance

- Jugadores de fútbol que entrenan con las mismas cargas relativas pero con distinto grado de esfuerzo en la serie
  - Grupo V15: hacen repeticiones hasta perder el 15% de la velocidad de la primera repetición
  - Grupo V30: hacen repeticiones hasta perder el 30% de la velocidad de la primera repetición
  - Ejercicio: sentadilla
  - Variables dependientes: fuerza y velocidad en sentadilla y CMJ

Pareja-Blanco et al. (2017)

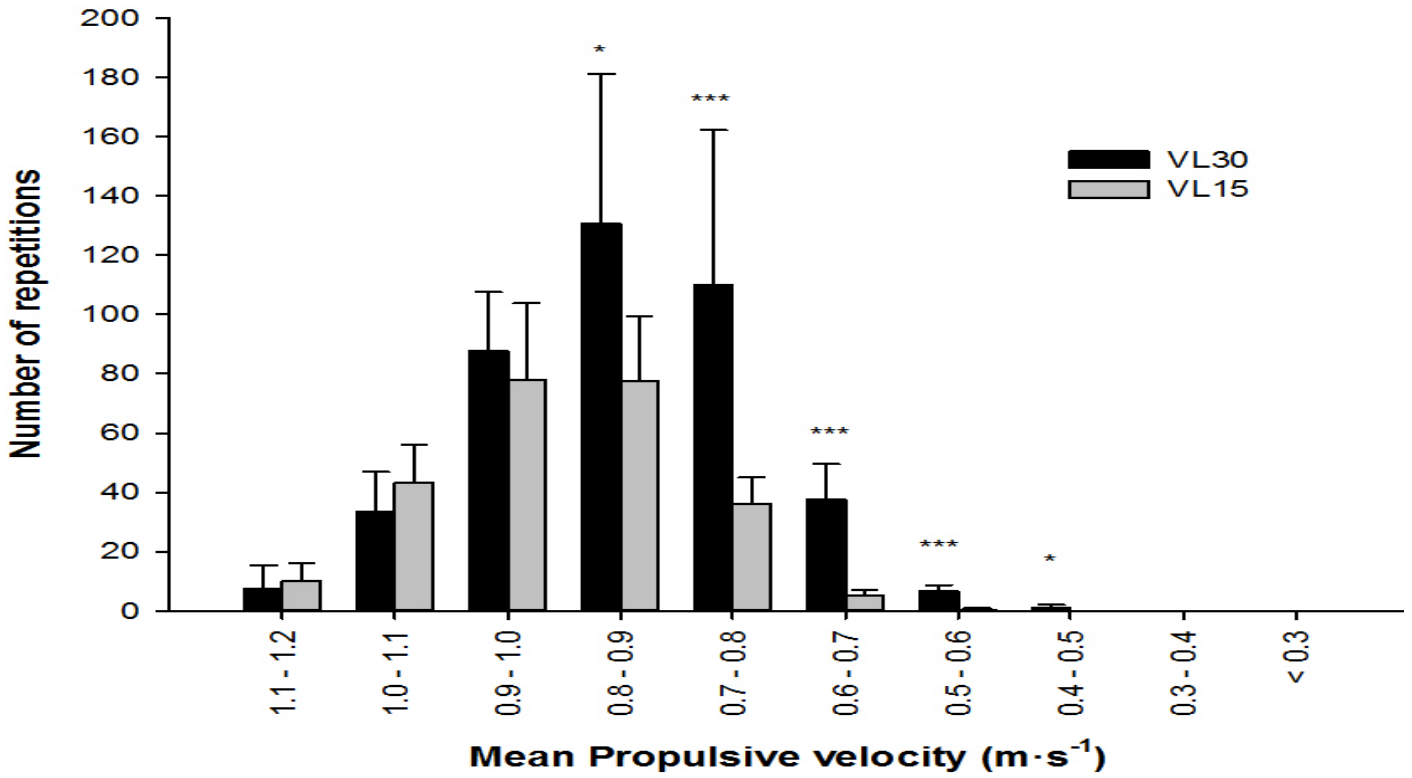
Table 1. Descriptive characteristics of the training program performed by both experimental groups

Scheduled	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6	Session 7	Session 8	Session 9
Sets x VL (%)									
VL15	2 x 15%	3 x 15%	3 x 15%	2 x 15%	3 x 15%	3 x 15%	2 x 15%	3 x 15%	3 x 15%
VL30	2 x 30%	3 x 30%	3 x 30%	2 x 30%	3 x 30%	3 x 30%	2 x 30%	3 x 30%	3 x 30%
Target MPV ($m \cdot s^{-1}$)	1.13 (~50% 1RM)	1.13 (~50% 1RM)	1.13 (~50% 1RM)	1.06 (~55% 1RM)	1.06 (~55% 1RM)	1.06 (~55% 1RM)	0.98 (~60% 1RM)	0.98 (~60% 1RM)	0.98 (~60% 1RM)

Scheduled	Session 10	Session 11	Session 12	Session 13	Session 14	Session 15	Session 16	Session 17	Session 18
Sets x VL (%)									
VL15	3 x 15%	2 x 15%	3 x 15%	3 x 15%	3 x 15%	2 x 15%	3 x 15%	3 x 15%	2 x 15%
VL30	3 x 30%	2 x 30%	3 x 30%	3 x 30%	3 x 30%	2 x 30%	3 x 30%	3 x 30%	2 x 30%
Target MPV ($m \cdot s^{-1}$)	0.98 (~60% 1RM)	0.90 (~65% 1RM)	0.90 (~65% 1RM)	0.90 (~65% 1RM)	0.90 (~65% 1RM)	0.82 (~70% 1RM)	0.82 (~70% 1RM)	0.82 (~70% 1RM)	0.98 (~60% 1RM)

Actually Performed	Fastest MPV ($m \cdot s^{-1}$)	MPV all reps ($m \cdot s^{-1}$)	Total rep	Rep per set	Rep per set with 50% 1RM	Rep per set with 55% 1RM	Rep per set with 60% 1RM	Rep per set with 65% 1RM	Rep per set with 70% 1RM
VL15	0.98 ± 0.02	0.84 ± 0.02	414.6 ± 124.9	10.5 ± 1.9	14.7 ± 2.3	11.9 ± 2.6	9.5 ± 1.9	9.1 ± 3.1	7.2 ± 2.1
VL30	0.97 ± 0.02	0.91 ± 0.01***	251.2 ± 55.4***	6.0 ± 0.9***	10.9 ± 2.0**	6.1 ± 1.4***	5.0 ± 1.1***	4.8 ± 1.6**	4.1 ± 1.1**

ata are mean ± SD


Number of repetitions
200
180
160
140
120
100
80
60
40
20
0
VL30
VL15
*
***
***
***
*
1.1 - 1.2
1.0 - 1.1
0.9 - 1.0
0.8 - 0.9
0.7 - 0.8
0.6 - 0.7
0.5 - 0.6
0.4 - 0.5
0.3 - 0.4
< 0.3
Mean Propulsive velocity (m·s-1)

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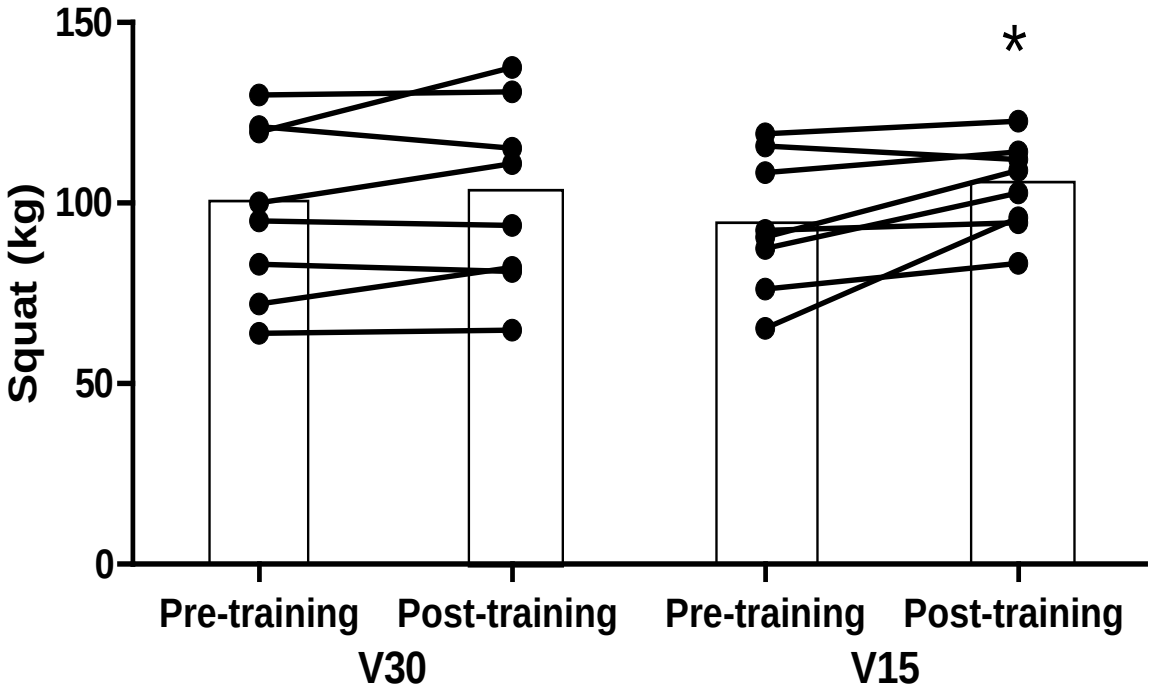
	Pre	Post	ES (90% CI)	Percent changes of better/trivial/worse effect	
1RM-VL15 (kg)	101.3 ± 18.8	110.3 ± 14.3**	0.43 (0.14 to 0.71)	91/9/0	Likely
1RM-VL30 (kg)	100.2 ± 20.3	106.5 ± 28.5	0.28 (-0.09 to 0.64)	65/33/2	Possibly
AV-VL15 ($m \cdot s^{-1}$)	1.19 ± 0.12	1.23 ± 0.09	0.35 (-0.09 to 0.79)	73/25/2	Possibly
AV-VL30 ($m \cdot s^{-1}$)	1.16 ± 0.11	1.18 ± 0.13	0.16 (-0.55 to 0.87)	46/36/18	Unclear
CMJ-VL15 (cm)	33.7 ± 3.6	35.5 ± 5.1*†	0.45 (0.06 to 0.85)	87/12/1	Likely
CMJ-VL30 (cm)	34.4 ± 3.5	33.5 ± 3.1	-0.24 (-0.66 to 0.18)	4/38/57	Possibly Negative
T30-VL15 (s)	4.32 ± 0.19	4.30 ± 0.20	0.10 (-0.14 to 0.35)	24/74/3	Unlikely
T30-VL30 (s)	4.28 ± 0.14	4.27 ± 0.10	0.06 (-0.27 to 0.39)	21/70/9	Unclear
YYIRT-VL15 (m)	1390 ± 417	1862 ± 639**	1.01 (0.63 to 1.39)	100/0/0	Most Likely
YYIRT-VL30 (m)	1611 ± 422	2043 ± 842**	0.97 (0.13 to 1.82)	94/4/2	Likely

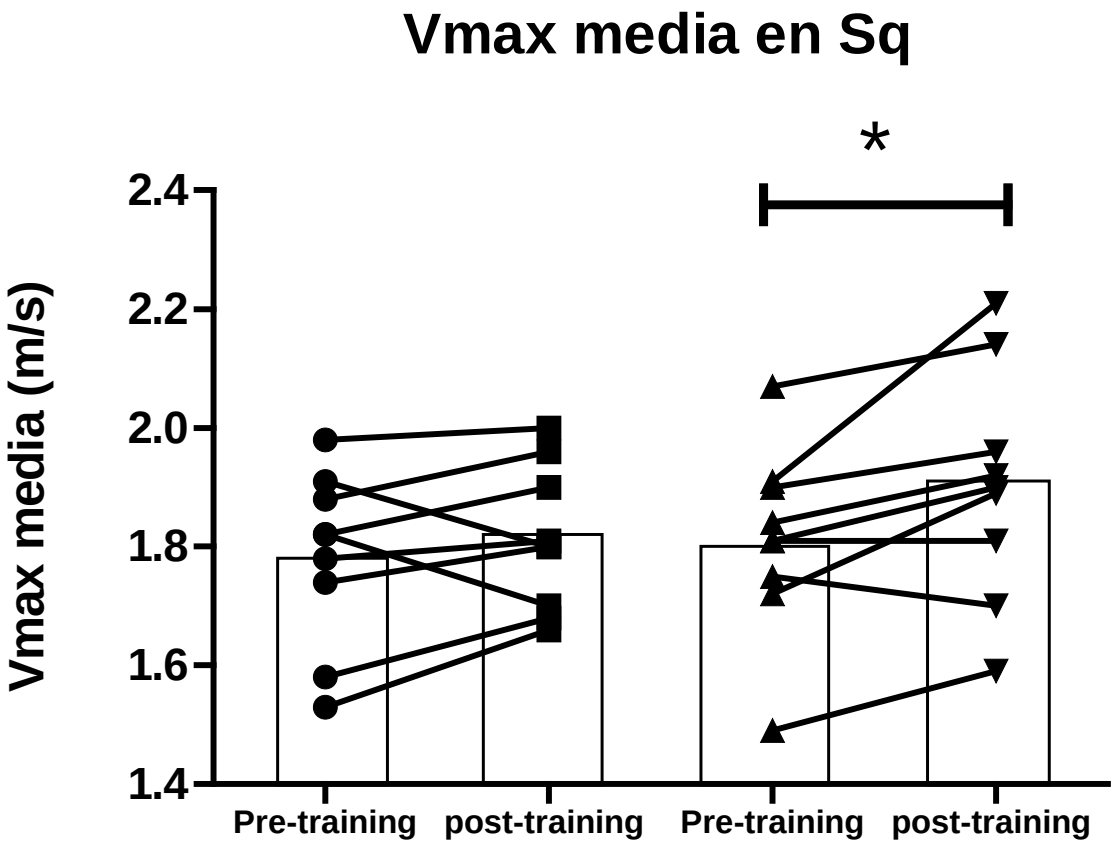
Data are mean ± SD; ES = Effect Size within group; CI = Confidence Interval

Efecto sobre la fuerza en sentadilla

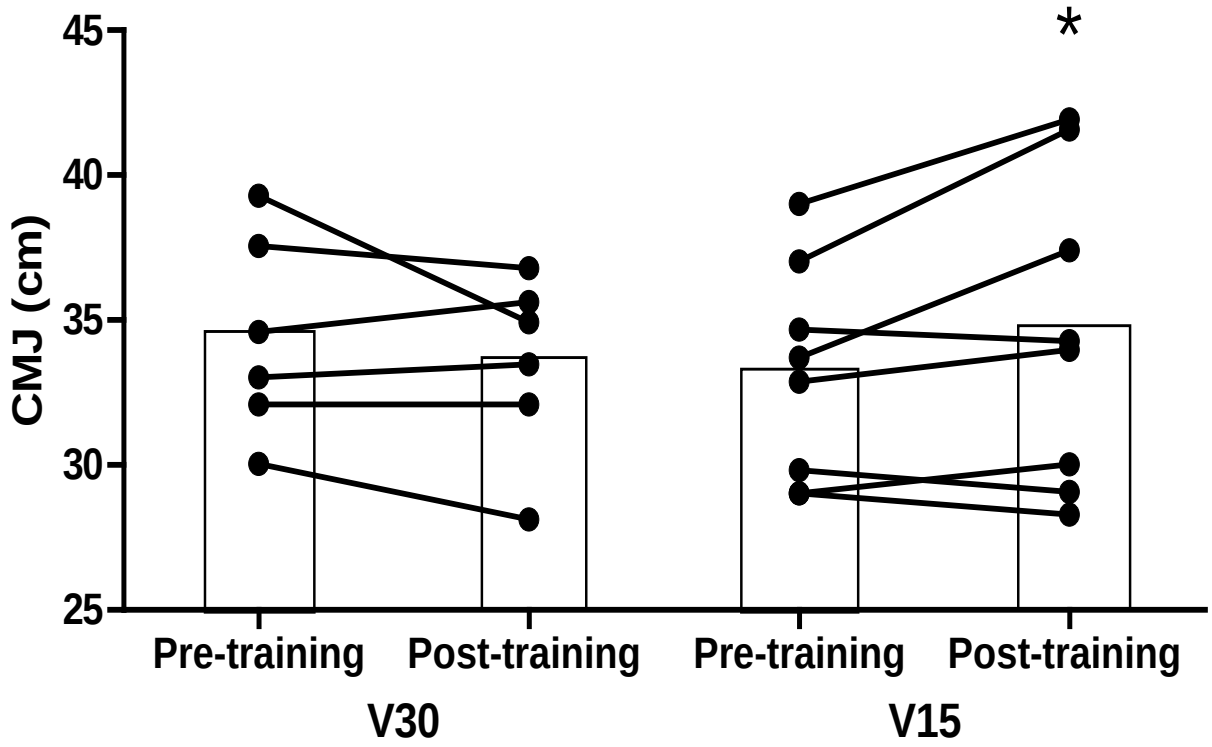


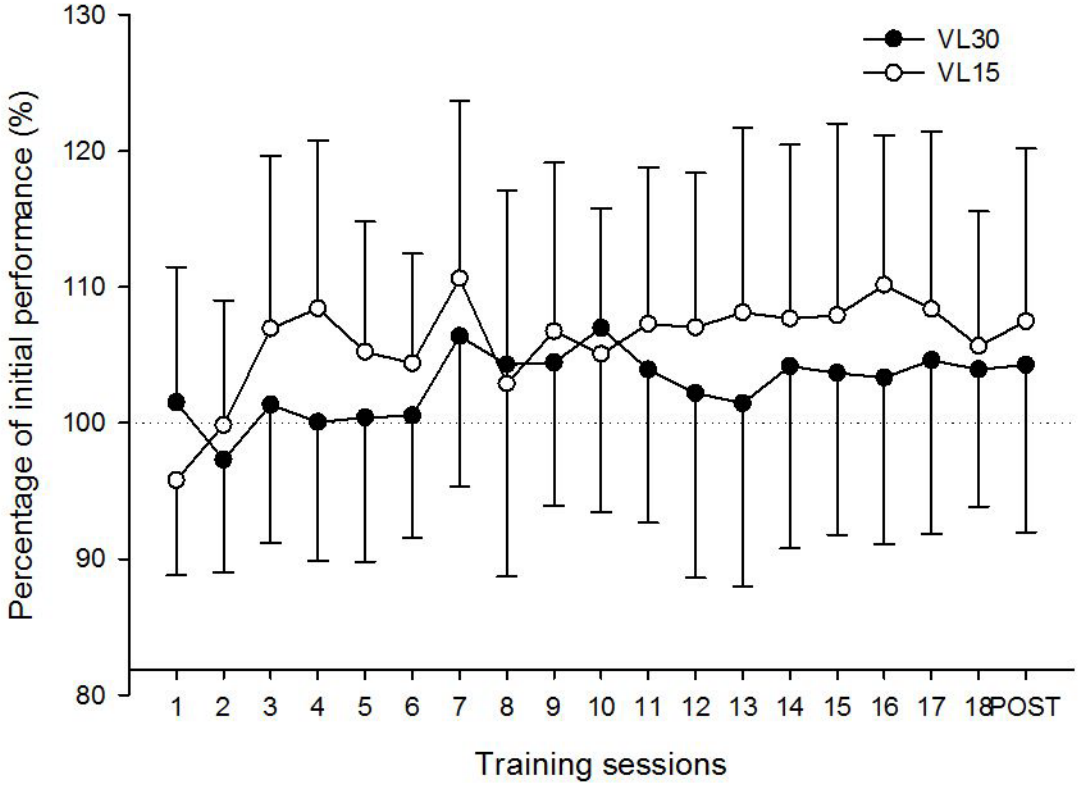
Pareja-Blanco et al. (2017)

Efecto sobre la Vmáx media en sentadilla



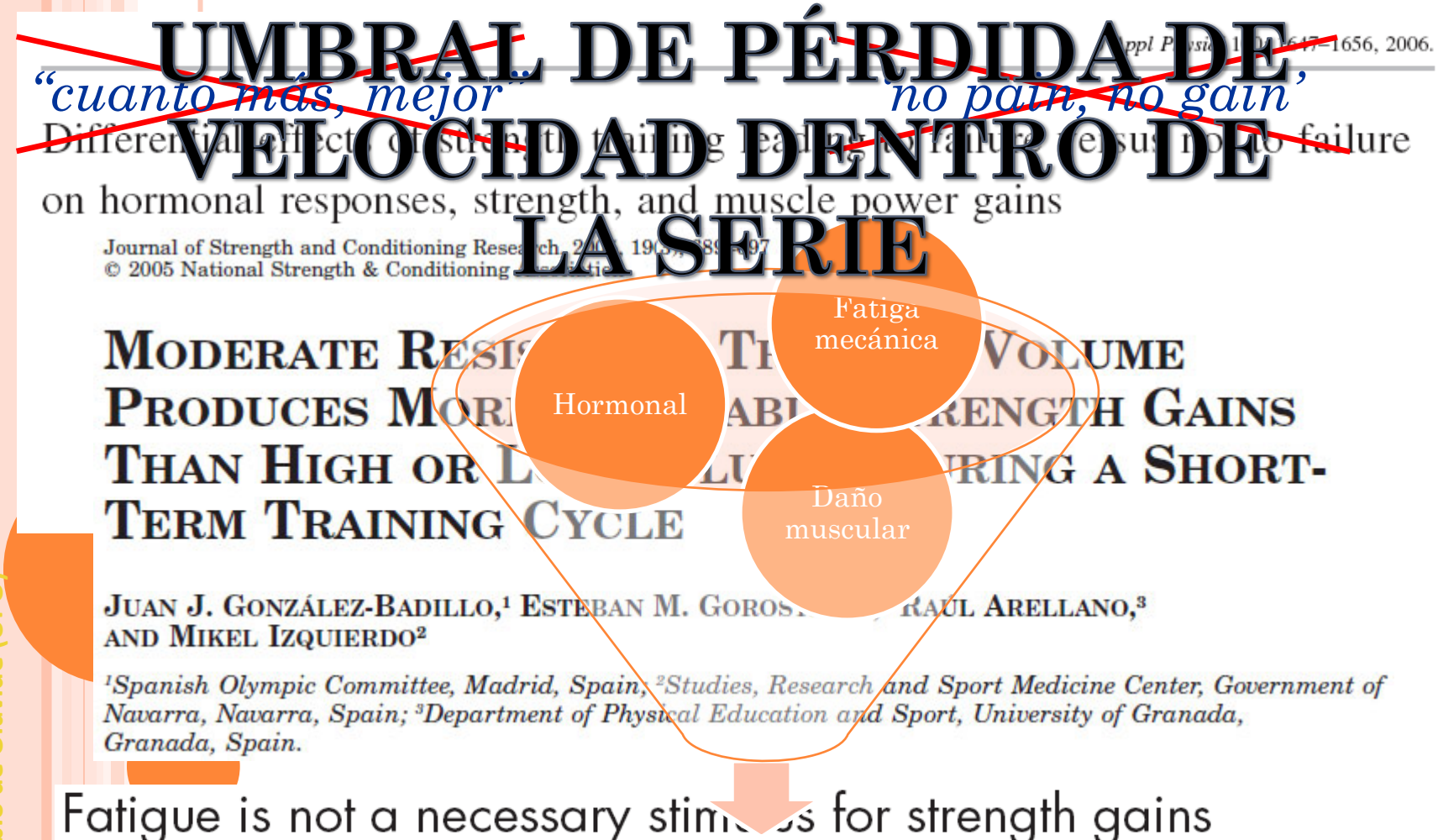
Efecto sobre el CMJ




VL30
VL15
Percentage of initial performance (%)
130
120
110
100
90
80
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
POST
Training sessions

DETERMINAR UN UMBRAL DE PÉRDIDA DE VELOCIDAD DENTRO DE LA SERIE

~~"cuanto más, mejor"~~ ~~"no pain, no gain"~~



Fatigue is not a necessary stimulus for strength gains during resistance training

J P Folland, C S Irish, J C Roberts, J E Tarr, D A Jones

Br J Sports Med 2002;36:370–374

Maximizar adaptaciones para aumentar el rendimiento físico

MUCHAS GRACIAS POR VUESTRA ATENCIÓN