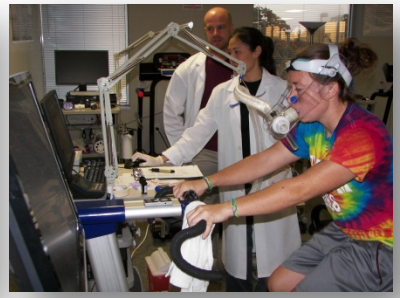
Exercise, Nutrition and Health Research: Translation of Science into Practice





Richard B. Kreider, PhD, FACSM, FISSN, FACN
Professor & Head, Department of Health & Kinesiology
Thomas A. & Joan Read Endowed Chair for Disadvantaged Youth
Director, Exercise & Sport Nutrition Lab
Texas A&M University

rbkreider@tamu.edu
ExerciseAndSportNutritionLab.com

Disclosures: Receive industry sponsored research grants and serve as a scientific and legal consultant. Serve as scientific consultant to Nutrabolt Inc. (Bryan, TX)

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Overview

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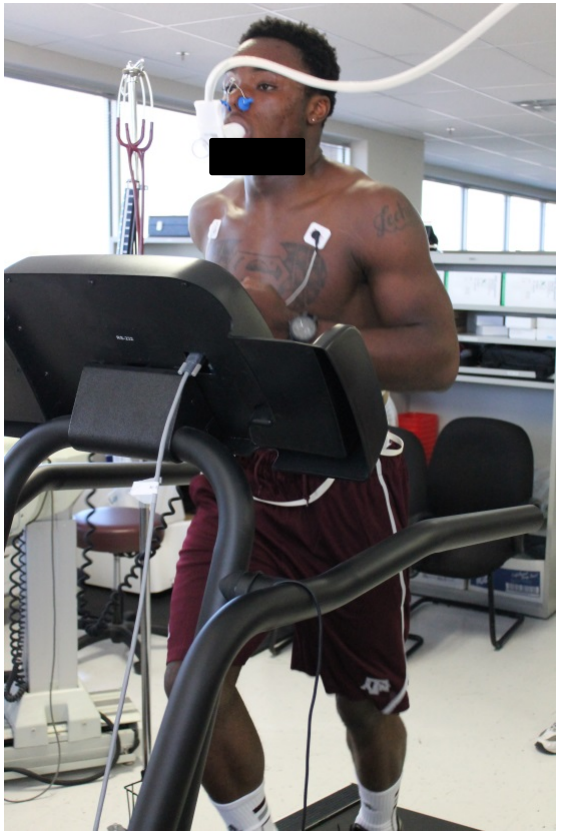
- Translational Research
- Overview of ESNL Research Approach
- Examples of ESNL Translational Research
- Translation of Science into Practice
- Summary and Future Directions



Translational Research

Definition

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- Translation of basic research findings more quickly and efficiently into medical practice and policy in order to improve health outcomes.
- Bench to clinical trials
- Clinical trials to bedside
- Clinical practice to health policy
- Health policy to improved health outcomes

Translational Research

Characteristics

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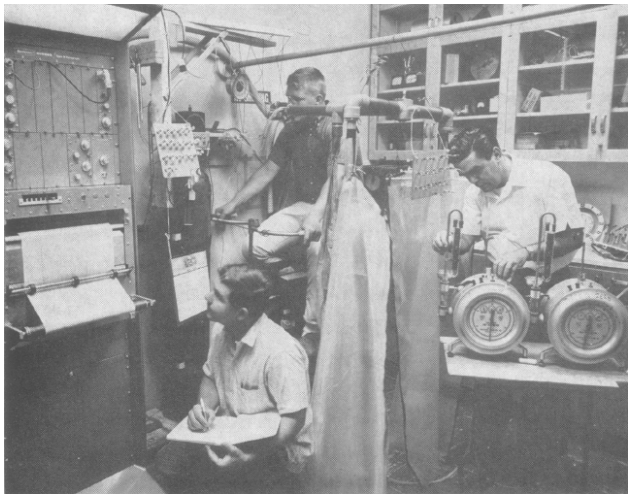
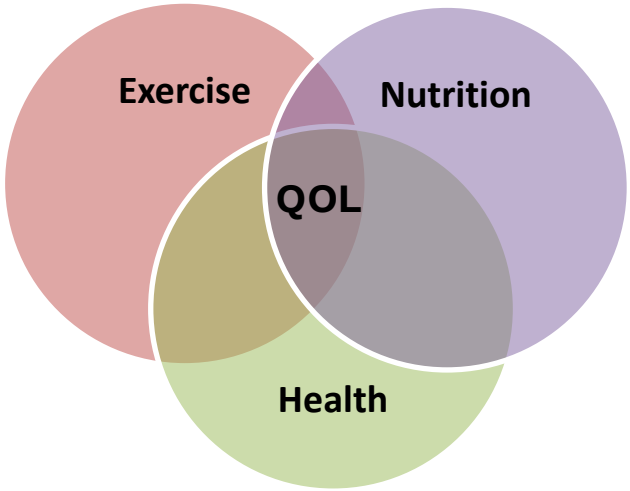
- Multi-disciplinary collaboration among basic researchers, clinicians, and applied scientists
- Goal is to translate basic research findings into practical applications to improve health and well-being
- Comparative effectiveness trials to assess impact of intervention on health outcomes
- Evidence-based practice & decision science approach
- Reduce risk and/or improve care through changes in health policy and behavior

Exercise Science

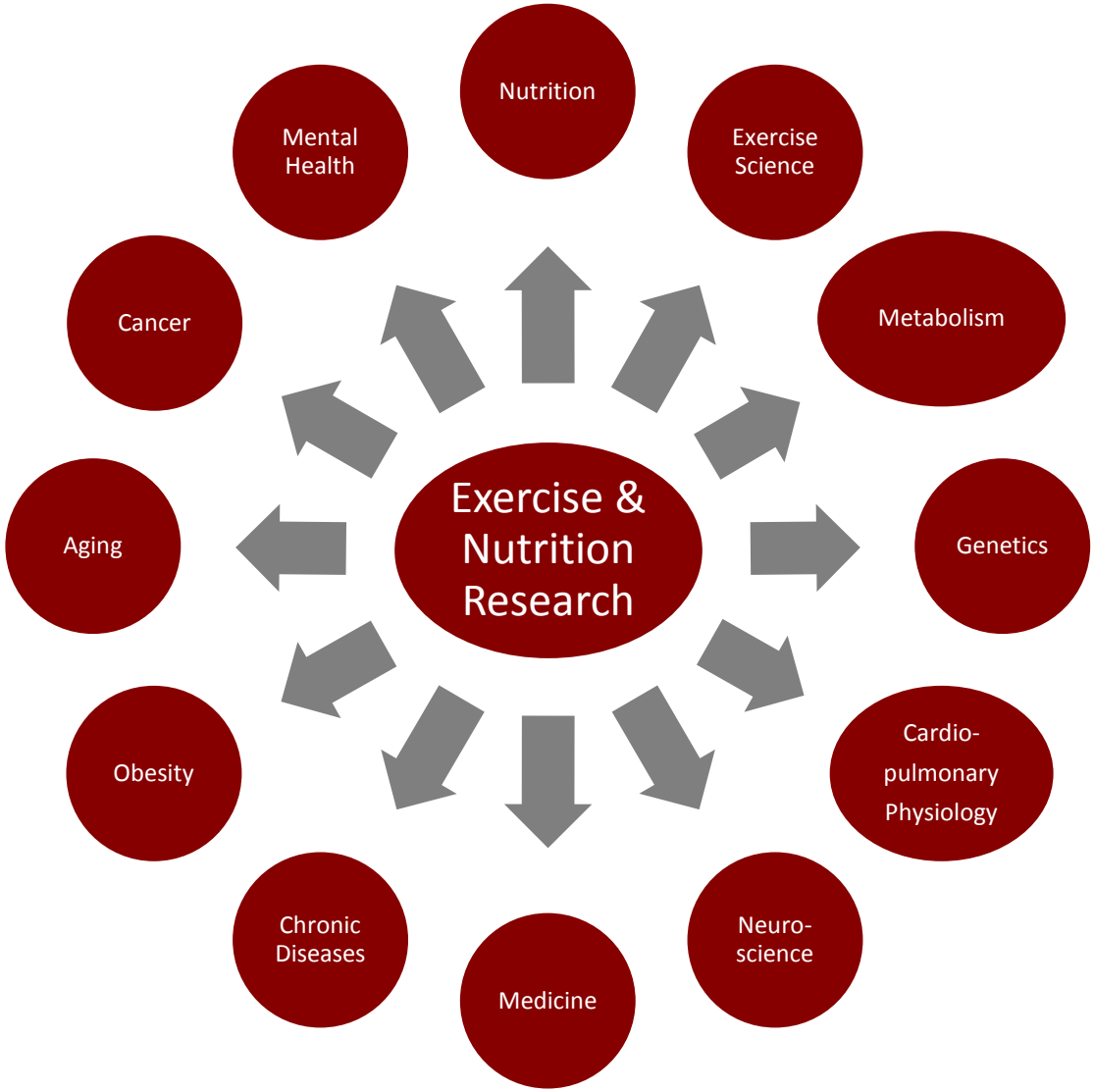
- Study of the effects of exercise on biological systems and health
- Area of study may include:
  - Pulmonary Physiology
  - Cardiopulmonary Physiology
  - Metabolism
  - Body Composition
  - Nutrition
  - Biochemistry/Bioenergetics
  - Endocrinology
  - Immunology
  - Neuroscience
  - Biomechanics
  - Psychology
- Methods range from basic science, to clinical research, to sport science



Exercise, Nutrition, Health Research



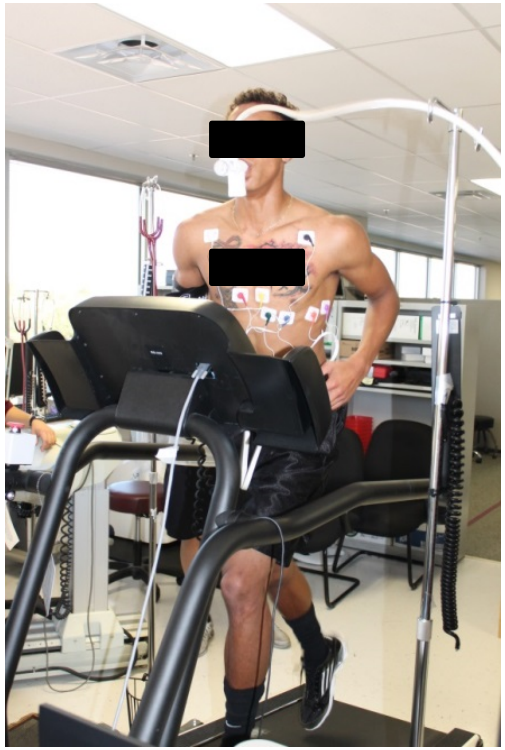
Provides a unique opportunity to assess impact of physical activity, diet/nutritional interventions, and behavioral modification interventions on quality of life and disease from a translational research perspective.


Exercise & Nutrition Research
Nutrition
Exercise Science
Metabolism
Genetics
Cardio-pulmonary Physiology
Neuro-science
Medicine
Chronic Diseases
Obesity
Aging
Cancer
Mental Health

Department of Health & Kinesiology

Exercise/Nutrition Related Institutes, Centers, & Labs

- **Institute**
  - Sydney and J.L. Huffines Institute for Sports Medicine and Human Performance
- **Centers**
  - Center for Translational Research on Aging and Longevity (Animal & Human)
- **Labs**
  - Athletic Training & Sports Medicine Lab (Human)
  - Applied Exercise Science Laboratories (Human)
  - Biology of Physical Activity Lab (Animal)
  - Bone Biology Laboratory (Animal)
  - Exercise Genetics Laboratory (Animal)
  - Exercise & Sport Nutrition Laboratory (Human)
  - Human Countermeasures Laboratory (Human)
  - Motor Behavior Laboratories (Human)
  - Muscle Biology Laboratory (Animal/Human)
  - Redox Biology & Cell Signaling Laboratory (Animal)
  - Vascular Biology Laboratory (Animal)



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Dedicated to evaluating the interaction between exercise and nutrition on health, disease, and human performance

www.ExerciseAndSportNutritionLab.com

Research Process

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- Conduct cutting-edge innovative research
- Present data at leading scientific conference
- Publish results in peer-reviewed open-access journals
- Translate findings to public
- Influence exercise, nutrition, and health practices and policy
- Train the next generation of scientists to impact field

ESNL Research

- Endurance / Overtraining
- Ergogenic Aids
  - Carbohydrate
  - Inosine
  - Phosphate
  - BCAA/glutamine
  - Creatine
  - HMB
  - Calcium Pyruvate
  - CLA
  - Protein/EAA
  - CHO Gels (Honey)
  - Ribose
  - Green Tea / Caffeine
  - Meal Timing
  - Colostrums
  - D-Pinitol
  - Coleus Forskohlii
  - ZMA
  - Methoxyisoflavones
  - Ecdysterones
  - Sulfo-Polysaccharides “Myostatin Inhibitor”
  - Calcium
  - Glucosamine and Chondroitin
  - Aromatase Inhibitors
  - BCAA, CHO, Leucine – Protein Synthesis
  - Melatonin
  - Arachidonic Acid
  - Novel Milk Peptides
  - CoQ10
  - Soy Protein
  - Beta Alanine
  - Russian Tarragon
  - Creatine Forms
  - Acai Juice
  - Tart Cherry Powder
  - Pre-workout Supplements
- Weight Loss & Maintenance

Exercise, Nutrition, Health

Translational Examples

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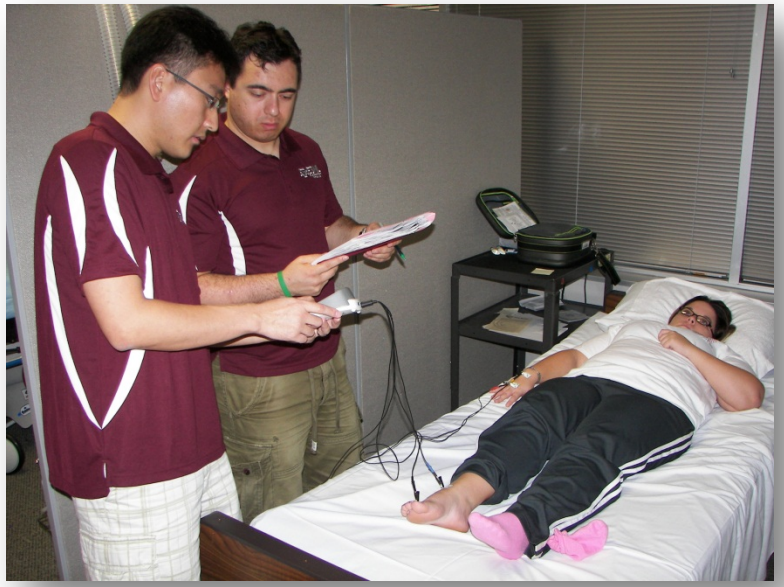
- Basic Research
- Clinical Trials Based on Basic Research Findings
- Applied Research (Weight Loss)
- Comparative Effectiveness Trials



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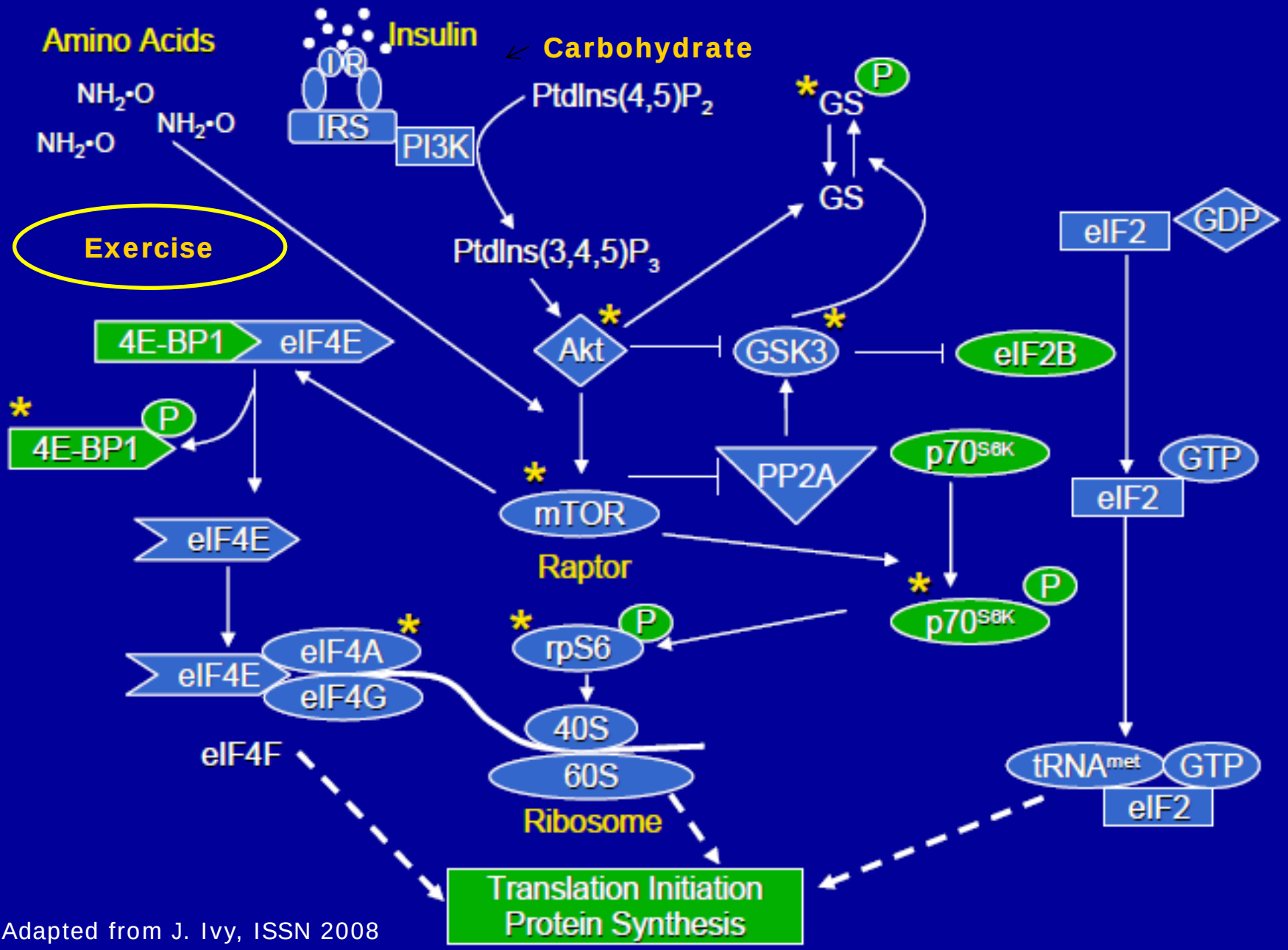
Basic Research

Myogenic Regulating Factors

INSULIN-mTOR PATHWAYS



Adapted from J. Ivy, ISSN 2008

Influence of Exercise Intensity on Myogenic Regulation

Wilborn et al. J Strength Cond Res 23(8): 2179–2187, 2009

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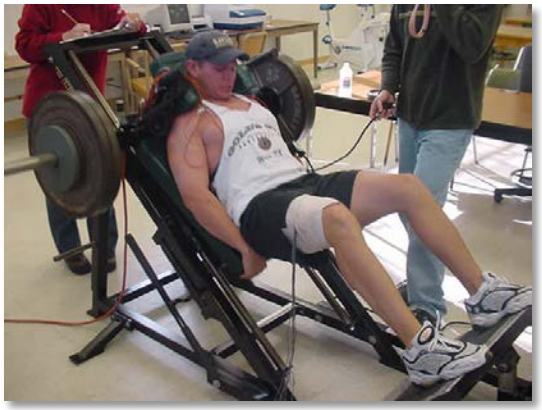

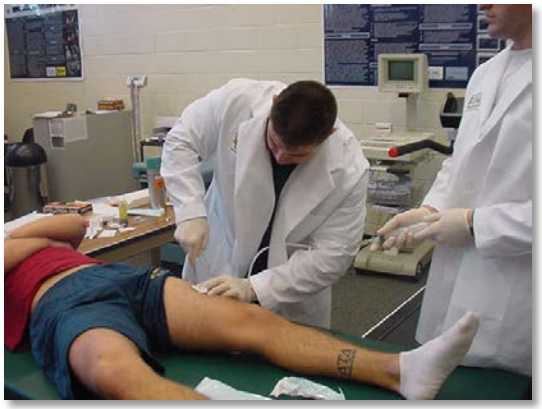

- A single bout of high-intensity resistance exercise is capable of activating the expression of various genes in skeletal muscle involved in hypertrophy such as myosin heavy chain (MHC) isoforms, myogenic regulatory factors (MRFs), and growth factors.
- Role exercise intensity plays on expression of these genes is not well-defined.
- This study examined the effects of exercise intensity on ***MHC (type I, IIA, IIX), MRF (Myo-D, myogenin, MRF-4, myf5), and growth factor (insulin-like growth factor [IGF]-1, IGF-1 receptor [IGF-R1], mechanogrowth factor [MGF]) mRNA expression***.

Influence of Exercise Intensity on Myogenic Regulation

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TABLE 1. Resistance exercise repetitions.

Bout	Leg press repetitions	Leg extension repetition
60–65%	17.94 ± 0.96	17.71 ± 0.83
80–85%	8.79 ± 0.82	9.27 ± 0.77

Data are mean ± *SD*.

- 13 male participants (21.5±2.9 years, 86.1±19.5 kg, 69.7±2.7 in) completed bouts of RE involving 4 sets of 18–20 repetitions with 60–65% 1RM and 4 sets of 8–10 repetitions with 80–85% 1RM.
- Vastus lateralis biopsies were obtained immediately before and at 30-minutes, 2-hrs, and 6-hrs after exercise.
- The levels of mRNA expression were determined using real-time polymerase chain reaction.

Influence of Exercise Intensity on Myogenic Regulation

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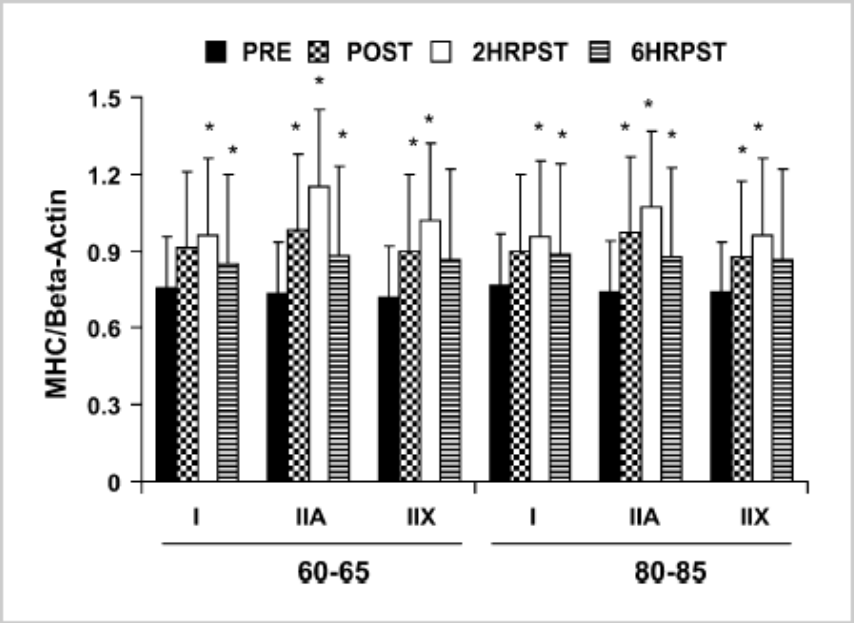

Figure 1. Myosin heavy chain (MHC) isoform mRNA expression in response to resistance exercise bouts with 60–65% and 80–85% 1 repetition maximum. Compared to immediately before exercise, MHC expression was significantly greater at 2 hours (2HRPST). MHC IIA was significantly greater at 30 minutes (PST), 2HRPST, and 6 hours (6HRPST) after exercise. MHC IIX was significantly greater at PST and 2HPST. *Significant main effect for time ($p < 0.05$).

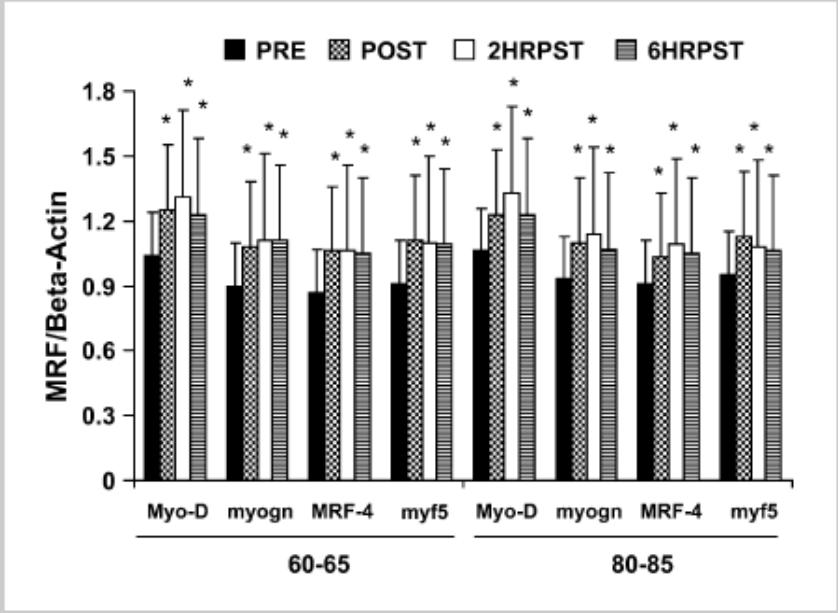

Figure 2. Myogenic regulatory factors (MRF) mRNA expression in response to resistance exercise bouts with 60–65% and 80–85% 1 repetition maximum. Compared to immediately before exercise, Myo-D expression was significantly greater at 30 minutes (PST), 2 hours (2HRPST), and 6 hours (6HRPST) after exercise. Myogenin, MRF-4, and myf5 were significantly greater at PST, 2HPST, and 6HPST. *Significant main effect for time ($p < 0.05$).

Influence of Exercise Intensity on Myogenic Regulation

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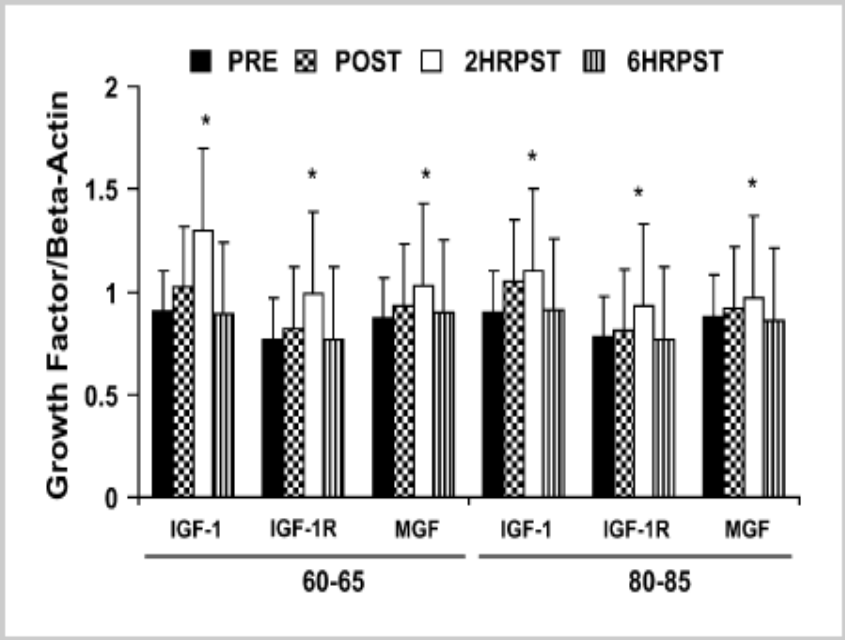

Figure 3. Growth factor mRNA expression in response to resistance exercise bouts with 60–65% and 80–85% 1 repetition maximum. Compared to immediately before exercise, IGF-1, IGF-R1, and MGF were all significantly increased at 2 hours after exercise. *Significant main effects for time ($p < 0.05$).

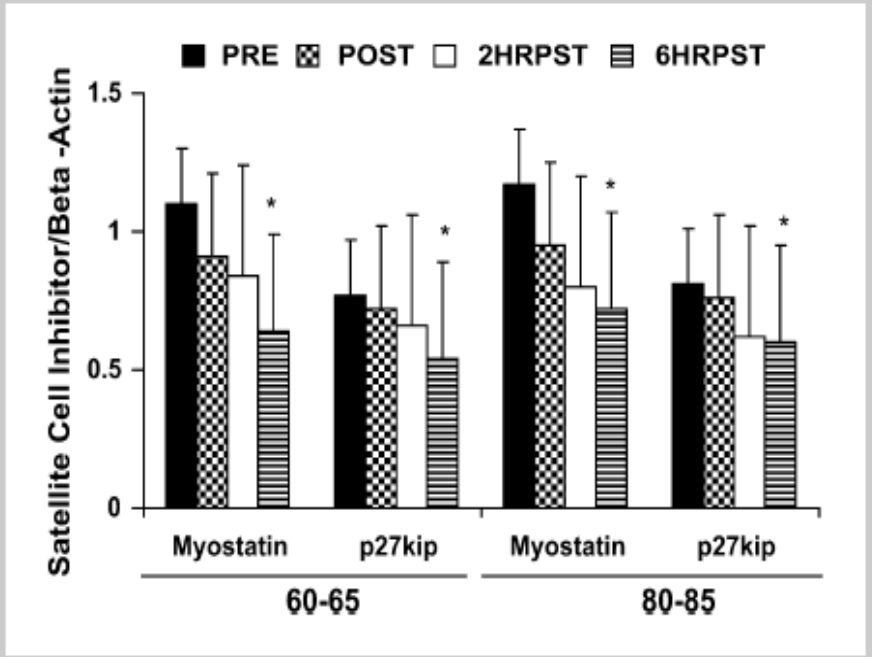

Figure 4. Satellite cell activation inhibitor mRNA expression in response to resistance exercise bouts with 60–65% and 80–85% 1 repetition maximum. Compared to immediately before exercise, myostatin and $p27^{kip}$ were significantly decreased at 6 hours after exercise. *Significant main effects for time ($p < 0.05$).

Effects of resistance exercise intensity on extracellular signal-regulated kinase 1/2 mitogen-activated protein kinase activation in men

Taylor et al. J Strength Cond Res 26(3): 599-607, 2012

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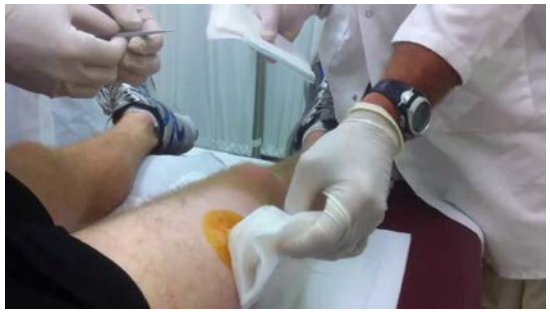

- 12 active men completed separate bouts of single-legged resistance exercise with 8-10 repetitions (reps) at 80-85% of 1RM) (85%) and 18-20 reps at 60-65% 1RM (65%) in a randomized crossover fashion.
- Vastus lateralis biopsies and blood draws were taken immediately before exercise (PRE) and at 30 minutes (30MPST), 2 hours (2HRPST), and 6 hours (6HRPST) post exercise, with an additional blood draw occurring immediately after exercise (POST).
- The phosphorylated levels of ***pIGF-1R, pMEK1, pERK1/2, and activated Elk-1*** were assessed by phosphoELISA, and serum insulin-like growth factor 1 (IGF-1) was assessed via enzyme-linked immunosorbent assay.

Effects of resistance exercise intensity on extracellular signal-regulated kinase 1/2 mitogen-activated protein kinase activation in men

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Taylor et al. J Strength Cond Res 26(3): 599-607, 2012

- Both exercise intensities significantly increased the activity of insulin-like growth factor 1 receptor (IGF-1R), mitogen-activated protein kinase 1, ERK1/2, and Elk-1, with peak activity occurring at 2HRPST ($p < 0.001$).
- However, 65% resulted in a preferential increase in IGF-1R and Elk-1 activation when compared with 85% ($p < 0.05$).
- No differences were observed for serum IGF-1 levels regardless of intensity and time.
- These findings demonstrate that resistance ***exercise upregulates ERK1/2 signaling in a manner that does not appear to be preferentially dependent on exercise intensity.***

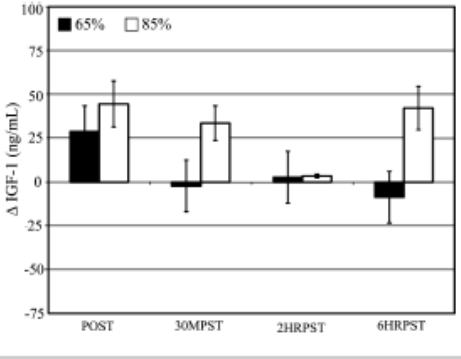


Figure 1. Changes (delta change from pretest) in serum IGF-1 (mean ± *SD*) after resistance exercise at 65 and 85% 1RM. No significance was observed for the variable serum IGF-1.

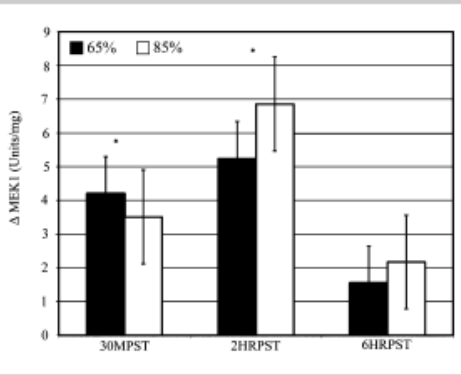
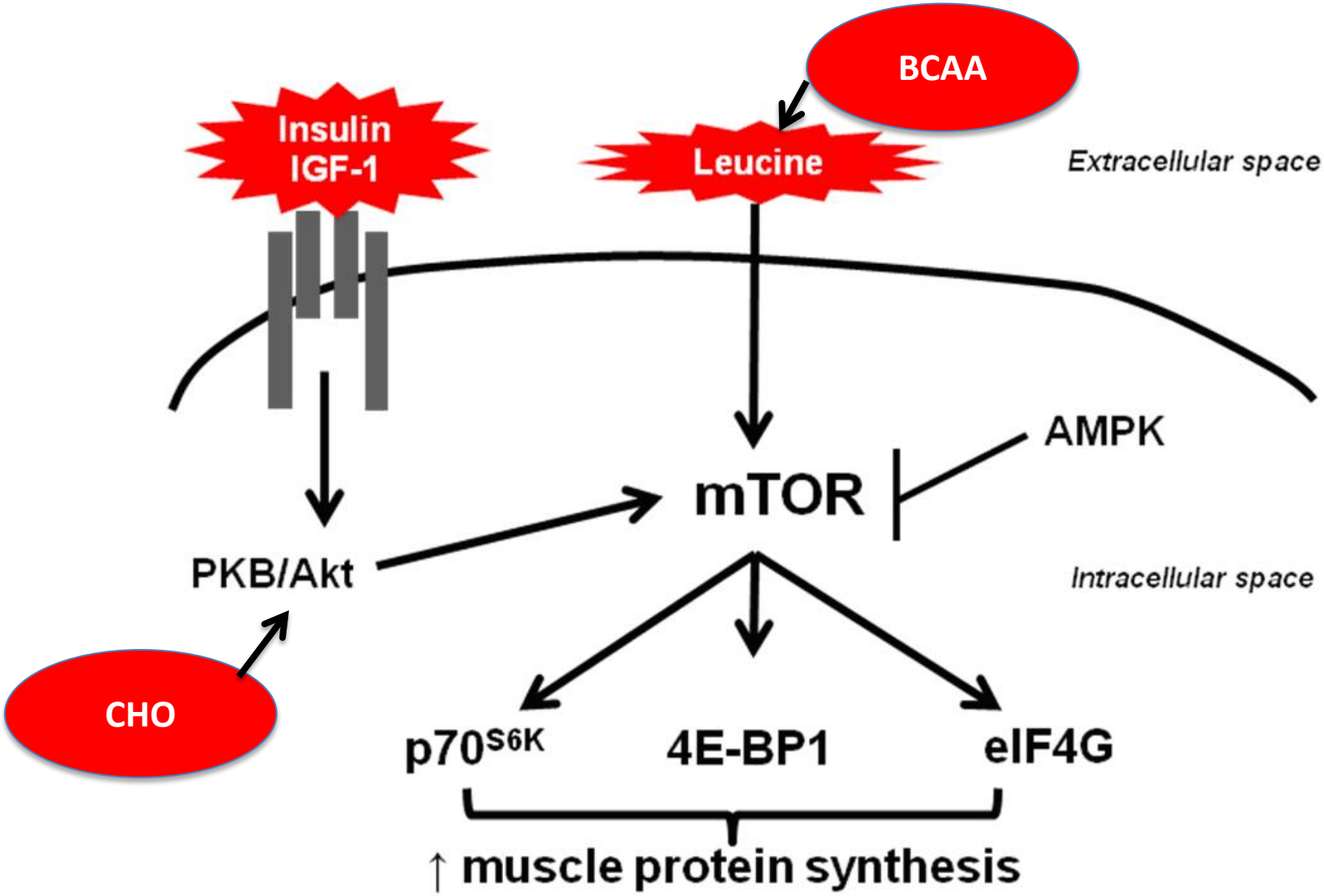


Figure 3. Changes (delta change from pretest) in muscle MEK1 phosphorylation (mean ± *SD*) after resistance exercise at 65 and 85% 1RM. *Significant main effects for time point ($p < 0.05$).


BCAA
Insulin
IGF-1
Leucine
Extracellular space
AMPK
mTOR
PKB/Akt
Intracellular space
CHO
p70S6K
4E-BP1
eIF4G
↑ muscle protein synthesis

Myogenic Regulatory Factors – Exercise + Nutrition

Campbell et al. MSSE 40(5) S242, 2008; Campbell et al. JISSN S1(P19), 2008.

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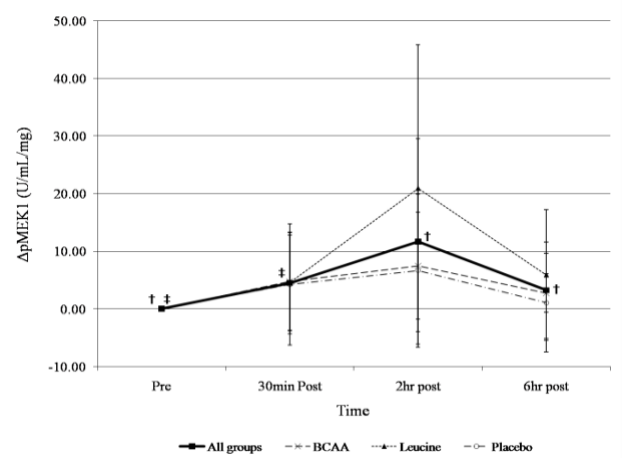
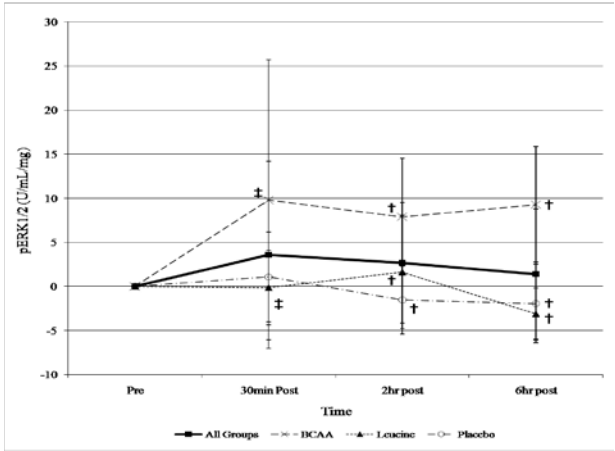
- 30 males were randomly assigned to ingest 30-min before, 0-min before, and post- RE (4 sets x 80% to failure of LP & LE)
  - LEU (60 mg/kg)
  - BCAA (120 mg/kg)
  - Placebo
- Muscle biopsies taken at 0, 30, 2, & 6-hr post
- BCAA and LEU increased the phosphorylation status of 4E-BP1 at 2-hr while BCAA increased the phosphorylation of 4E-BP1 greater than LEU at 6-hr.
- BCAA increased the ERK1/2 at 2 and 6 hrs
- ***Leucine supplementation did not have any effect on ERK1/2 activation***.
- ***No effect on insulin***





Effects of ingesting protein with various forms of carbohydrate following resistance-exercise on substrate availability and markers of anabolism, catabolism, and immunity

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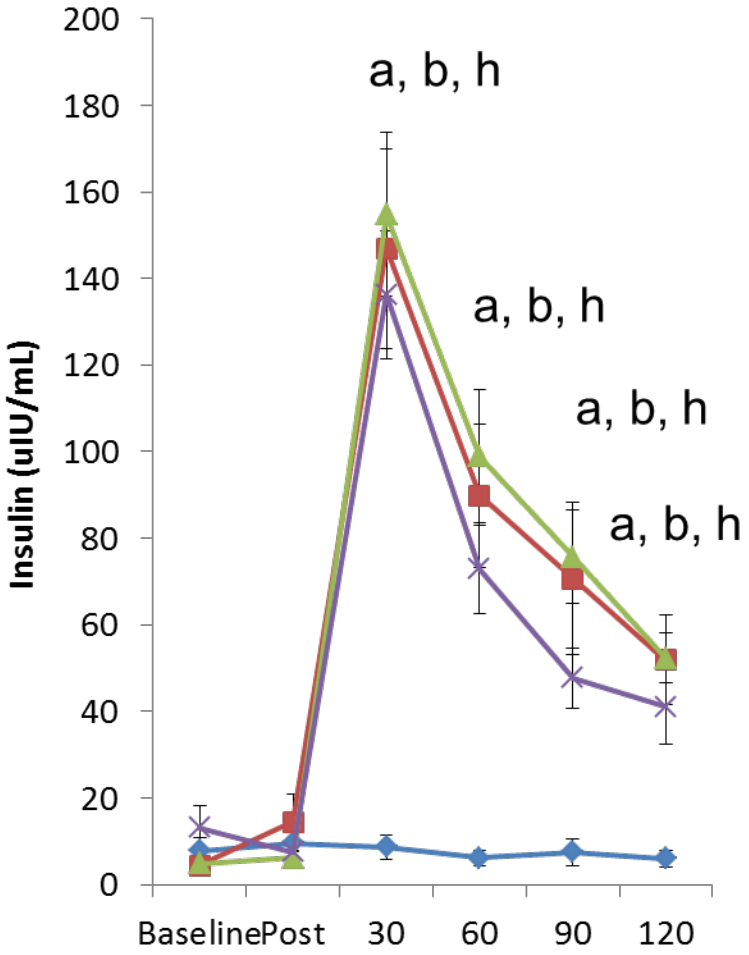
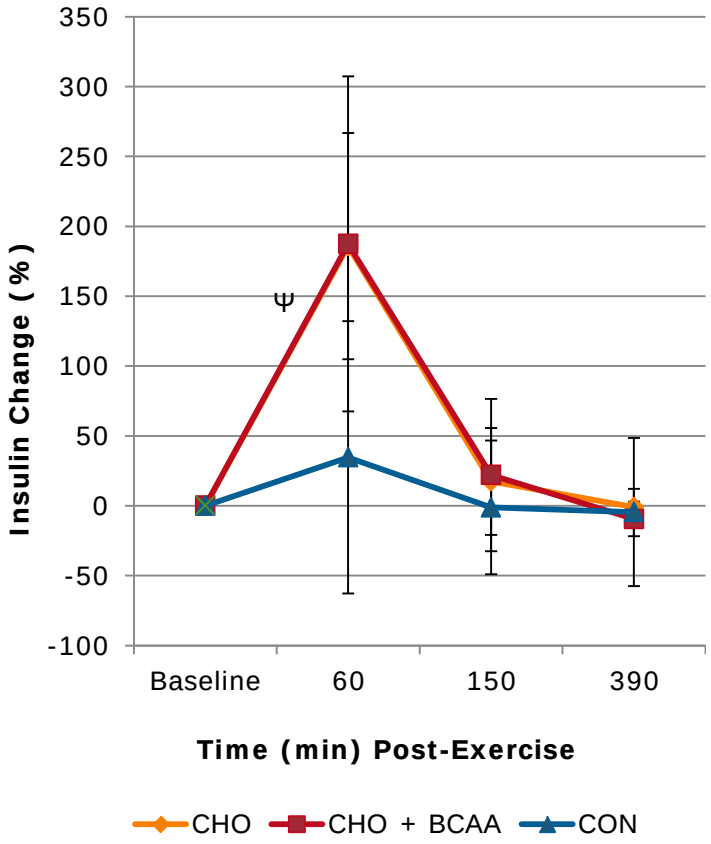
Kreider et al. JISSN: 4:18, 2007

- 40 resistance-trained males participated in 90-min of heavy resistance training
- Immediately after exercise, subjects were randomly assigned to ingest 40g of whey protein with 120 g of:
  - Sucrose
  - Honey powder
  - Maltodextrin
- Glucose, insulin, and markers of catabolism (testosterone, cortisol, muscle and liver enzymes, general markers of immunity were monitored for 12 minutes following exercise



Periexercise coingestion of branched-chain amino acids and carbohydrate in men does not preferentially augment resistance exercise-induced increases in phosphatidylinositol 3 kinase/protein kinase B-mammalian target of rapamycin pathway markers indicative of muscle protein synthesis. *Ferreira et al. Nutrition Research. 34(3):191-98, 2014*

- 27 recreationally trained males (20.9 y; 81.8 kg) were randomly assigned to:
  - BCAA (30 g) + CHO (350 g)
  - CHO (350 g)
  - CON
- Participants performed 4 sets of leg press and extensions at 80% 1RM to failure.
- Supplements were ingested 30-min prior to RE, and immediately pre-, and post.
- Glucose & insulin measured at 0, 30-min, 2-hr, and 6-hr post RE
- Muscle biopsies were obtained at baseline and at 30-min, 2-hr, and 6-hr post RE and assayed for ***ERK1/2, IRS, Akt/PKB, GSK, mTOR, 4E-BP1, and P70S6K.***
- Insulin and glucose increase 3-fold with no differences between CHO and BCAA + CHO



Periexercise coingestion of branched-chain amino acids and carbohydrate in men does not preferentially augment resistance exercise-induced increases in phosphatidylinositol 3 kinase/protein kinase B-mammalian target of rapamycin pathway markers indicative of muscle protein synthesis. *Ferreira et al. Nutrition Research. 34(3):191-98, 2014*

- Significant time main effects were observed for IRS-1 (*P* = .001), protein kinase B (*P* = .031), mammalian target of rapamycin (*P* = .003), and phosphorylated 70S6 kinase (*P* = .001).
- Carbohydrate and CHO + BCAA supplementation significantly increased IRS-1 compared with PLC (*P* = .002).
- ***Periexercise coingestion of CHO and BCAA did not augment RE-induced increases in skeletal muscle signaling markers indicative of muscle protein synthesis when compared with CHO.***

Table 2 – Skeletal muscle phosphoprotein content for PLC, CHO, and CHO + BCAA groups

Variable	PLC	CHO	CHO + BCAA	Group	Time	Group × time
IRS-1 (μg/mg)				0.002	0.001	0.695
PRE	31.85 ± 20.75	24.77 ± 14.47	34.96 ± 17.62			
0.5 h postexercise	22.97 ± 19.18	25.37 ± 17.82[a,b]	31.67 ± 17.90[a,b]			
2 h postexercise	18.12 ± 8.63	25.73 ± 17.82[a,b]	36.41 ± 17.34[a,b]			
6 h postexercise	11.36 ± 3.04	16.58 ± 6.24	22.25 ± 9.14			
Akt (ng/mg)				0.114	0.031	0.075
PRE	202.86 ± 85.01	263.29 ± 144.80	260.54 ± 96.44			
0.5 h postexercise	260.55 ± 411.35[b]	550.52 ± 732.68[b]	190.36 ± 134.18[b]			
2 h postexercise	85.33 ± 63.16[b]	131.14 ± 128.69[b]	598.79 ± 735.08[b]			
6 h postexercise	38.87 ± 47.11	61.24 ± 81.85	193.4 ± 289.98			
mTOR (AU/mg)				0.280	0.003	0.714
PRE	23.69 ± 22.30	22.57 ± 22.01	24.88 ± 22.80			
0.5 h postexercise	28.42 ± 30.59[b]	39.66 ± 83.60[b]	111.64 ± 35.21[b]			
2 h postexercise	33.12 ± 29.70[b]	50.34 ± 61.73[b]	49.36 ± 18.27[b]			
6 h postexercise	27.12 ± 22.51	26.31 ± 21.92	28.72 ± 22.28			
p70S6K (ng/mg)				0.059	0.001	0.309
PRE	191.92 ± 107.79	150.63 ± 92.09	218.58 ± 120.81			
0.5 h postexercise	169.06 ± 124.58	215.12 ± 148.26	237.86 ± 139.96			
2 h postexercise	110.84 ± 55.21	215.84 ± 256.29	266.34 ± 288.40			
6 h postexercise	1148.62 ± 1530.34[b]	881.74 ± 664.17[b]	4353.32 ± 6131.50[b]			
4E-BP1 (μg/mg)				0.549	0.183	0.456
PRE	12.59 ± 5.38	10.21 ± 4.27	11.54 ± 5.81			
0.5 h postexercise	8.54 ± 4.91	9.77 ± 3.41	9.27 ± 4.25			
2 h postexercise	8.93 ± 1.97	10.75 ± 2.89	11.46 ± 3.53			
6 h postexercise	8.58 ± 2.03	11.38 ± 2.60	9.67 ± 2.34			

Skeletal muscle phosphoprotein content of intermediates within the PI3K/Akt-mTOR signaling pathways for the PLC (n = 10), CHO (n = 9), and CHO + BCAA (n = 8) groups. Values are expressed as means ± SD. No significant group × time interactions were observed ($P > .05$). A significant main effect for group occurred for IRS-1 ($P = .002$), and significant main effects for time were observed for all intermediates except for 4E-BP1.
[a] A significant increase ($P = .001$) compared with PLC.
[b] A significant increase ($P < .05$) compared with PRE.

Co-ingestion of carbohydrate with branched-chain amino acids or L-leucine does not preferentially increase serum IGF-1 and expression of myogenic-related genes in response to a single bout of resistance exercise. *Li et al. Amino Acids. 2015 Jun;47(6)*

- 41 college-age males were randomly assigned to 1 of 4 groups: CHO, CHO-BCAA, CHO-LEU, or placebo (PLC).
- Resistance exercise consisted of 4 sets of 10 repetitions of leg press and leg extension at 80 % 1RM.
- Supplements were ingested peri-exercise, and venous blood and muscle biopsies were obtained pre-exercise (PRE), and at 30, 120, and 360 min post-exercise.
- ***Serum IGF-1*** was determined with ELISA, and skeletal muscle mRNA expression of myostatin, ***ACTRIIB, p21kip, p27kip, CDK2, cyclin B1, cyclin D1, Myo-D, myogenin, MRF-4, and myf5*** was determined using real-time PCR.
- Results were analyzed by two-way ANOVA for serum IGF-1 and two-way MANOVA for mRNA expression.

Table 4 mRNA expression for markers of myogenic activation for the CHO, CHO + BCAA, CHO + LEU, and PLC groups before and after resistance exercise

Variable	Pre	30 min post-ex	120 min post-ex	360 min post-ex	Group mean	*G* (ES)	*T* (ES)	*G* × *T* (ES)
CDK2						0.002* (0.09)	0.88 (0.01)	0.76 (0.04)
CHO	0.98 ± 0.04	1.01 ± 0.04	1.01 ± 0.03	0.99 ± 0.05	0.99 ± 0.04			
CHO + BCAA	1.06 ± 0.05	1.05 ± 0.06	1.03 ± 0.07	1.04 ± 0.04	1.04 ± 0.05	>CHO		
CHO + LEU	1.04 ± 0.06	1.02 ± 0.07	1.01 ± 0.06	1.05 ± 0.06	1.03 ± 0.06	>CHO		
PLC	1.05 ± 0.08	1.02 ± 0.06	1.05 ± 0.04	1.03 ± 0.07	1.03 ± 0.06	>CHO		
Time mean	1.03 ± 0.05	1.02 ± 0.05	1.02 ± 0.05	1.02 ± 0.05				
Cyclin B1						0.06 (0.05)	0.001† (0.13)	0.13 (0.09)
CHO	1.01 ± 0.03	1.04 ± 0.02	1.02 ± 0.01	1.02 ± 0.02	1.01 ± 0.02			
CHO + BCAA	1.02 ± 0.01	1.03 ± 0.02	1.07 ± 0.06	1.04 ± 0.04	1.04 ± 0.03			
CHO + LEU	1.01 ± 0.02	1.04 ± 0.05	1.04 ± 0.03	1.05 ± 0.04	1.03 ± 0.03			
PLC	1.01 ± 0.01	1.02 ± 0.05	1.05 ± 0.02	1.02 ± 0.03	1.02 ± 0.02			
Time mean	1.01 ± 0.02;	1.03 ± 0.03	1.04 ± 0.03; >pre	1.03 ± 0.03				
Cyclin D1						0.001* (0.22)	0.001† (0.42)	0.001‡ (0.30)
CHO	0.93 ± 0.04	0.99 ± 0.03	0.98 ± 0.02	1.04 ± 0.02	0.98 ± 0.02	<PLC		
CHO + BCAA	1.00 ± 0.04	0.98 ± 0.02	1.01 ± 0.03	1.00 ± 0.01	0.99 ± 0.02	<PLC		
CHO + LEU	0.98 ± 0.03	0.95 ± 0.02	1.01 ± 0.01	1.03 ± 0.03	0.99 ± 0.02	<PLC		
PLC	0.99 ± 0.03	1.01 ± 0.03	1.04 ± 0.02	1.06 ± 0.04	1.02 ± 0.03			
Time mean	0.97 ± 0.03	0.98 ± 0.02	1.01 ± 0.02; >pre, 30 min post-ex	1.03 ± 0.03; >pre, 30 min post-ex				
Myo-D						0.006* (0.08)	0.52 (0.02)	0.79 (0.04)
CHO	1.07 ± 0.09	1.04 ± 0.07	1.05 ± 0.08	1.05 ± 0.07	1.05 ± 0.07	>CHO + BCAA		
CHO + BCAA	1.00 ± 0.05	1.02 ± 0.09	0.97 ± 0.07	0.99 ± 0.06	0.99 ± 0.06			
CHO + LEU	1.04 ± 0.07	1.04 ± 0.12	1.07 ± 0.07	1.03 ± 0.08	1.04 ± 0.08	>CHO + BCAA		
PLC	1.07 ± 0.06	1.02 ± 0.09	1.02 ± 0.06	1.01 ± 0.05	1.03 ± 0.06	>CHO + BCAA		
Time mean	1.04 ± 0.06	1.03 ± 0.09	1.02 ± 0.07	1.02 ± 0.06				
Myogenin						0.34 (0.02)	0.58 (0.01)	0.54 (0.05)
CHO	1.12 ± 0.10	1.11 ± 0.06	1.09 ± 0.10	1.11 ± 0.11	1.10 ± 0.09			
CHO + BCAA	1.08 ± 0.09	1.08 ± 0.10	1.09 ± 0.12	1.07 ± 0.10	1.08 ± 0.10			
CHO + LEU	1.05 ± 0.04	1.13 ± 0.11	1.10 ± 0.07	1.06 ± 0.11	1.08 ± 0.08			
PLC	1.21 ± 0.06	1.14 ± 0.07	1.06 ± 0.08	1.10 ± 0.04	1.12 ± 0.06			
Time mean	1.11 ± 0.07	1.11 ± 0.08	1.08 ± 0.09	1.08 ± 0.09				
MRF-4						0.13 (0.04)	0.07 (0.05)	0.62 (0.04)
CHO	1.20 ± 0.15	1.19 ± 0.15	1.19 ± 0.18	1.20 ± 0.17	1.19 ± 0.16			
CHO + BCAA	1.20 ± 0.12	1.18 ± 0.11	1.20 ± 0.14	1.16 ± 0.12	1.17 ± 0.12			
CHO + LEU	1.28 ± 0.10	1.24 ± 0.19	1.27 ± 0.15	1.19 ± 0.12	1.24 ± 0.14			
PLC	1.03 ± 0.10	1.31 ± 0.12	1.23 ± 0.13	1.12 ± 0.12	1.17 ± 0.12			
Time mean	1.17 ± 0.11	1.23 ± 0.14	1.22 ± 0.13	1.16 ± 0.13				
Myf5						0.007* (0.08)	0.26 (0.03)	0.30 (0.07)
CHO	1.06 ± 0.09	1.02 ± 0.07	1.02 ± 0.08	1.02 ± 0.09	1.03 ± 0.08	>PLC, CHO + LEU		
CHO + BCAA	1.01 ± 0.05	1.03 ± 0.07	1.04 ± 0.09	1.00 ± 0.06	1.02 ± 0.06	>PLC, CHO + LEU		
CHO + LEU	1.08 ± 0.05	1.06 ± 0.07	1.07 ± 0.05	1.01 ± 0.07	1.05 ± 0.06			
PLC	1.09 ± 0.05	1.07 ± 0.06	1.04 ± 0.03	1.09 ± 0.06	1.07 ± 0.05			
Time mean	1.06 ± 0.06	1.04 ± 0.07	1.04 ± 0.06	1.03 ± 0.07				

Data are presented as mean ± SD for the ratio of C_t values for β-actin and each target mRNA variable. *G* (ES), *T* (ES), and *G* × *T* (ES) represent the univariate main effects and effect sizes for group, time, and group × time interaction, respectively, at a probability level of ≤0.05. The symbol * denotes a significant main effect for group. The symbol † denotes a significant main effect for test. The symbol ‡ denotes a significant group × time interaction

Co-ingestion of carbohydrate with branched-chain amino acids or L-leucine does not preferentially increase serum IGF-1 and expression of myogenic-related genes in response to a single bout of resistance exercise. *Li et al. Amino Acids. 2015 Jun;47(6)*

- ***Serum IGF-1 in CHO + BCAA was greater than PLC*** ($p < 0.05$) but was not affected by RE ($p > 0.05$).
- A significant group × time interaction was located for cylin D1 ($p < 0.05$), but not for any other genes.
- A significant time effects were noted for cyclin B1 and p21cip ($p < 0.05$).
- At 30, 120 and 360 min post-exercise, p21cip was significantly less than PRE.
- Cyclin D1 was greater than PRE and 30 min post-exercise at 120 and 360 min post-exercise, whereas cyclin B1 was significantly greater than PRE at 120 min post-exercise ($p < 0.05$).
- Unlike the co-ingestion of CHO with either BCAA or L-leucine in conjunction with RE, *the expression of various myogenically related genes were up-regulated with RE.*

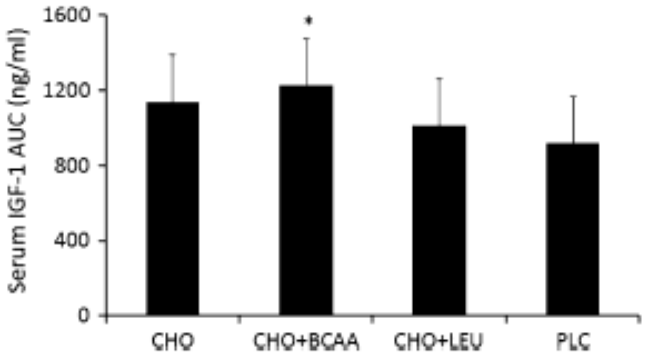


Fig. 1 Area under the curve (AUC) for serum IGF-1. Data are presented as mean ± SD. *Asterisk* denotes a significant difference between CHO + LEU and PLC ($p < 0.05$)

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Clinical Trials Based on Basic Research Findings

Creatine

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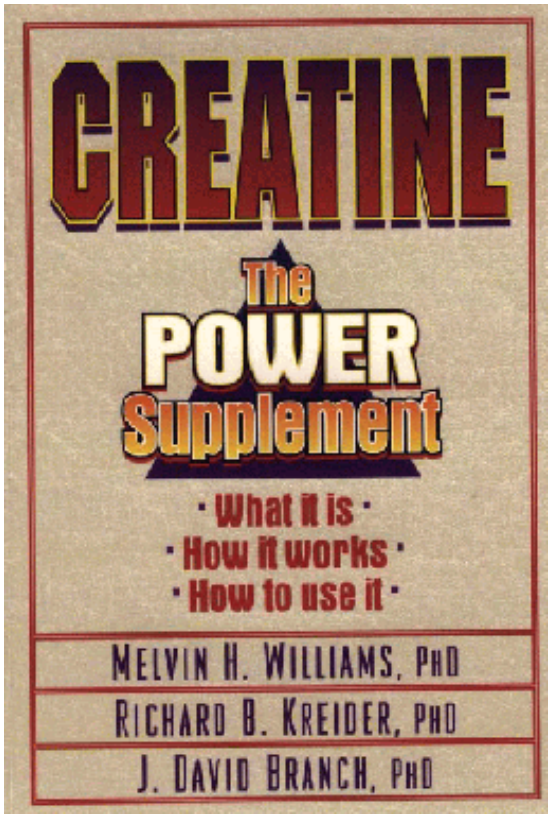
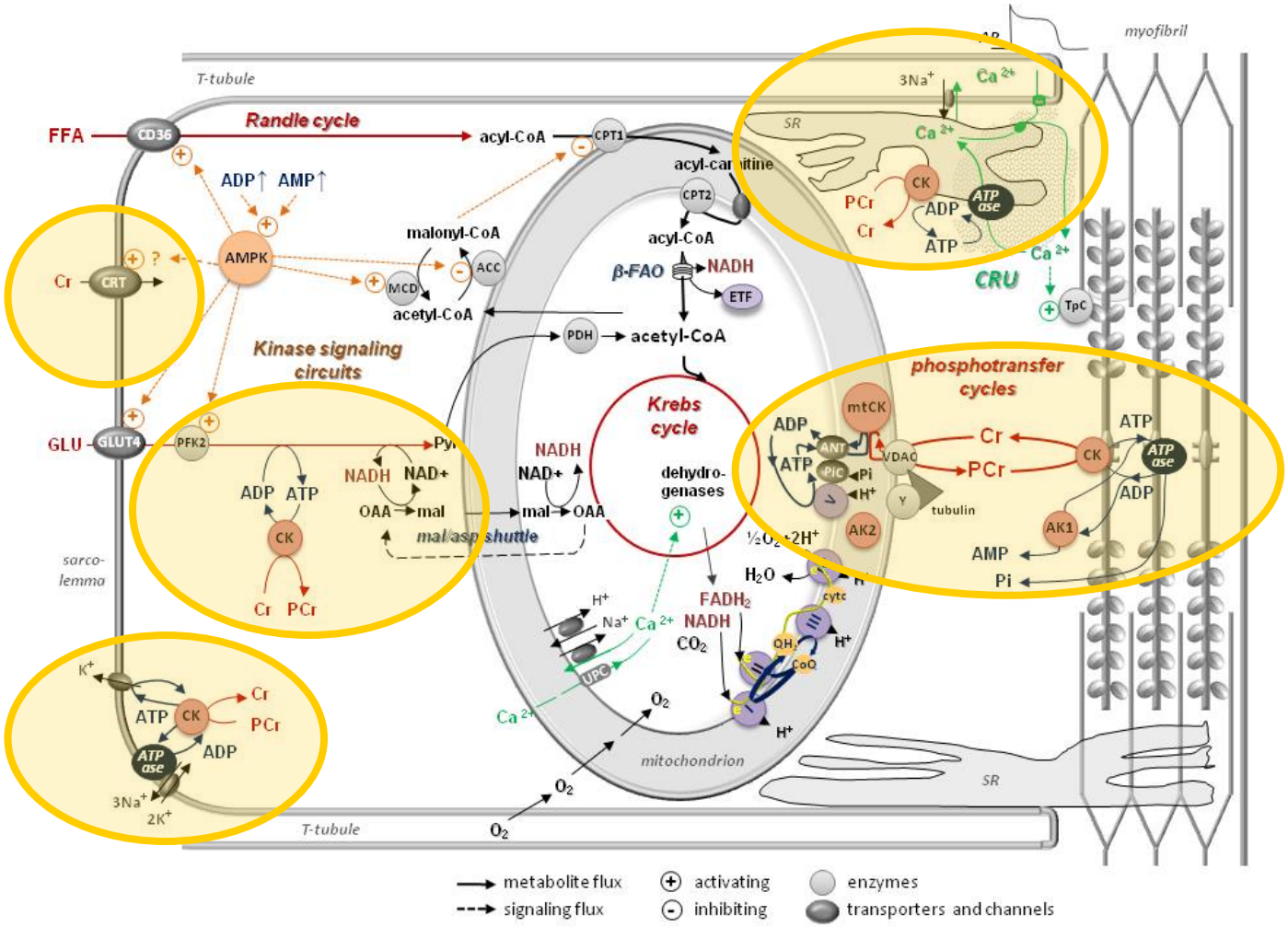


- Creatine is a naturally occurring non-essential amino acid discovered in 1832.
- Creatine supplementation studies began in early 1900s with interest rekindled by Ingwall and Hultman in 1970s.
- Athletes reported to be using creatine as an ergogenic aid since 1960's.
- Potential therapeutic role investigated since 1970's.
- Emphasis on ergogenic value in athletes since early 1990s as synthetic creatine became available.
- Current research on potential medical uses

Modeling CK transfer for systems bioenergetics

Modular organization of cardiac energy metabolism:
energy conversion, transfer and feedback regulation in cardiac intracellular energetic units



Saks et al. (2013) in: Systems biology of metabolic and signaling networks, Springer

Effects of ingesting Effects of Ingesting Supplements Designed to Promote Lean Tissue Accretion on Body Composition During Resistance-Training

Kreider et al. IJSN 6:234-46, 1996

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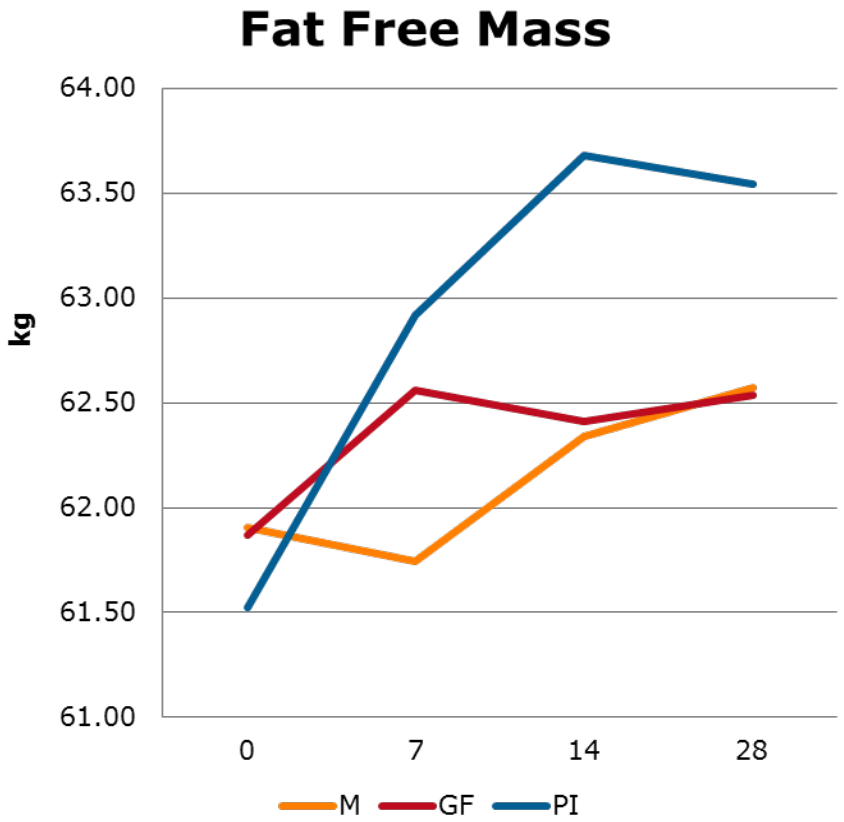
- 28 resistance trained males
- In a DB-R-P manner, assigned to supplement diet with:
  - Maltodextrin (190 g/d)
  - Gainers Fuel 1000 (290 g/d)
  - Phosphagain (64 g/d CHO, 67 g/d PRO, 20 g/d CM)
- Greater gain in FFM and body mass in CM group
- Improved strength & muscle endurance in CM group



Effects of Nutritional Supplementation During Off-Season College Football Training on Body Composition & Strength

Kreider et al. JEP 2(2):24-39, 1999

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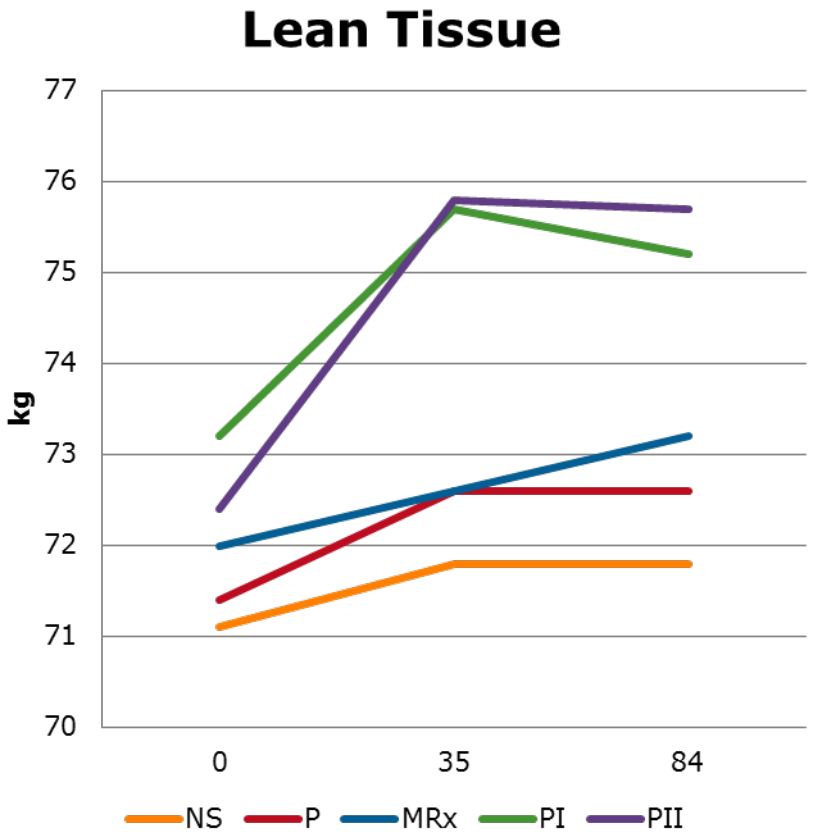
- 62 DI football players
- In a DB-R-P manner, assigned to supplement diet with:
  - Non-Supplemented Control
  - Maltodextrin Placebo
  - MetRx
  - Phosphagain I (20 g/d CM)
  - Phosphagain II (25 g/d CM)
- Greater gains in FFM & strength in CM groups



Effects of Creatine Supplementation on Body Composition, Strength, and Sprint Performance

Kreider et al. MSSE 30:73-82, 1998

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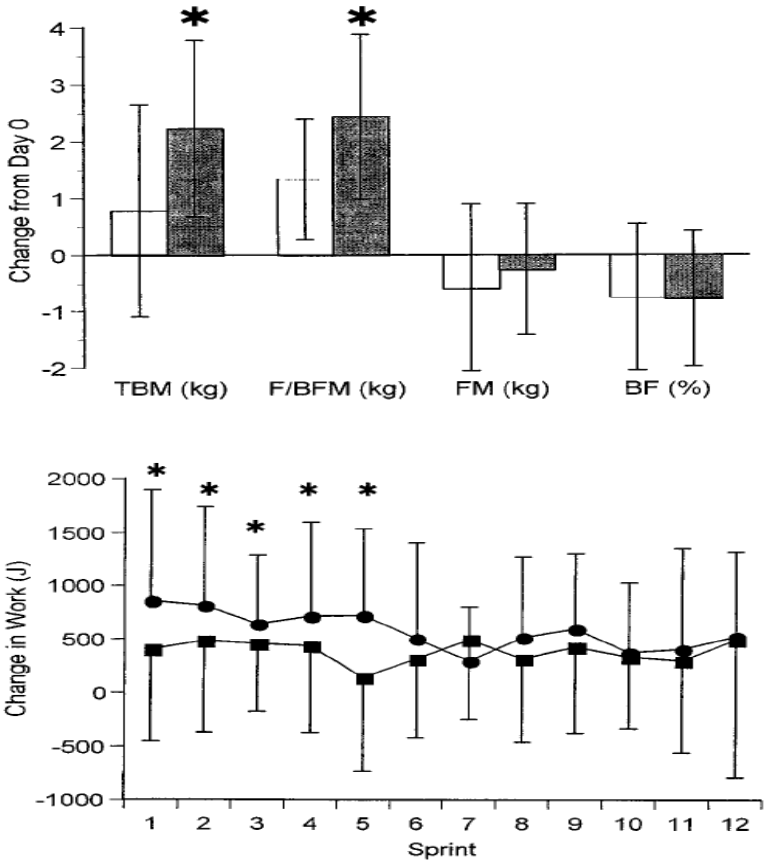
- 28 DI football players
- In a DB-R-P controlled manner, assigned to supplement diet with:
  - CHO containing placebo
  - CHO plus 15.75 g/d CM
- Greater gains in FFM, strength, and sprint performance
- Comprehensive safety analysis revealed no adverse effects during intense training



Cited over 500 times

Long-term Safety of Creatine Supplementation Among Athletes

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21 Month Open Label Safety Study

- 100 NCAA division IA football players volunteered to participate
- Subjects elect to ingest creatine containing supplements or non-creatine supplements.
- Creatine supplementation:
  - 15.75 g/d for 5-d
  - Average of 5 g/d for 21 months
- Supplements administered following workouts/practices and documented
- Blood/urine samples collected at 0, 1.5, 2, 4, 6, 9, 12, 15, & 21 months.

Long-term Safety of Creatine Supplementation Among Athletes

Kreider et al. J Mol Cellular Biochem. 244:95–104, 2003

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- MANOVA revealed *no significant differences* (p=0.51) in a 55-item panel of blood and urine markers.
- RM ANOVA revealed *no clinically significant differences* among creatine users and controls in markers of renal function, muscle & liver enzymes, markers of catabolism, electrolytes, blood lipids, red cell status, lymphocytes, urine volume, clinical urinalysis, or urine specific gravity.
- No perception of greater incidence of side effects
- Some evidence of greater training tolerance

Long-term Safety of Creatine Supplementation Among Athletes

Greenwood et al. J Mol Cellular Biochem. 244:83–88, 2003

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- Creatine users (45-54% use rate) experienced:
  - Cramping (37/96, 39%)
  - Heat/dehydration (8/28, 36%)
  - Muscle tightness (18/42, 43%)
  - Muscle strains/pulls (25/51, 49%)
  - Non-contact joint injuries (44/132, 33%)
  - Contact injuries (39/104, 44%)
  - Illness (12/27, 44%)
  - Missed practices due to injury (19/41, 46%)
  - Players lost for season (3/8, 38%)
  - Total injuries/missed practices (205/529, 39%)

Effects of serum creatine supplementation on muscle creatine content. *Kreider et al. JEP online. 6(4):24-33, 2003*

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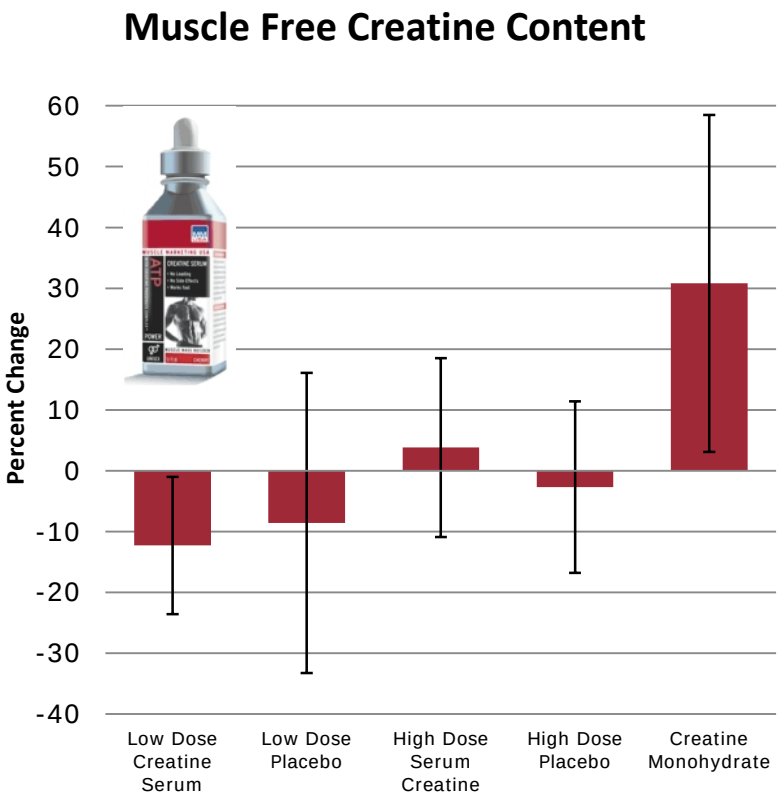
- 40 male subjects (83±13 kg) with no history of creatine use had percutaneous muscle biopsies obtained from the vastus lateralis prior to and following 5-days of supplementing their diet in a randomized and double blind manner with:
  - 5 mL of CS purportedly providing 2.5 grams of CM equivalent (LD-CS),
  - 5 mL of a placebo (LD-P)
  - 8 x 5 mL of CS purportedly providing 20 grams of CM equivalent (HD-CS), or
  - 8 x 5 mL of P (HD-P)
  - 4 x 5 grams of CM for 5 days as a non-blinded benchmark control.
- ***CM supplementation significantly increased muscle Free Creatine content by 31±28 %***
- ***Serum Creatine had no affect on Free Cr, TCr, or PC***



The effects of creatine ethyl ester supplementation combined with heavy resistance training on body composition, muscle performance, and serum and muscle creatine levels.

Spillane et al., JISSN, 6:6, 2009

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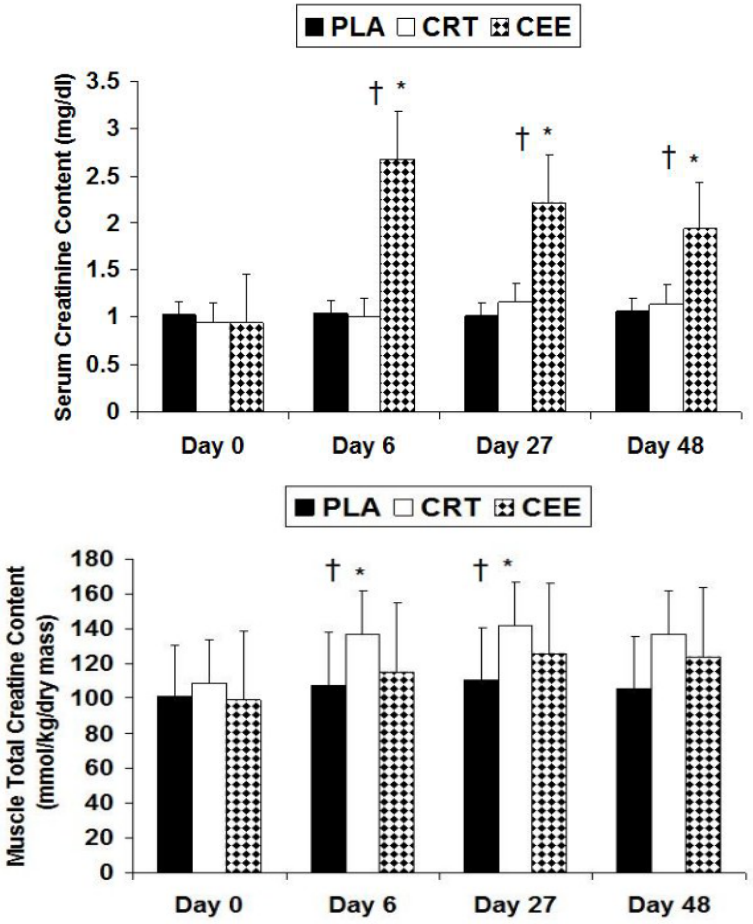
- In a double blind manner, 30 participants were randomly assigned to ingest 0.30 g/kg FFM for 5-days and 0.075 g/kg FFM for 42 days of a PLA, CRT), or CEE.
- Serum creatine concentrations in PLA (p = 0.007) and CRT (p = 0.005) compared to CEE.
- Serum creatinine was greater in CEE compared to the PLA (p = 0.001) and CRT (p = 0.001) and increased at days 6, 27, and 48.
- Total muscle creatine content was significantly higher in CRT (p = 0.026) and CEE (p = 0.041) compared to PLA, with no differences between CRT and CEE.
- Significant changes over time were observed for body composition, body water, muscle strength and power variables, but no significant differences were observed between groups.



A buffered form of creatine does not promote greater changes in muscle creatine content, body composition, or training adaptations than creatine monohydrate.

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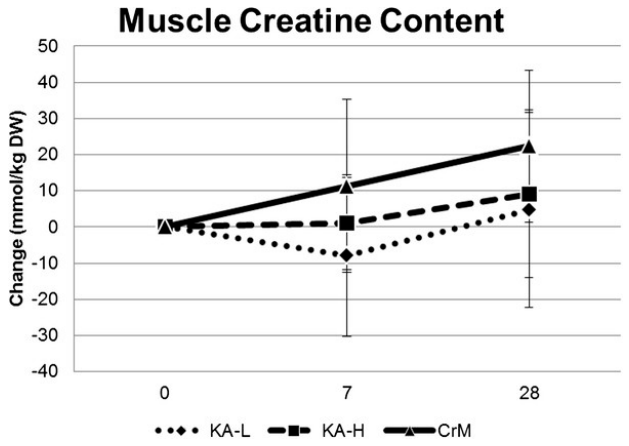
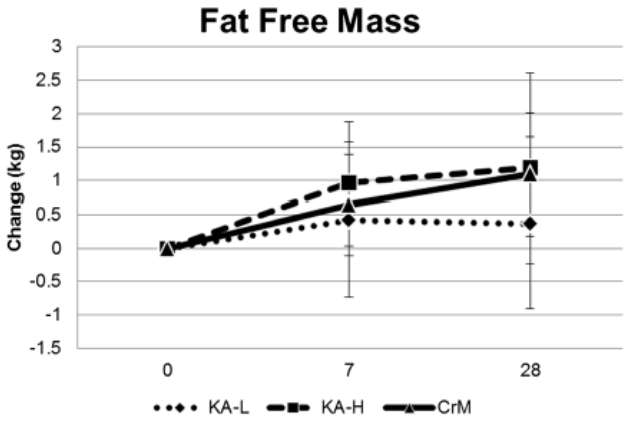
Jagim et al. JISSN 9:43. 2012

- 36 resistance-trained participants (20.2 ± 2 years, 181 ± 7 cm, 82.1 ± 12 kg, and 14.7 ± 5% body fat) were randomly assigned to supplement their diet with:
  - CrM at normal loading (4 x 5 g/d for 7-days) and maintenance (5 g/d for 21-days) doses;
  - KA at manufacturer's recommended doses (KA-L, 1.5 g/d for 28-days); or,
  - KA with equivalent loading (4 x 5 g/d for 7-days) and maintenance (5 g/d) doses of CrM (KA-H).
- ***Neither manufacturers recommended doses or equivalent loading and maintenance doses of CrM promoted greater changes in muscle creatine content, body composition, strength, or anaerobic capacity than CrM.***
- ***There was no evidence that supplementing the diet with a buffered form of creatine resulted in fewer side effects than CrM.***





Acute and chronic safety and efficacy of dose dependent creatine nitrate supplementation and exercise performance. *Galvan et al. JISSN 13:12, 2016*

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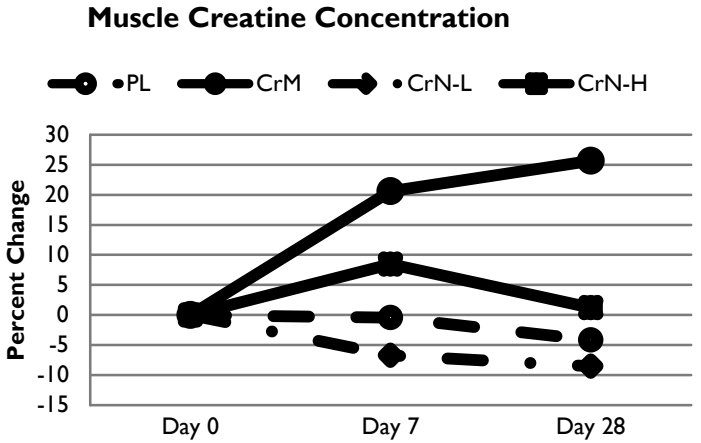
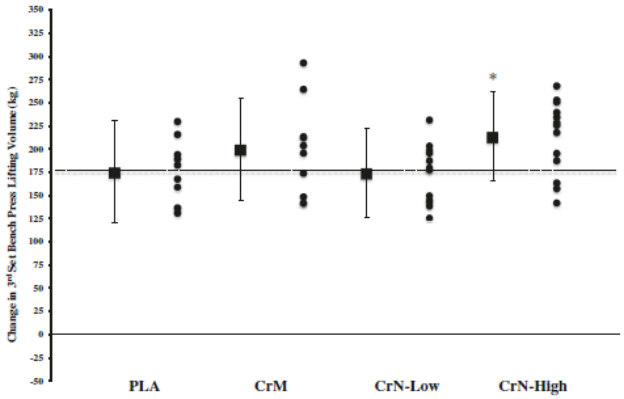
- Day 0 – 7: Loading Phase (4 doses/d)
  - PL: **26 g dextrose**/d
  - CrM: **12 g CrM** + 2 g flavoring + 8 g dextrose/d
  - CrN-L: **6 g CrN** + 2 g flavoring + 8 g dextrose/d
  - CrN-H: **12 g CrN** + 2 g flavoring + 8 g dextrose/d
- Day 8 – 28: Maintenance Phase (1 dose/d)
  - PL: **6.5 g dextrose**/d
  - CrM: **3 g CrM** + 0.5 g flavoring + 2 g dextrose/d
  - CrN-L: **1.5 g CrN** + 0.5 g flavoring + 2 g dextrose/d
  - CrN-H: **3.0 g CrN** + 0.5 g flavoring + 2 g dextrose/d
- Muscle creatine increased significantly by d-7 in the CrM and CrN-High groups, but then decreased by d-28 for CrN-High.
- Some ergogenic benefits were observed among groups most likely due to influence of nitrate.
- CrN delivered at 3 g was well-tolerated, demonstrated similar performance benefits to 3 g CrM, and within the confines of this study, there were no safety concerns.
- ***There was no evidence that CrN at recommended or twice recommended doses is more efficacious than CrM at the doses studied.***





Effects of calcium B-hydroxy B-methylbutyrate (HMB) supplementation during resistance-training on markers of catabolism, body composition and strength.

Kreider et al. ***Inter J Sports Med****. 20:503-9, 1999*

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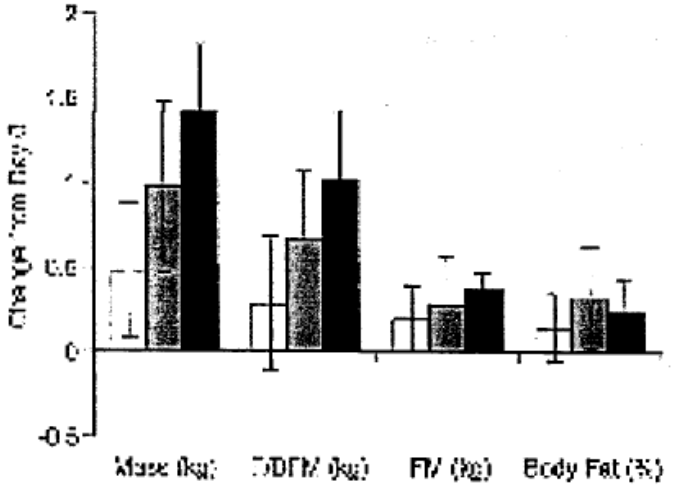
- 40 experienced resistance-trained athletes were matched and assigned to supplement their diet for 28 d with a fortified carbohydrate/protein powder containing either 0, 3 or 6 g × d^{-1} of calcium HMB.
- HMB supplementation resulted in significant increases in serum and urinary HMB concentrations.
- No significant differences in general markers of whole body anabolic/ catabolic status, muscle and liver enzyme efflux, fat/bone-free mass, fat mass, percent body fat, or 1 RM strength.
- One of first studies showing HMB does not affect training adaptations in trained athletes



Effects of conjugated linoleic acid (CLA) supplementation during resistance training on body composition, bone density, strength, and selected hematological markers.

Kreider et al. ***JSCR***. *16(3):325-334, 2002.*

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- 23 resistance-trained subjects were matched and randomly assigned to supplement their diet with 9 g/d of an olive oil placebo or 6 g/d of CLA with 3 g/d of fatty acids for 28-d.
- Although some statistical trends were observed, changes in total body mass, FFM, fat mass, percent body fat, bone mass, strength, serum substrates, or general markers of catabolism and immunity during training.
- First study to examine effects of CLA on body composition in humans.

Table 3. DEXA body composition and bone mass data for P and CLA groups.

Variable	Group		Day 0	Day 28		p
Body mass (kg)	P	$\bar{x}$*	79.5	79.4	Group	0.55
		±	3.1	3.3	Time	0.75
	CLA	$\bar{x}$	82.0	82.3	Group × time	0.43
		±	3.1	3.1		
Scanned mass (kg)	P	$\bar{x}$	73.2	73.3	Group	0.51
		±	3.1	3.2	Time	0.12
	CLA	$\bar{x}$	75.5	76.1	Group × time	0.26
		±	3.1	3.0		
Fat/bone-free mass (kg)	P	$\bar{x}$	59.0	59.0	Group	0.37
		±	1.9	1.9	Time	0.31
	CLA	$\bar{x}$	61.5	62.0	Group × time	0.49
		±	2.5	2.5		
Fat mass (kg)	P	$\bar{x}$	11.9	12.0	Group	0.92
		±	1.6	1.6	Time	0.20
	CLA	$\bar{x}$	11.5	12.0	Group × time	0.37
		±	2.0	2.0		
Bone mass (g)	P	$\bar{x}$	2,558	2,554	Group	0.74
		±	102	100	Time	0.21
	CLA	$\bar{x}$	2,492	2,516	Group × time	0.08
		±	121	117		
Body fat (%)	P	$\bar{x}$	15.9	15.9	Group	0.79
		±	1.6	1.5	Time	0.33
	CLA	$\bar{x}$	15.0	15.3	Group × time	0.44
		±	2.2	2.1		

* $\bar{x}$ = group mean; ± = *SE* of mean.

Effects of oral D-ribose supplementation on anaerobic capacity and selected metabolic markers in healthy males.

Kreider et al. IJSNEB. 13:76-86, 2003.

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- 19 resistance trained males
- In a DB-PC-R manner, assigned to supplement diet during resistance-training with:
  - 10 g/d placebo
  - 10 g/d D-ribose
- Total work significantly declined (-18±51 J) during the second post-supplementation sprint in the P group while being maintained in the R group (–0.0±31 J).
- No significant interactions were observed in peak power, average power, torque, fatigue index, lactate, ammonia, glucose, or uric acid.
- First study to examine ergogenic value of D-ribose in trained athletes

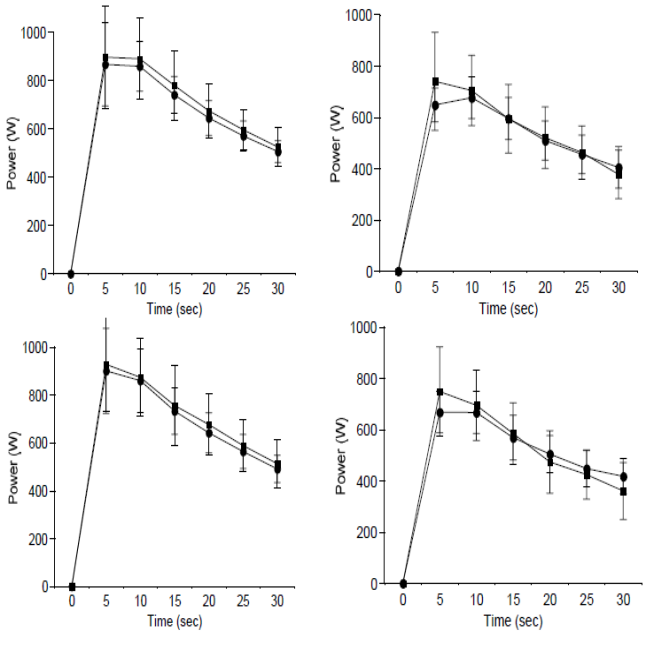

Figure 1. Power output values observed at each 5-sec interval for the placebo (■) and ribose (●) groups in sprint 1 (top panel) and sprint 2 (lower panel) for pre and post supplementation tests. Data are means and standard deviations.

Pharmacokinetics, safety and effects on exercise performance of L-Arginine Alpha-Ketoglutarate in trained adult men. Campbell et al. ***Nutrition.*** *22:872-81, 2006.*

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- 10 subjects pharmacokinetic trial
- In a DB-PC-R manner, 35 resistance-trained men ingested 12 g/d of AAKG or placebo during 8 weeks of training.
- Significant differences were observed in plasma arginine levels in subjects taking non–timed-release and timed-release AAKG
- AAKG increased 1RM bench press, Wingate peak power, blood glucose, and plasma arginine.
- No differences observed in body composition, isokinetic quadriceps muscle endurance, or aerobic capacity.
- One of first studies on effects of AAKG supplementation during training.

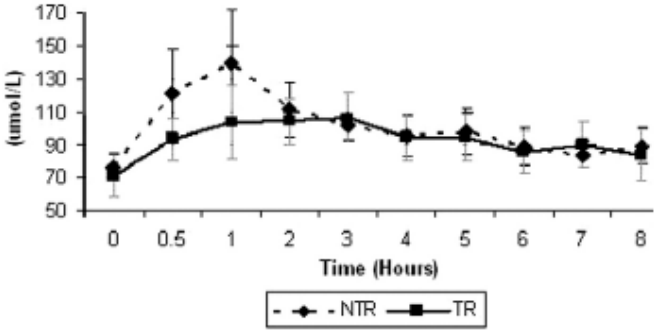

Table 2
Wingate anaerobic power indices.

	AAKG	Placebo	*P* (group × time)
Peak power (W)			
T1	1251 ± 236	1271 ± 257	
T2	1291 ± 254	1282 ± 219	
T3	1331 ± 242*	1202 ± 241	0.005
Time to peak power (s)			
T1	3.77 ± .55	3.83 ± 1.02	
T2	3.80 ± .80	4.12 ± 0.84	
T3	3.88 ± .48*	3.32 ± 1.25	0.050
Rate to fatigue (W/s)			
T1	34.9 ± 8.9	35.6 ± 8.6	
T2	36.4 ± 10.0	35.6 ± 9.1	
T3	37.6 ± 8.8*	31.9 ± 9.5	0.005

AAKG, L-arginine/α-ketoglutarate; T1 to T3, time 1 to time 3
* AAKG greater than placebo at T3 ($P < 0.05$).

Effects of acute and chronic coenzyme Q10 supplementation on exercise performance in both trained and untrained individuals

Cooke et al. JISSN. 5/8, 2008

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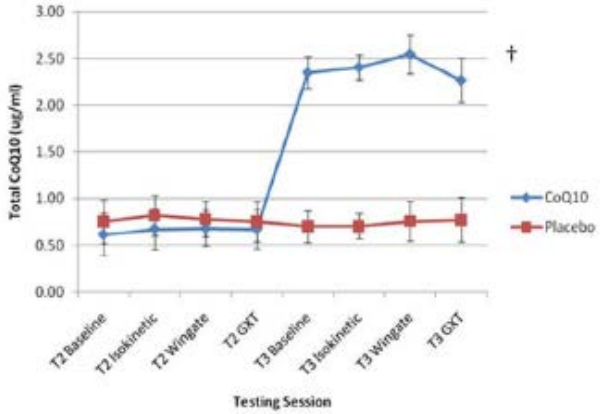
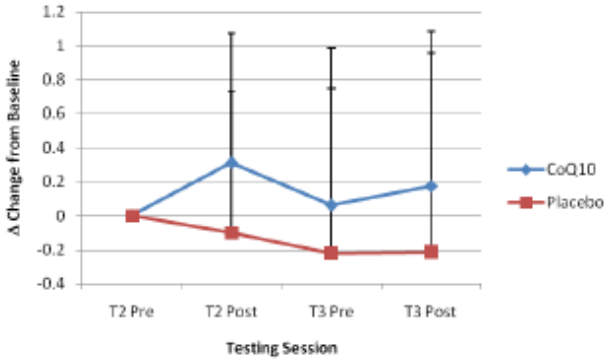
- In a DB – PC – R manner, 22 aerobically-trained and 19 untrained subjects ingested 200 mg/d of a placebo or CoQ10 for 14-d.
- Subjects completed an knee extension endurance test, an anaerobic capacity test, and a maximal CPXT test.
- Plasma CoQ10 levels were significantly increased following 2-wks while a trend for higher muscle CoQ10 levels was observed after acute ingestion.
- A trend for lower serum superoxide dismutase (SOD) was observed following acute supplementation whereas serum malondialdehyde (MDA) tended to be higher with CoQ10 supplementation.
- Plasma CoQ10 levels were correlated to muscle CoQ10; VO_2 max, and time to exhaustion.
- First study to show that CoQ10 can increase muscle CoQ10 levels in healthy individuals and influence exercise capacity.

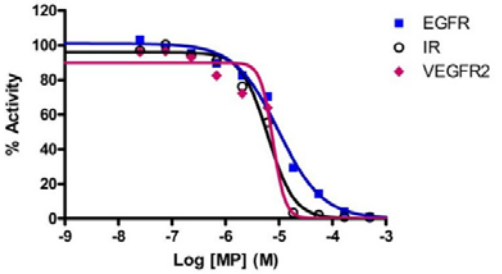




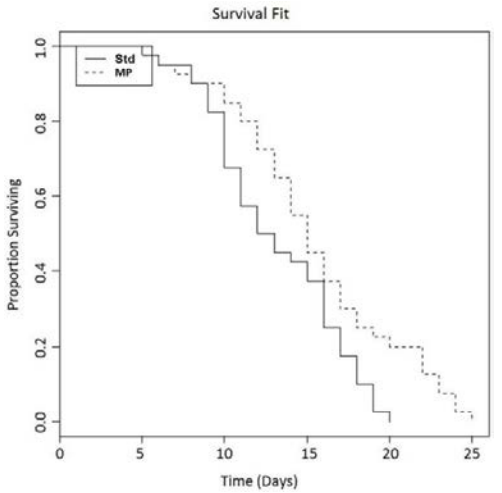
Bioactive properties and clinical safety of a novel milk protein peptide

Kreider et al. Nutri J. 10:99, 2011

- Milk protein fractions and peptides have been shown to have bioactive properties.
- This novel MP mixture inhibits the tyrosine kinase activity of epidermal growth factor receptor (EGFR), vascular endothelial growth factor receptor 2 (VEGFR2), and insulin receptor (IR).
- In vitro, this multi-kinase inhibitor causes apoptosis in HT-29 colon cancer cells, and in a C. elegans worm study, showed a weak but significant increase in lifespan.
- A six week double-blind, placebo-controlled study demonstrated that the MP mixture is safe to consume orally.
- There was some evidence of improved insulin sensitivity, neutrophil-to-lymphocyte ratio (NLR), and quality of life assessment of role of physical function.
- Additional research is warranted to assess potential anti-cancer benefits.



	EGFR	IR	VEGFR2
Hillslope	-1.059	-1.760	-3.797
IC_{50}	9.85μM	6.18μM	7.70μM



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Applied Research

Weight Loss

Weight Loss

Considerations

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- Rapid weight loss associated with reductions in FFM and REE while altering hormonal regulation of appetite and metabolism which makes it difficult to maintain weight loss.
- Goal should be to promote weight loss through diet and exercise while preventing loss of FFM and REE
- Weight loss programs typically involve caloric restriction and endurance exercise
- Resistance training can help maintain FFM during weight loss
- Diet and/or nutritional strategies may have differential affects on weight loss
- Need to identify effective weight maintenance strategies

Women's Health & Fitness Initiative

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

Established in 2002 to find ways to strengthen women through exercise and diet and provide research-based programs for Curves members

http://www.exerciseandsportnutritionlab.com/curves

Women's Health & Fitness Initiative

Completed and Current Studies

EXERCISE & SPORT NUTRITION LABORATORY
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- Curves I
- Curves II
- Curves Extension
- Curves Biomechanics
- Curves Exercise Intensity
- Curves Calcium
- Curves Special Populations (hypertension, diabetes, thyroid conditions, metabolic syndrome, etc.)
- Curves Elderly I
- Curves Osteoarthritis
- Curves Resistance Training (new equipment comparison)
- Curves in Middle Schools (2 studies)
- Curves Metabolism
- Curves Fit "Highly Trained Subjects"
- Curves/General Mills – RTE Meal Replacement
- Curves 30/30 Study
- Curves Web-Based Fitness Challenge Study
- Curves vs. WW
- Curves Complete vs. WW, JC, & NS
- Curves Elderly II - Nutrient Timing
- Curves Inflammation/Gene Expression
- Curves with Online Coaching
- Curves CIQ
- Curves Epigenetics I & II

http://www.exerciseandsportnutritionlab.com/curves

Women's Health & Fitness Initiative

Exercise & Diet Approach

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- Use of circuit-style resistance-exercise that promotes increases in energy expenditure and maintenance of FFM during weight loss
- Hypoenergetic higher protein/low fat meal plans
- Online monitoring and weekly coaching follow-up
- Social interaction and encouragement
- Scientifically tested and validated programs

http://www.exerciseandsportnutritionlab.com/curves

Training Program

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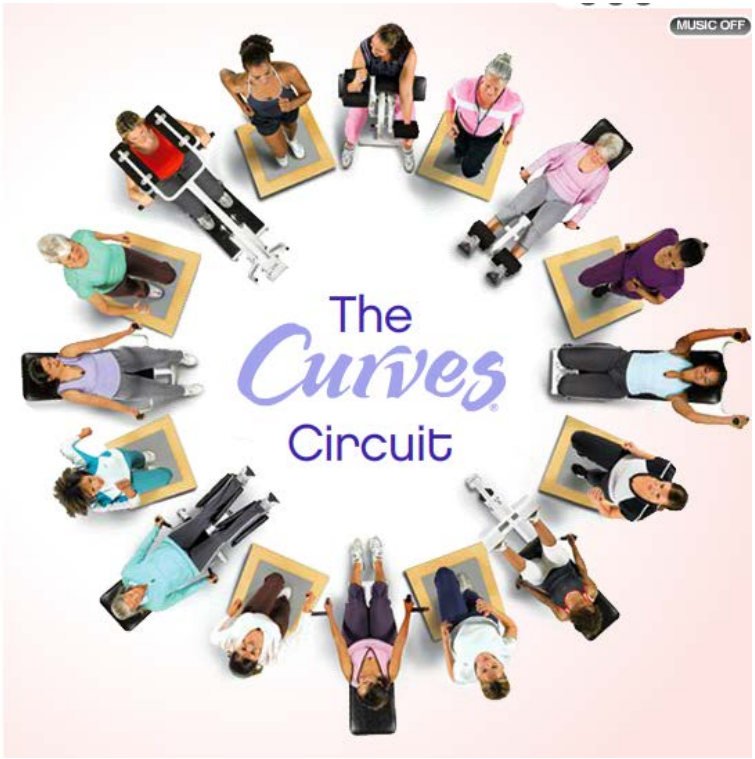
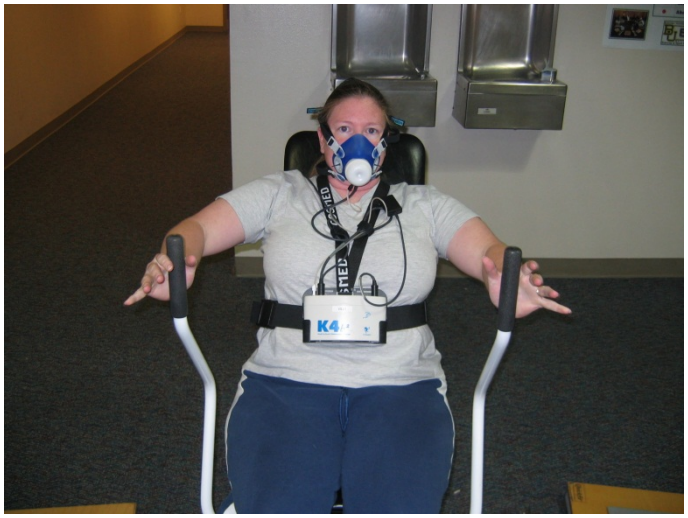
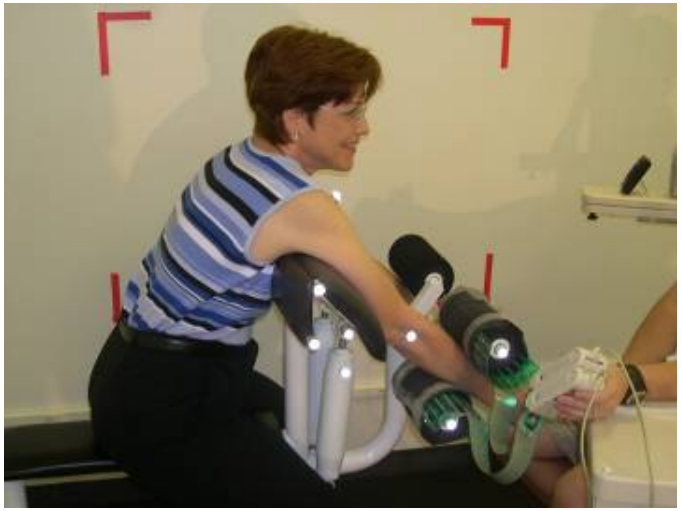


- Resistance exercises included:
  - Leg extension/curls
  - Shoulder Press/Lat Pull
  - Squat Push/Pull
  - Seated bench press/rows
  - Hip Adduction/Abduction
  - Abdominal Curl/Back Extension
  - Leg press
  - Arm curls/extensions
- Low impact calisthenics or Zumba® during recovery stations

Exercise Intensity

- Heart Rate Analysis (n=80)
  - Mean HR - 119±15 bpm
  - 79% max HR
  - 63% of HRR
- Biomechanical Analysis
  - 61% - 73% of 1RM
  - Reliability (r=0.71 to r=0.87)
- Metabolic Analysis
  - 63% VO_2 max (post-menopausal)
  - RER of 0.98
- Exercise intensity meets ACSM & NSCA guidelines





La Bounty et al. & Farris et al., FASEB J. LB93-94, 2006
Kreider et al. JSCR, 22(6):A77-78, 2008
Lockard et al., JSCR, In press, 2012

Curves Smart II

EXERCISE & SPORT NUTRITION LABORATORY
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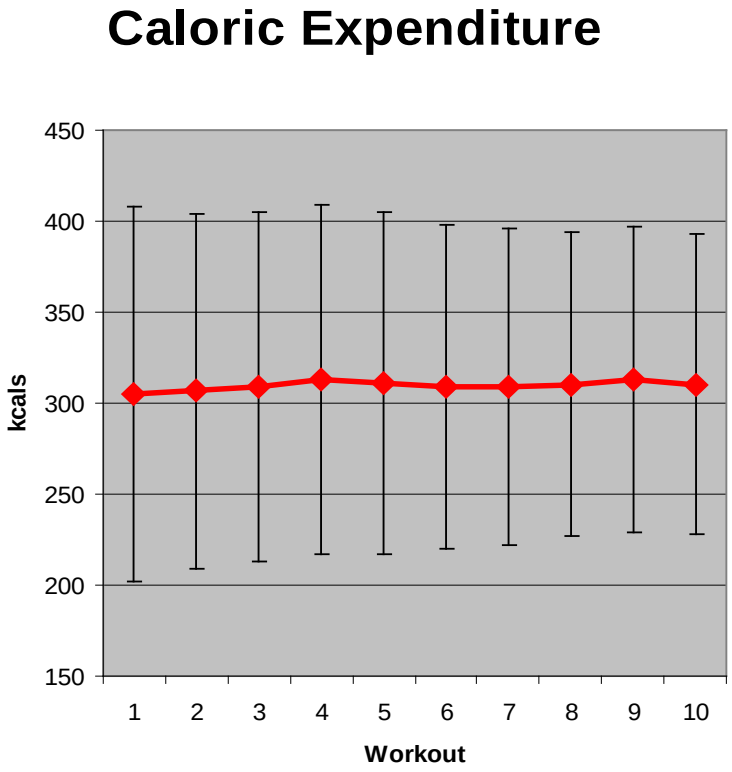

n = 1,031; 49.3±14 yrs; 174±40 lbs; 64.3±3 in

JSCR, 22(6):A69-70, 2008

- Average energy expenditure from first 10 workouts from 1,031 clients at 7 different clubs:

310±91 kcals

Curves Smart Intensity

EXERCISE & SPORT NUTRITION LABORATORY
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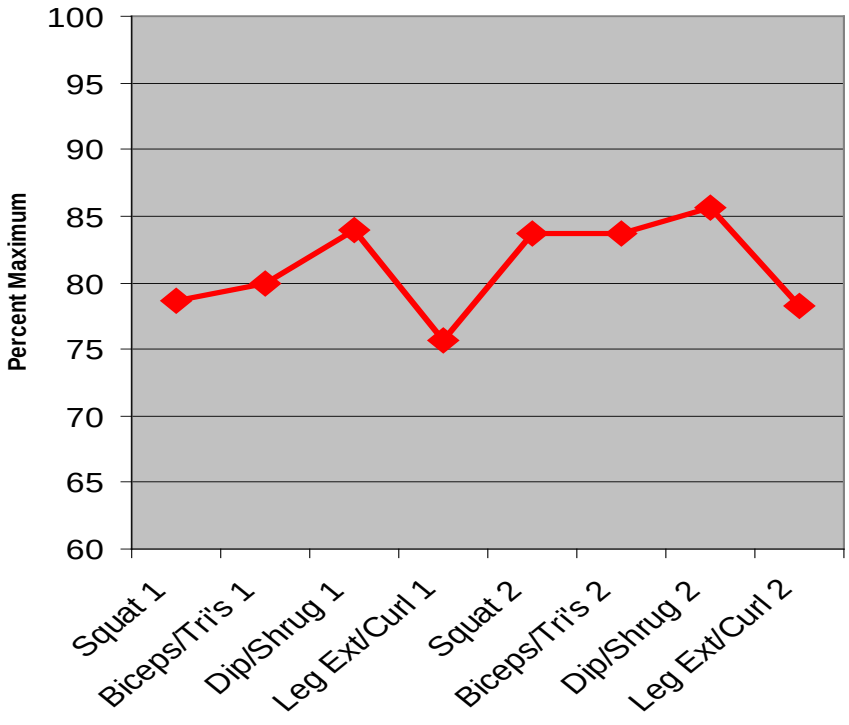
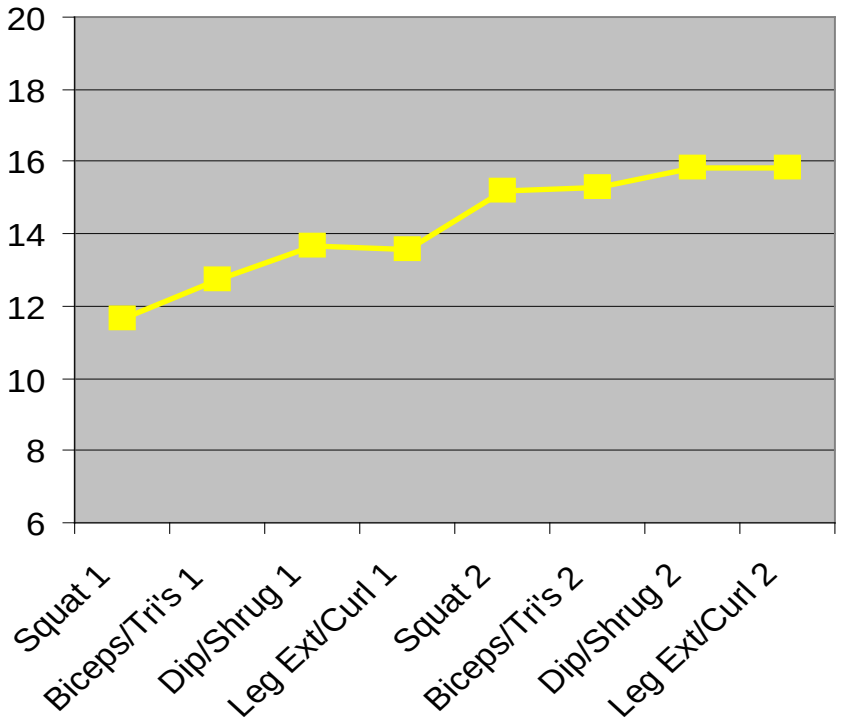
HR Intensity

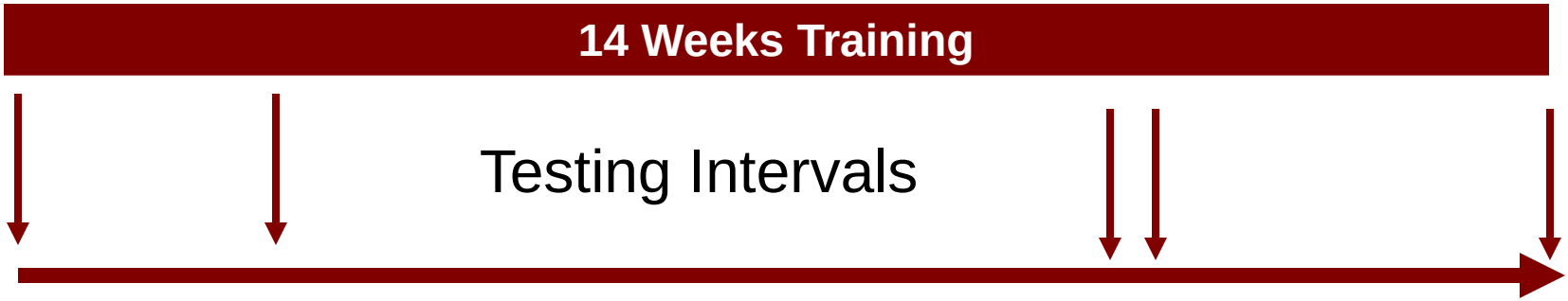


Rating of Perceived Exertion



n=48, 41±9 yrs, 65±2 inches, 191±35 lbs, 32±6 BMI, 42.9±5% fat, 13.55±7 weeks of training

Curves I



2 Wk
1,200 kcal/d

8 Wk
1,600 kcal/d

4 Wk
2,600 kcal/d

Intermittent
2d @ 1,200 kcal/d

CON, ND, HED, VLCHP, LCMP, HCLPD Groups

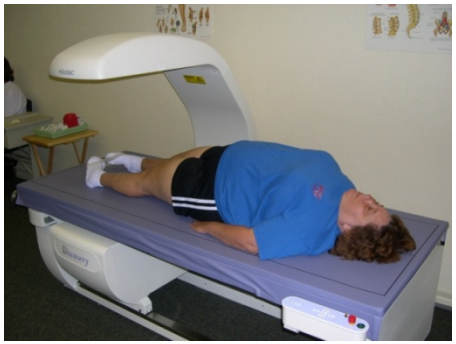
n = 161
38.5±8.5 yrs
94.2±18.8 kg
164.2±6.7 cm
34.9±6.4 kg/m^2
43.8±4.2% BF

Nutri Metabol. 6/1/23, 2009

- At ***0, 2, 10, 10.4, & 14 W***:
  - *Dietary Records* (4-d)
  - *Psychometric Tests*
  - *Body Composition/Bone Density* (DEXA)
  - *Total Body Water* (BIA)
  - *Hip & waist measurement*
  - *Resting HR & BP*
  - *Fasting Blood Samples* (12h)
  - *Resting Energy Expenditure* (REE)

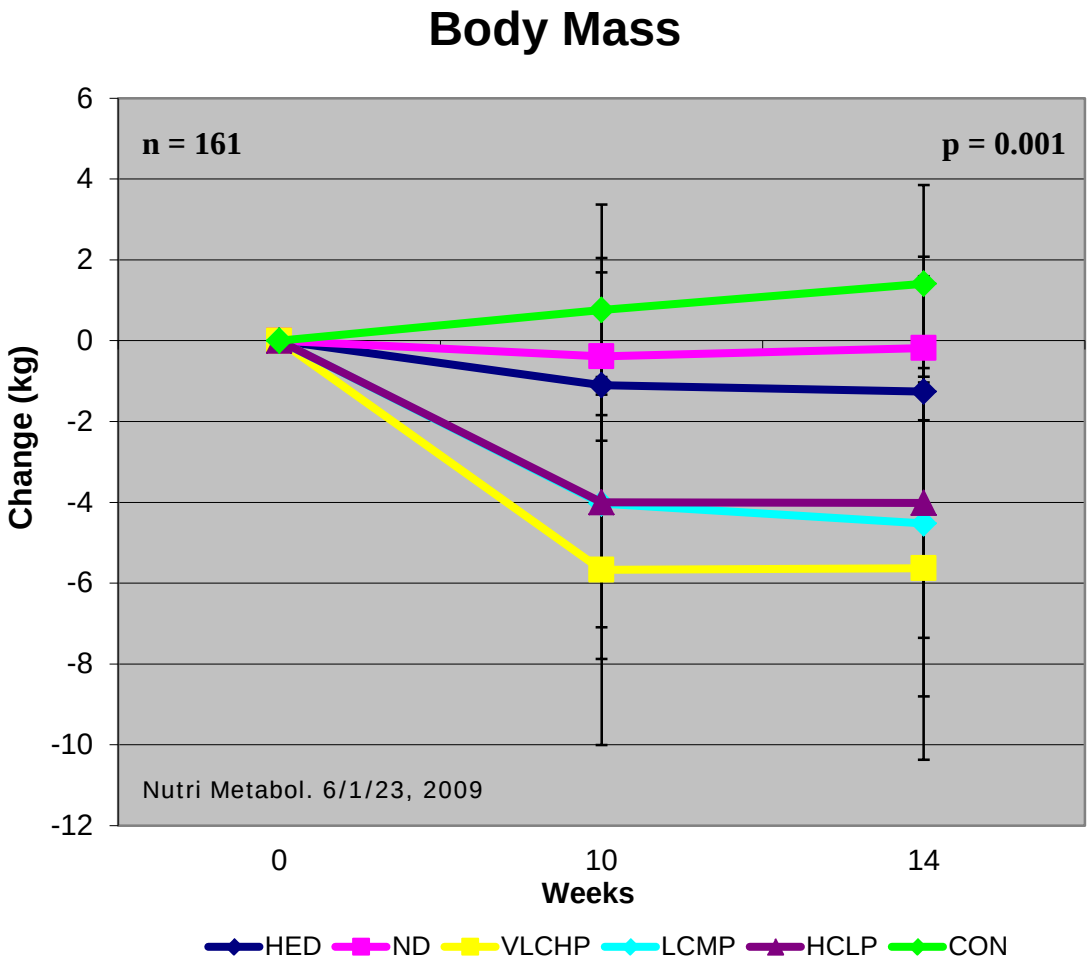
- At ***0, 10, & 14 wks:***
  - *Maximal Stress Test*
  - *1RM Bench Press*
  - *80% of 1RM on Bench Press*
  - *1RM Leg Press*
  - *80% of 1RM on Leg Press*
- Side effects were monitored by an RN on a weekly basis

Curves I

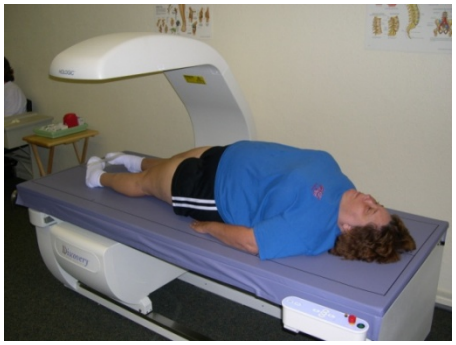


Greater weight loss in diet groups

VHP group slightly better

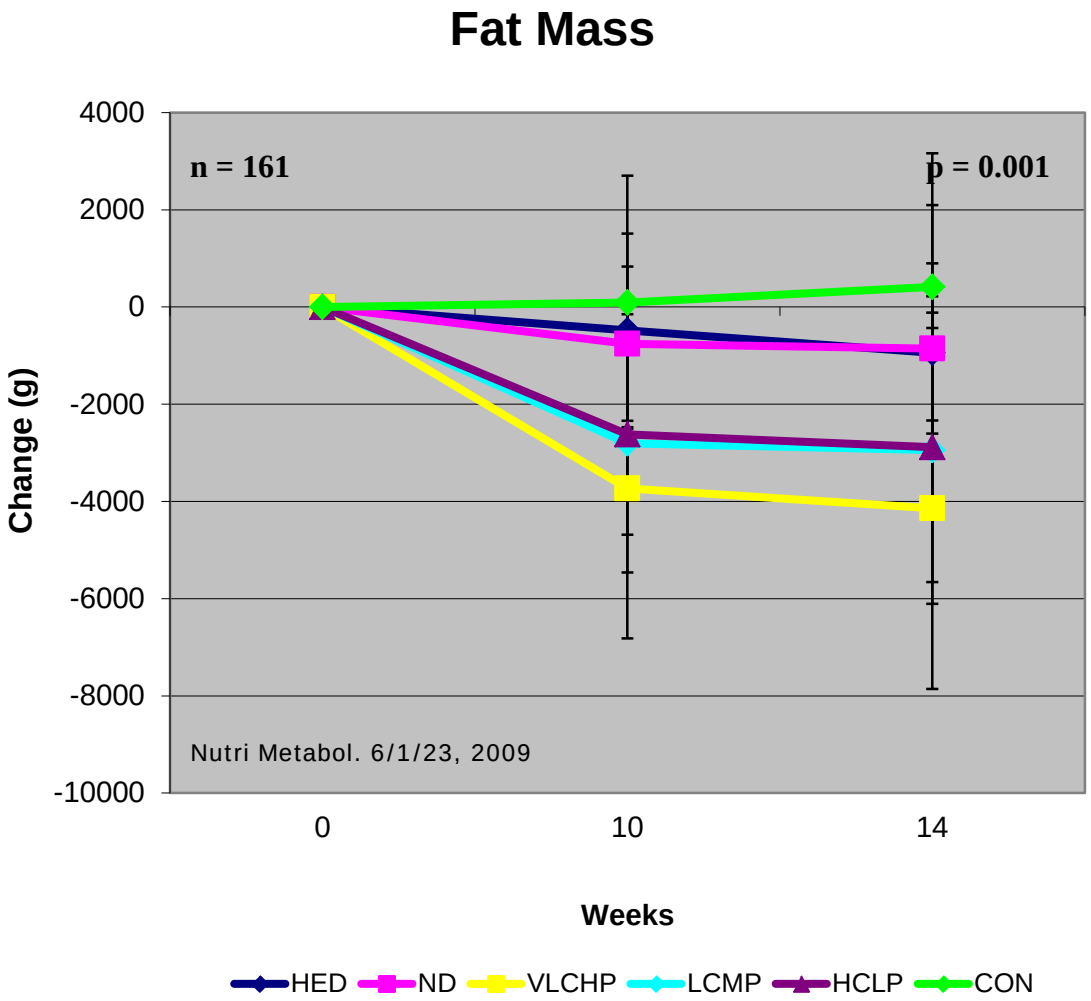


Curves I

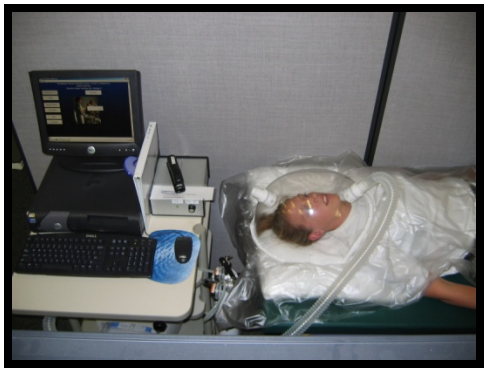


Fat loss in all exercise & diet groups

Slightly better fat loss in VHP group

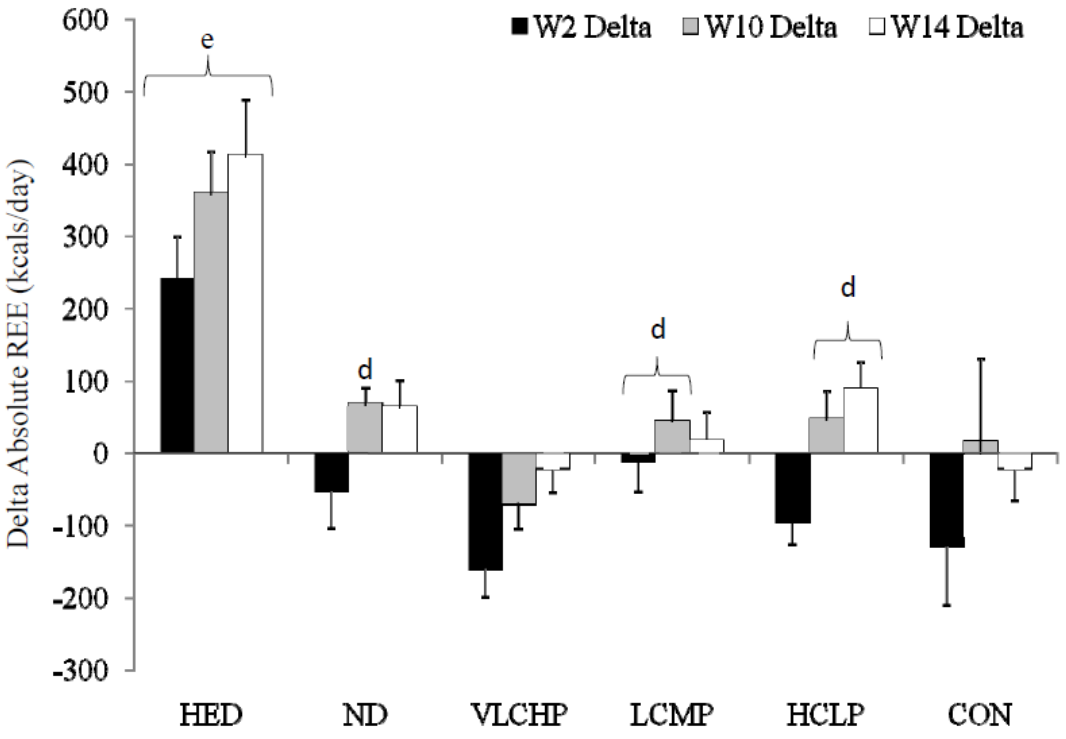


Curves I



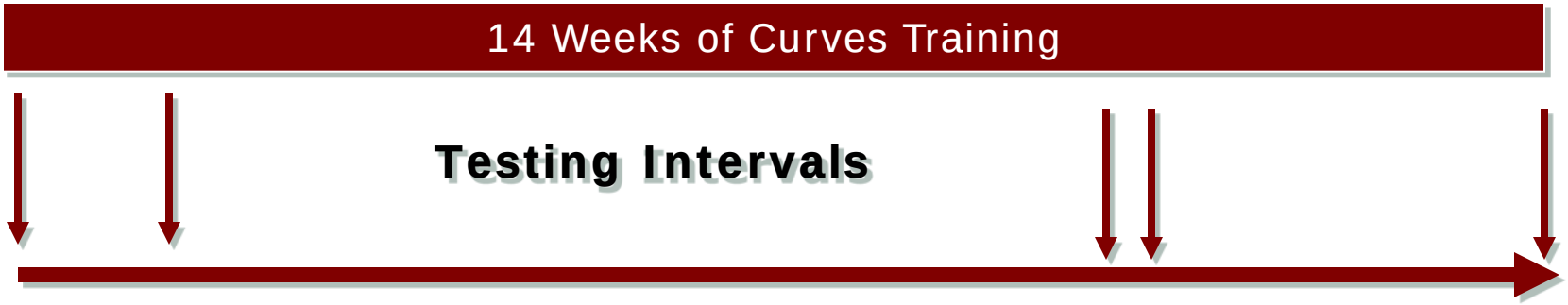
REE increased in HED group

REE maintained after 2 wk diet phase



Nutri Metabol. 6/1/23, 2009

Curves II



Control, EX Only, HCHO, MHP, VHP, HCD Diets

n = 141
38.7±8 yrs
35.0±6 kg•m^{-2}
44.8±4% fat

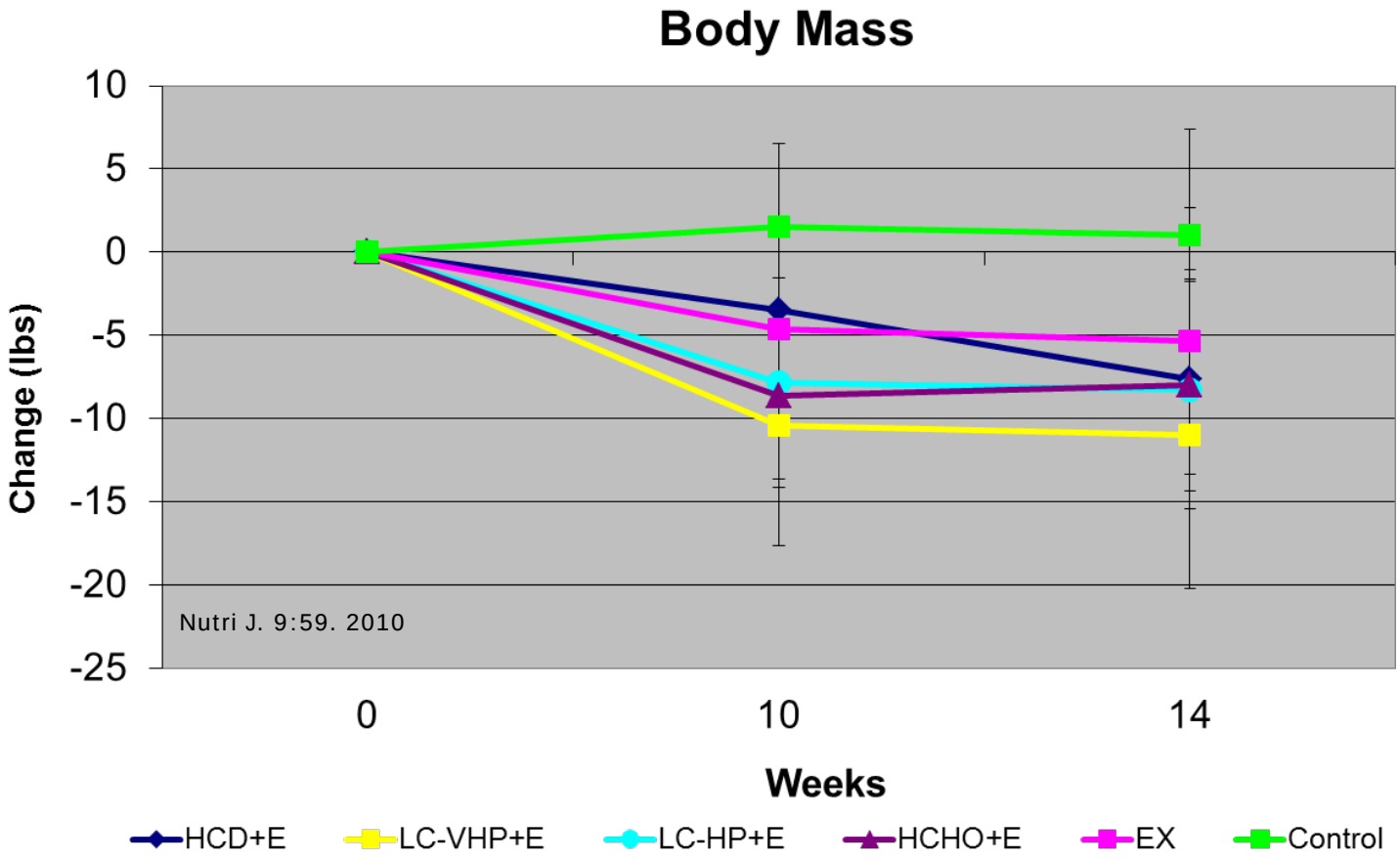
At ***0, 1, 10, 10.4, & 14 W***:
- ***Dietary Records*** (4-d)
- ***Psychometric Tests***
- ***Body Comp/Bone Density*** (DEXA)
- ***Total Body Water*** (BIA)
- ***Hip & waist measurement***
- ***Resting HR & BP***
- ***Fasting Blood Samples*** (12h)
- ***Resting Energy Expenditure*** (REE)

At ***0, 10, & 14 wks:***
- ***Maximal Stress Test***
- ***1RM Bench Press***
- ***80% of 1RM on Bench Press***
- ***1RM Leg Press***
- ***80% of 1RM on Leg Press***

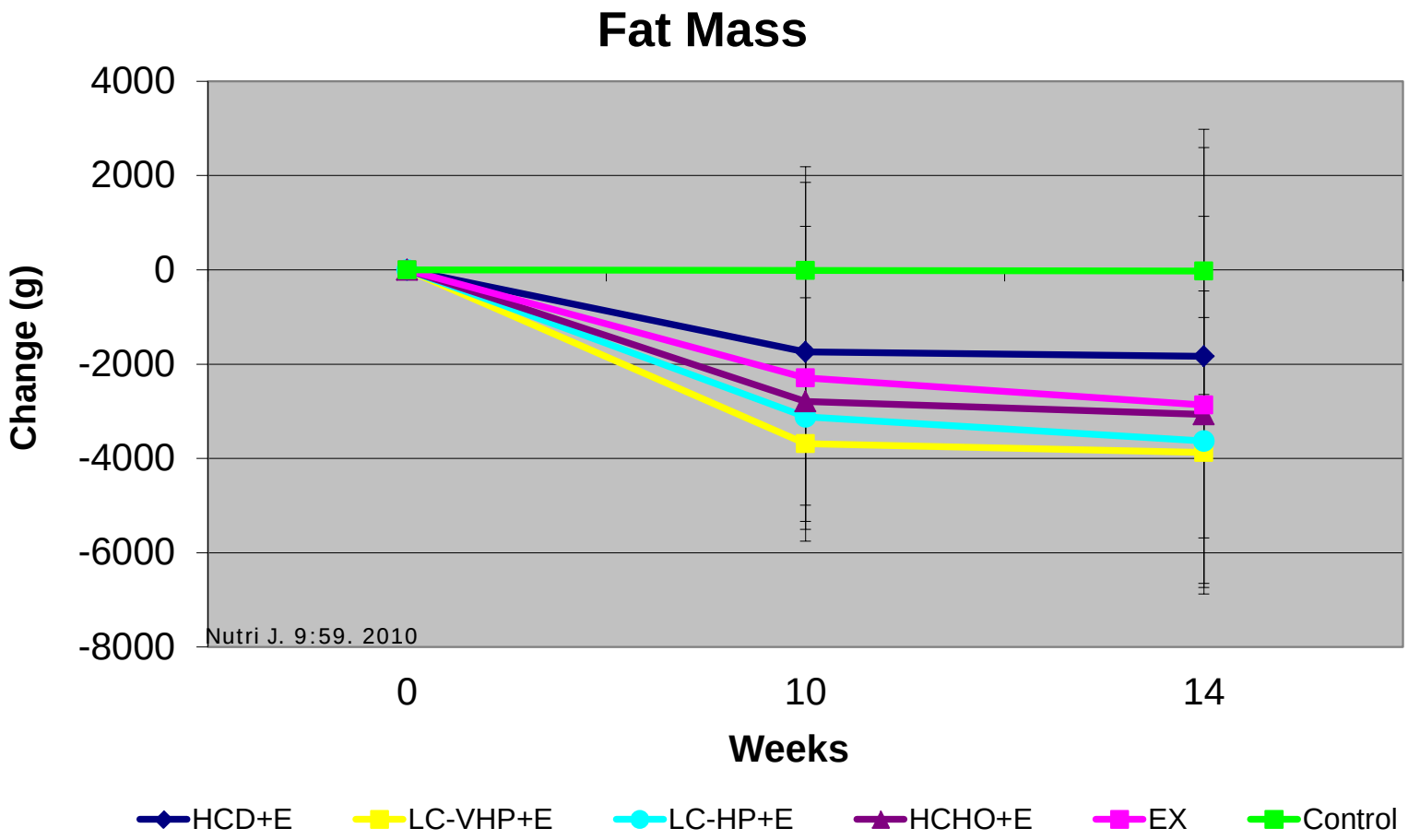
Side effects were monitored by an RN on a weekly basis

Nutri J. 9:59. 2010

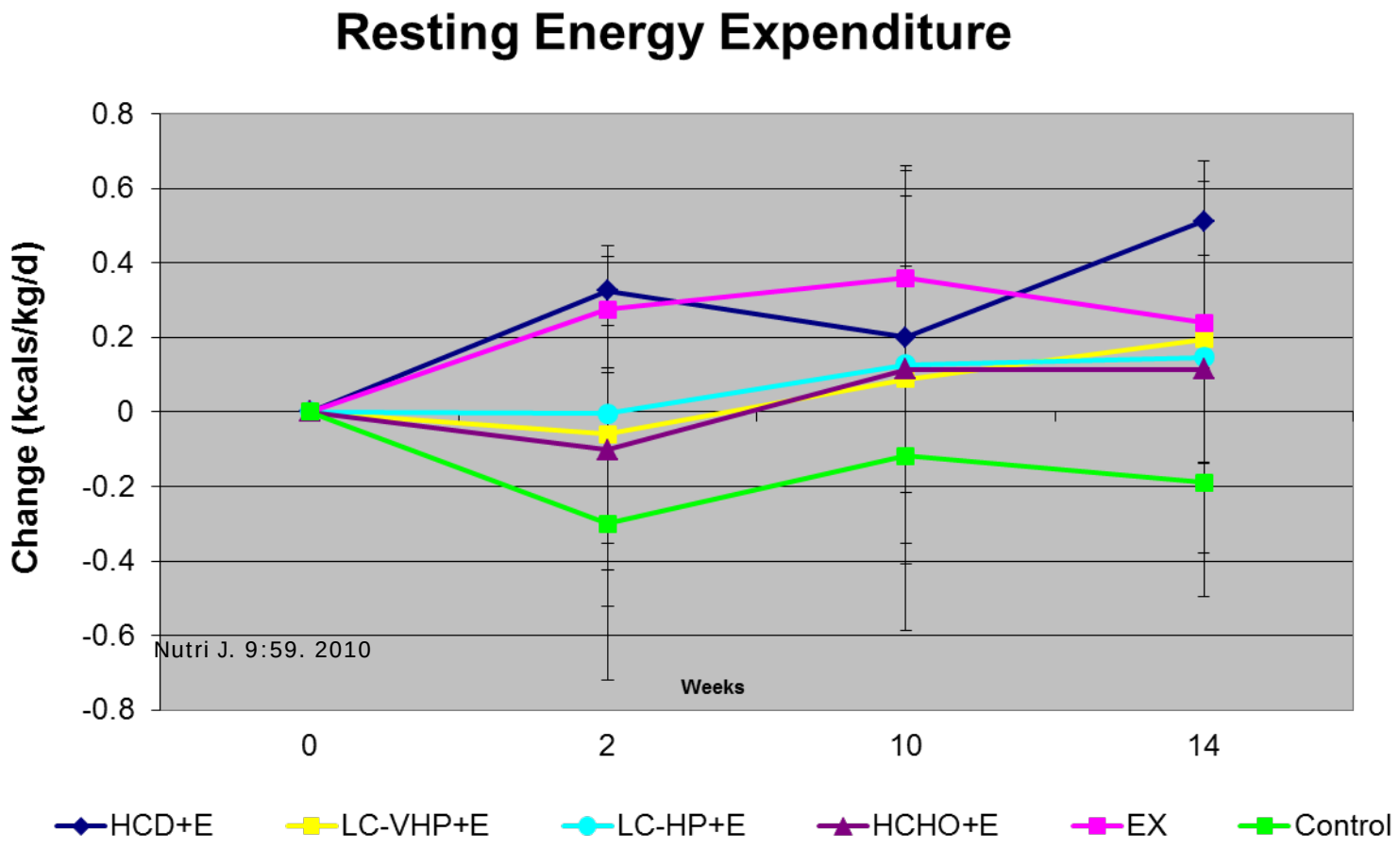
Curves II


Body Mass
10
5
0
-5
-10
-15
-20
-25
Change (lbs)
Nutri J. 9:59. 2010
0
10
14
Weeks
HCD+E
LC-VHP+E
LC-HP+E
HCHO+E
EX
Control

Curves II


Fat Mass
4000
2000
0
-2000
-4000
-6000
-8000
Change (g)
Nutri J. 9:59. 2010
0
10
14
Weeks
HCD+E
LC-VHP+E
LC-HP+E
HCHO+E
EX
Control

Curves II


Resting Energy Expenditure
Change (kcals/kg/d)
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
Nutri J. 9:59. 2010
Weeks
0
2
10
14
HCD+E
LC-VHP+E
LC-HP+E
HCHO+E
EX
Control

Curves II

Variable	Impact of Curves
Maximal Aerobic Capacity	↑ (7%)
Maximal Strength (BP & LP)	↑ (10%)
Hip & Waist Circumference	↓ (1.5 - 2”)
Resting DBP	↓ (4%)
Total Cholesterol	↓ (4% during diet)
LDL Cholesterol	↓ (3% during diet)
Triglycerides	↓ (12%)
Leptin	↓ (18% during diet; 17% overall)
Fasting Insulin	↓ (19% during diet; 15% overall)
Insulin Sensitivity	19% Improvement

Nutri J. 9:59. 2010

A Carbohydrate-Restricted Diet During Resistance Training Promotes More Favorable Changes in Body Composition and Markers of Health in Obese Women with and Without Insulin Resistance

Kreider et al. Physician and Sportsmedicine. 32:2, May 2011.

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- 221 obese women participated in a 10-wk weight loss and exercise program
- Subjects were prescribed low-fat (30%) isoenergetic diets that consisted of 1200 kcals per day for 1 week and 1600 kcals per day for 9 weeks with HC or HP.
- Subjects were retrospectively stratified into lower (LH) or higher (HH) than 3.5 HOMA groups.
- A HP diet promoted more favorable changes in weight loss, fat loss, and markers of health in obese women who initiated an exercise program compared with a HC diet.
- ***Subjects with HH levels, experienced greater reductions in BG on a HP diet***

Effects of exercise and diet-induced weight loss on markers of inflammation II: impact on microRNA 21 and microRNA 146a expression and their regulatory role

Simbo et al., JISSN, 2013; 10(Suppl 1): P24..

EXERCISE & SPORT NUTRITION LABORATORY
TEXAS A&M UNIVERSITY

- Forty-five overweight and sedentary women (48.16±10.5 yr, 45.9±4.4% body fat, BMI 35.6±5.6 kg/m2) were randomized into a control group (C, n=18) or an exercise and diet-induced weight loss group (EX, n=27).
- Participants followed an energy-restricted diet (1,200 kcal/d for 1 week and 1,500 kcal/d for 11weeks; 30% CHO, 45% P, and 25% F) while participating in a circuit resistance-training (3d/wk) program.
- MicroRNA (21 and 146a) and mRNA of IL-6, TNF-a, (PTEN, TRAF6)/PI3k/AKT/NF-kB signaling pathway expression levels were measured in serum/WBC by real-time RT-PCR.
- ***Exercise and diet-induced weight loss affects molecular changes in circulating microRNAs, significantly affects microRNA 21 and its target gene PTEN, mRNA TNF-a, and mRNA IL-6 levels suggesting a anti-inflammatory response compared to a control group.***

Retrospective Analysis of Protein- and Carbohydrate-Focused Diets Combined with Exercise on Metabolic Syndrome Prevalence in Overweight and Obese Women.

Lockard et al. Metab Syndr Relat Disord. 2015 Nov 10.

EXERCISE & SPORT NUTRITION LABORATORY
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- We retrospectively analyzed effect of protein-focused (PRO, 1.14 g/kg/day) and carbohydrate-focused (CHO, ~2.2 g/kg/day) diets (~1600 kcals) combined with 10 weeks of circuit exercise training in sedentary overweight/obese women (***N = 661, age 46 ± 11 years***) on metabolic syndrome (MetS).
- Primary (MetS), secondary (MetS z-scores and individual MetS components), and tertiary outcomes [BMI by WHO cut points] were analyzed using chi-square, GLM, and McNemar's tests.
- ***Both groups experienced significant weight loss, improvements in fitness, and reductions in MetS prevalence from baseline to follow-up*** (PRO: 49% to 42%, CHO: 42% to 36%, both $P < 0.01$).
- MetS z-score improvement (~66.5%) was similar for both groups.
- ***No significant differences for waist circumference*** (-0.28 ± 0.02 vs. -0.28 ± 0.025 cm, $P = 0.97$), glucose (-0.07 ± 0.03 vs. -0.08 ± 0.04 mM, $P = 0.87$), triglycerides (-0.16 ± 0.04 vs. -0.09 ± 0.04 mM, $P = 0.20$), high-density lipoprotein cholesterol (-0.21 ± 0.03 vs. -0.19 ± 0.04 mM, $P = 0.68$), and systolic BP (-0.16 ± 0.4 vs. -0.24 ± 0.05 mmHg, $P = 0.26$).
- DBP showed a minor advantage for the PRO group (-0.14 ± 0.05 vs. -0.30 ± 0.05 mmHg $P = 0.02$).
- When stratified by BMI, those with morbid obesity did not show a significant improvement in MetS while following a PRO-focused diet.
- ***Low-moderate calorie diet partitioned for CHO and PRO is equally effective when combined with a structured exercise program for reducing the prevalence of MetS prevalence in overweight women.***

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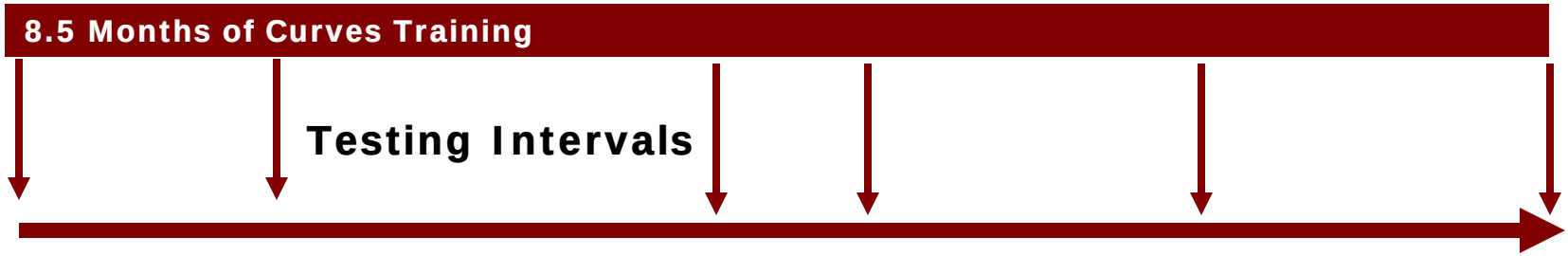
Comparative Effectiveness Trials

Comparative Effectiveness Trial I



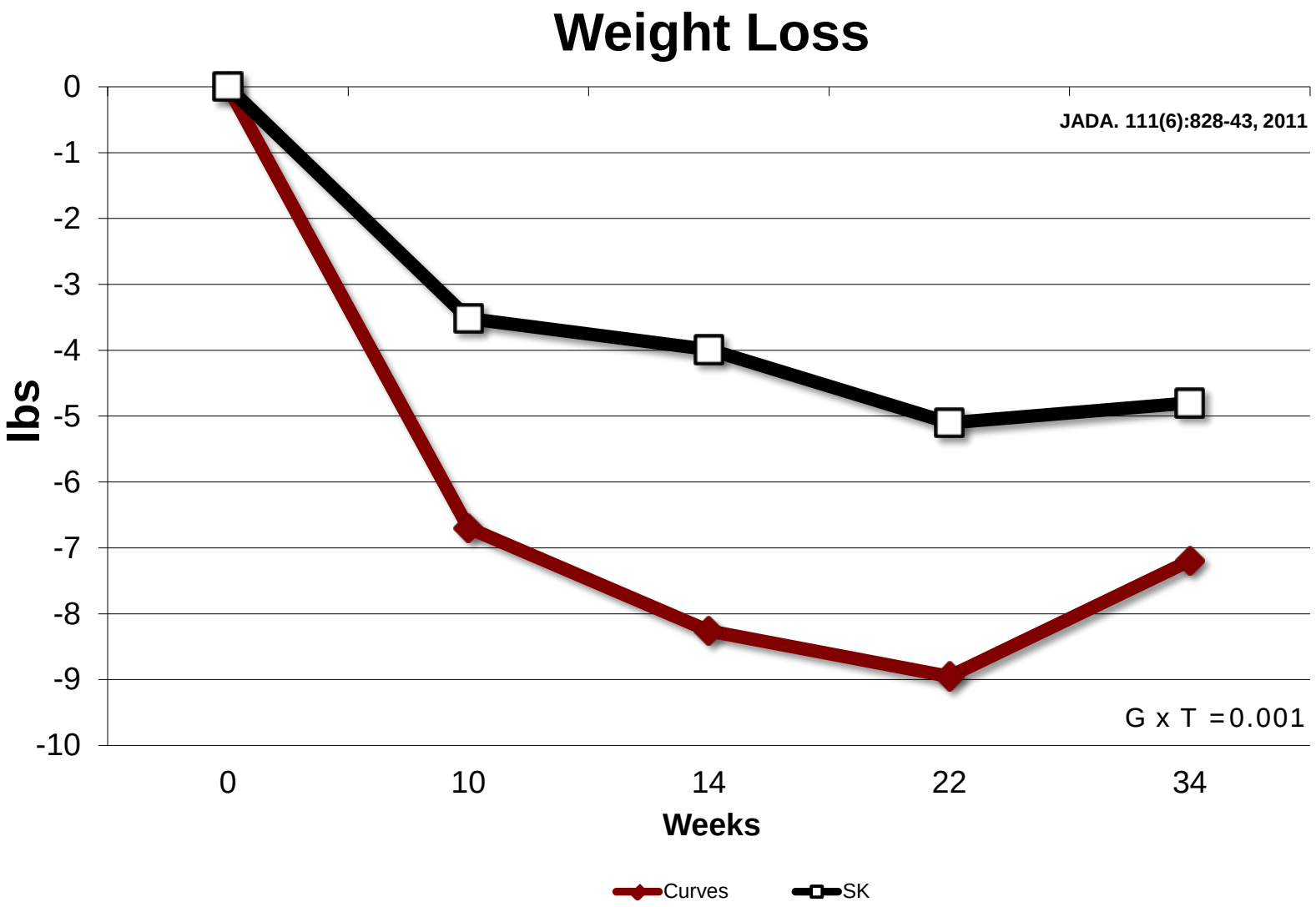
Curves/GM Program (HCHO) versus Special K® Weight Loss Program

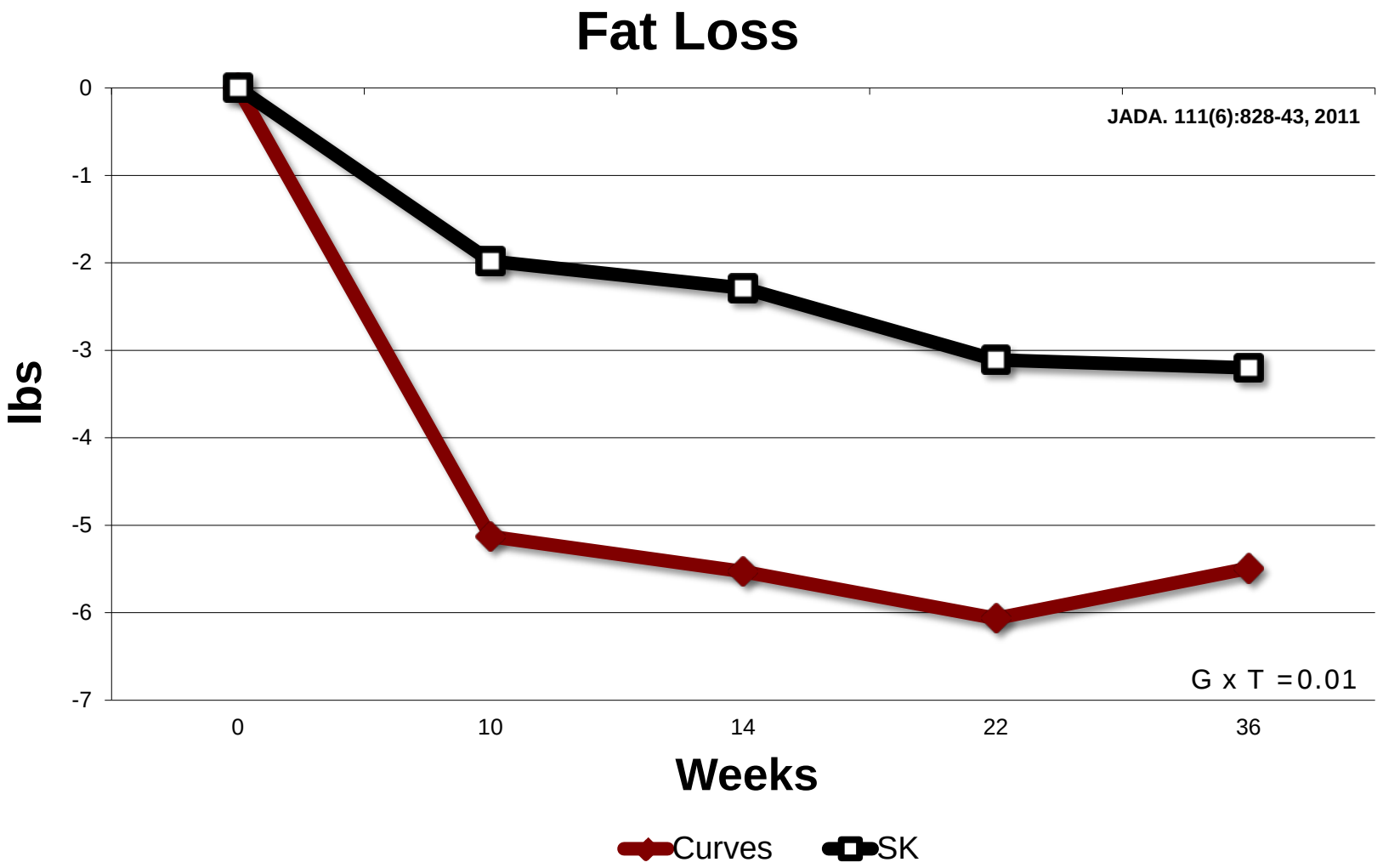
N=77
42.6±10 yrs
89±14 kg
33.5±5 kg/m2
44.1±4 % fat

- At ***0, 2, 10, 14, 22, 34 W***:
  - ***Dietary Records*** (4-d)
  - ***Psychometric Tests***
  - ***Body Composition/Bone Density*** (DEXA)
  - ***Total Body Water*** (BIA)
  - ***Hip & waist measurement***
  - ***Resting HR & BP***
  - ***Fasting Blood Samples*** (12h)
  - ***Resting Energy Expenditure*** (REE)

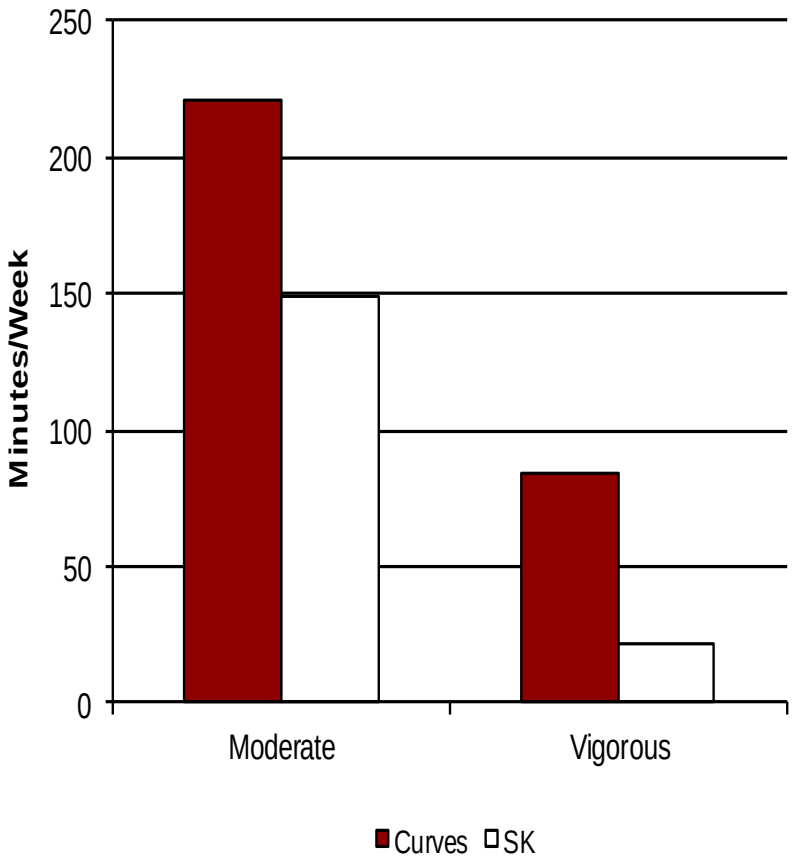
- At ***0, 10, 14, 22, 34 W :***
  - ***Maximal Stress Test***
  - ***1RM Bench Press***
  - ***80% of 1RM on Bench Press***
  - ***1RM Leg Press***
  - ***80% of 1RM on Leg Press***
- Side effects were monitored by an RN on a weekly basis

JADA. 111(6):828-43, 2011

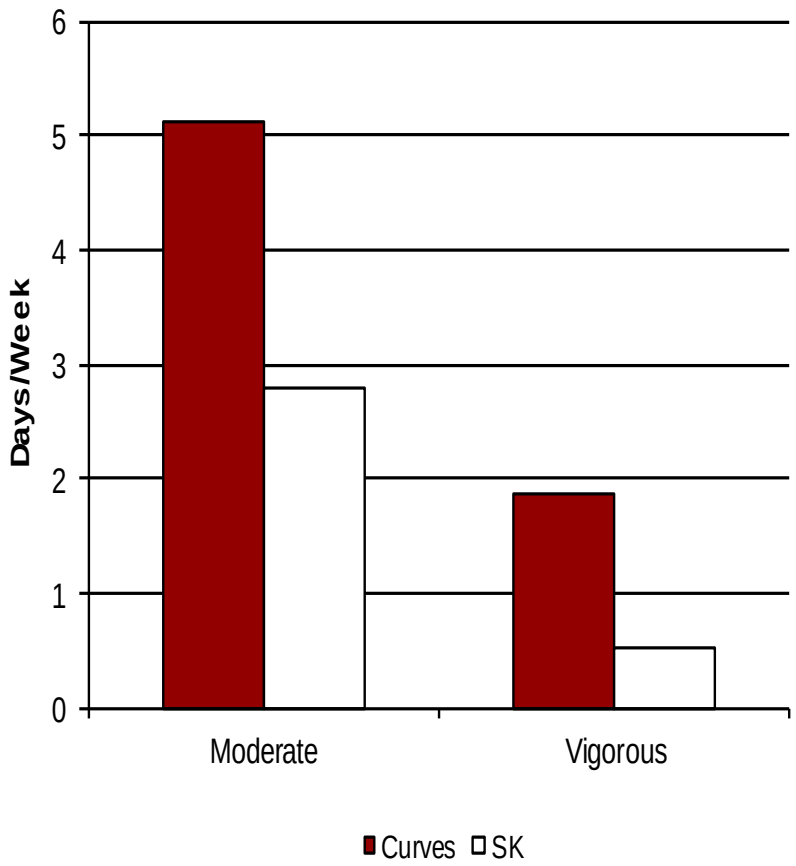

Weight Loss
JADA. 111(6):828-43, 2011
lbs
0
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
G x T =0.001
0
10
14
22
34
Weeks
Curves
SK


Fat Loss
JADA. 111(6):828-43, 2011
lbs
0
-1
-2
-3
-4
-5
-6
-7
G x T = 0.01
0
10
14
22
36
Weeks
Curves
SK

Physical Actvity

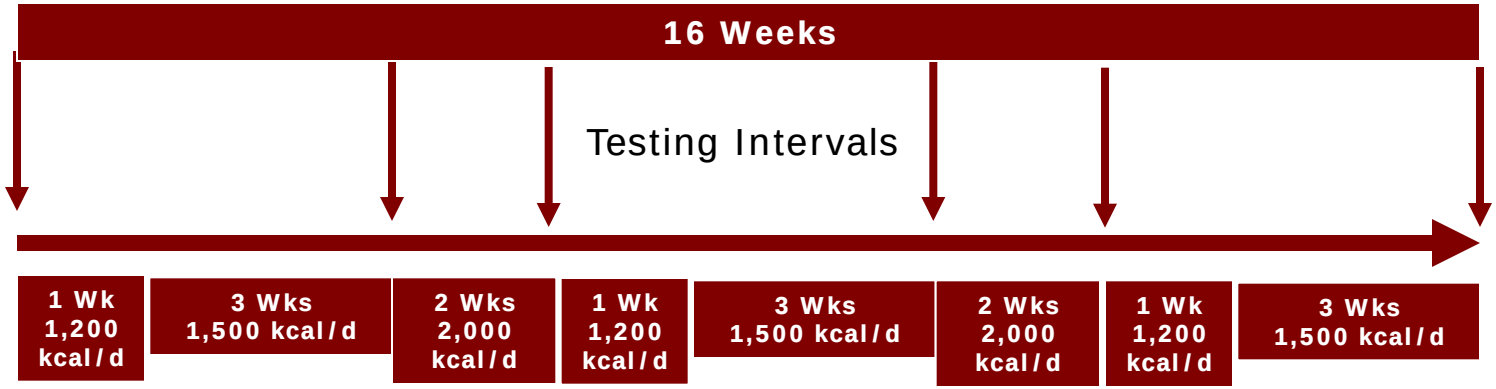


Physical Activity



JADA. 111(6):828-43, 2011

Comparative Effectiveness Trial II



Curves with Zumba (I & II 30:45:25; III 45:30:25)
Weight Watchers Program & Counseling

N=51
35±8 yrs
90±14 kg
47±7% fat
34±5 kg/m^2

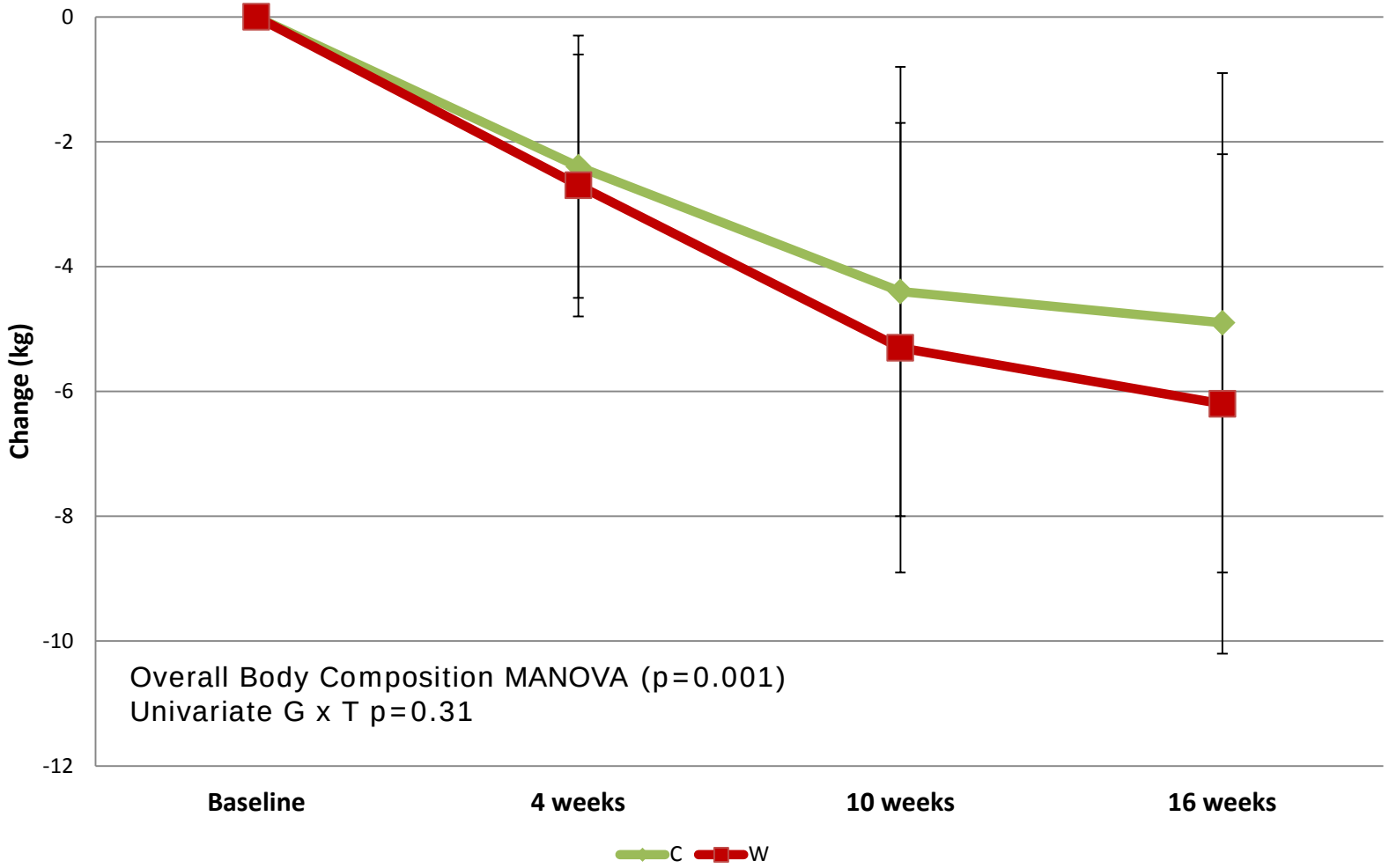
- At ***0, 4, 6, 10, 12, 16 W***:
  - ***Dietary Records*** (4-d)
  - ***Psychometric Tests***
  - ***IPAQ***
  - ***Body Composition/Bone Density*** (DEXA)
  - ***Total Body Water*** (BIA)
  - ***Hip & waist measurement***
  - ***Resting HR & BP***
  - ***Fasting Blood Samples*** (12h)
  - ***Resting Energy Expenditure*** (REE)

- At ***0 & 16W:***
  - ***Maximal Stress Test***
  - ***1RM Bench Press***
  - ***80% of 1RM on Bench Press***
  - ***1RM Leg Press***
  - ***80% of 1RM on Leg Press***
- Side effects were monitored by an RN on a weekly basis

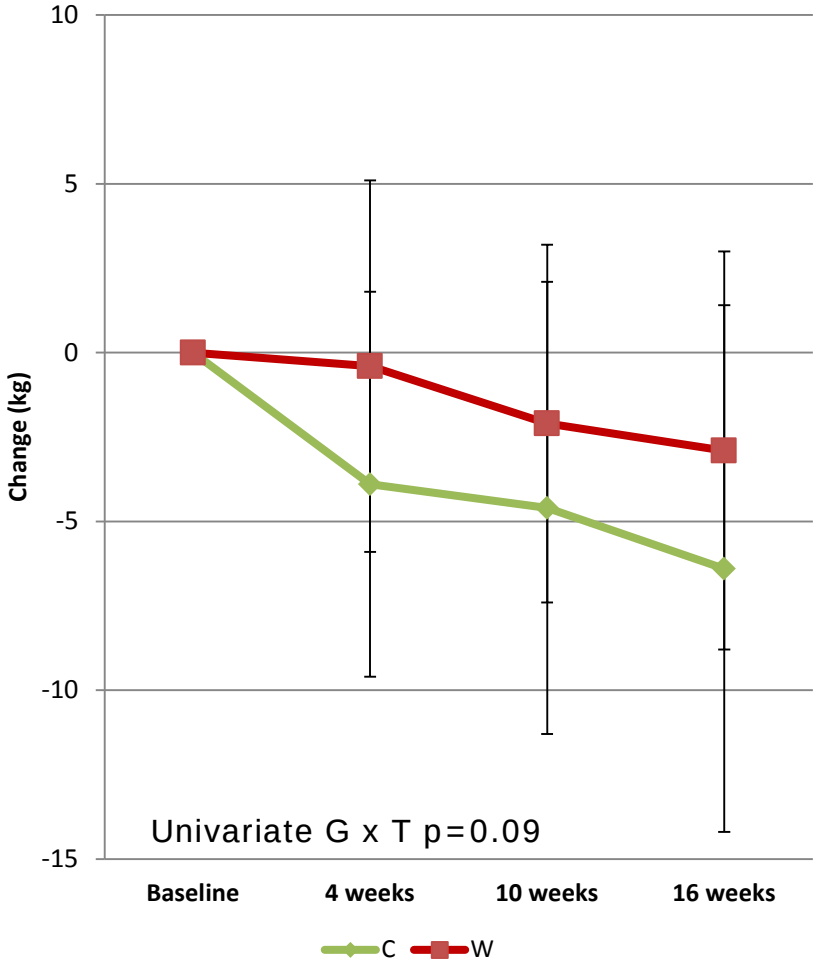
Mardock, et al., JISSN, 8(Suppl 1):P4, 2011

Weight Loss

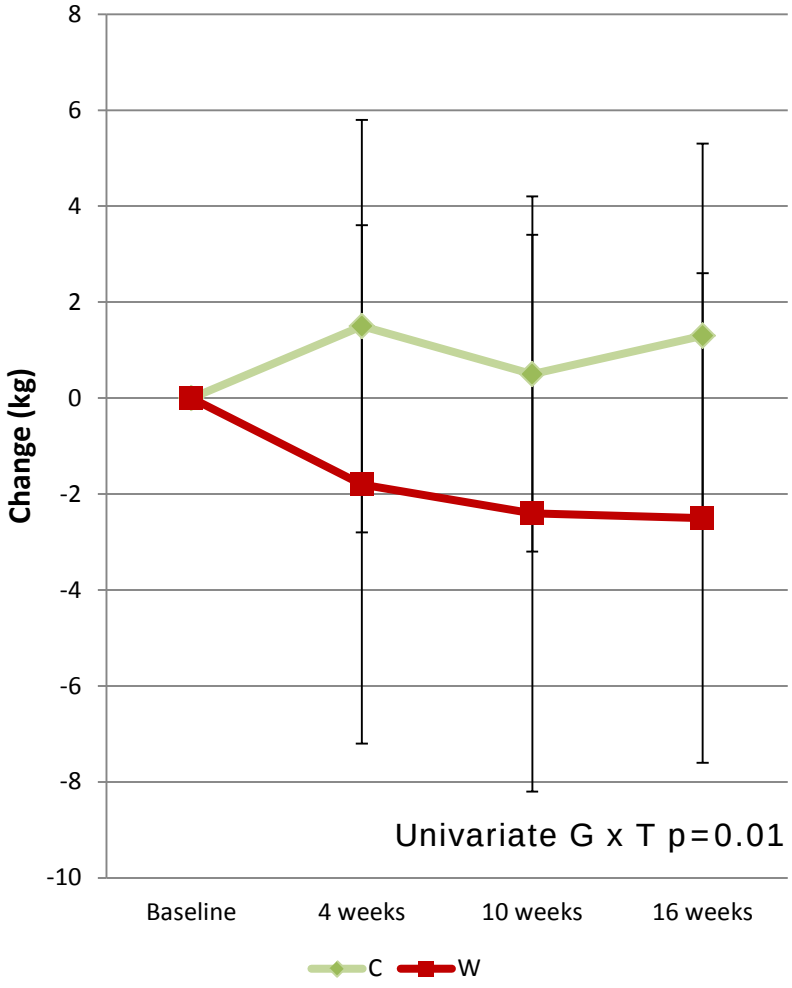
Mardock, et al., JISSN, 8(Suppl 1):P4, 2011



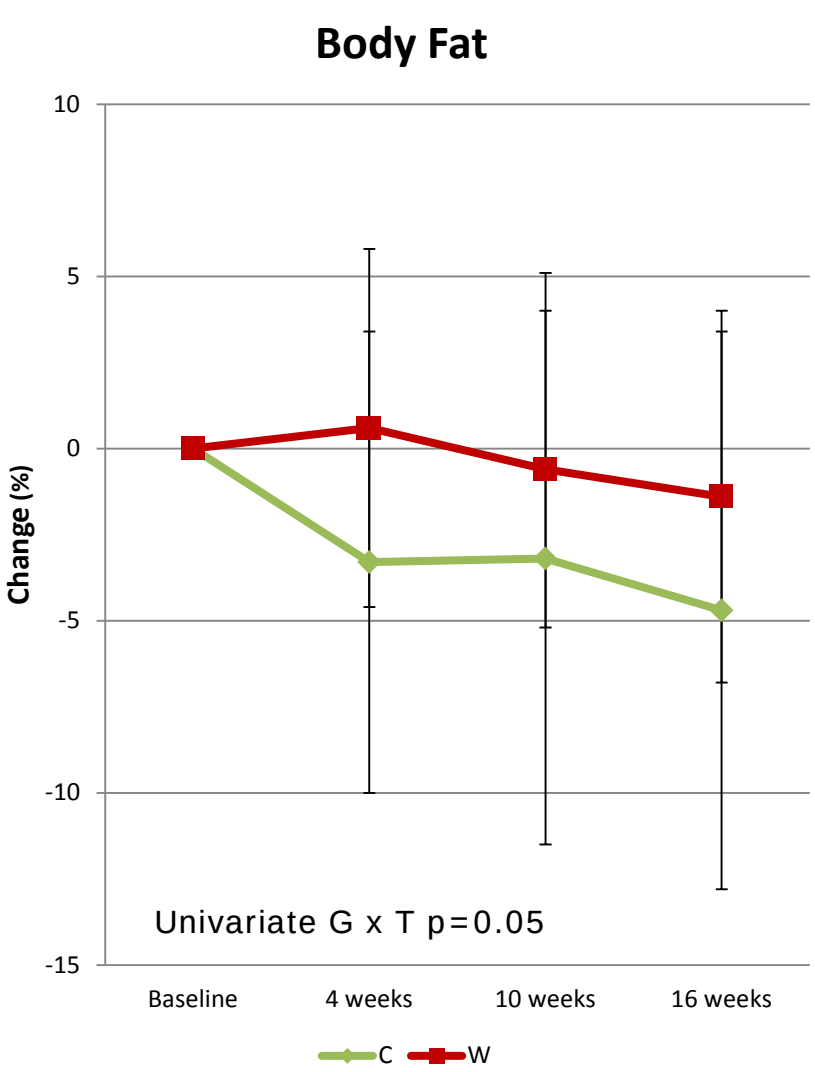
Fat Loss

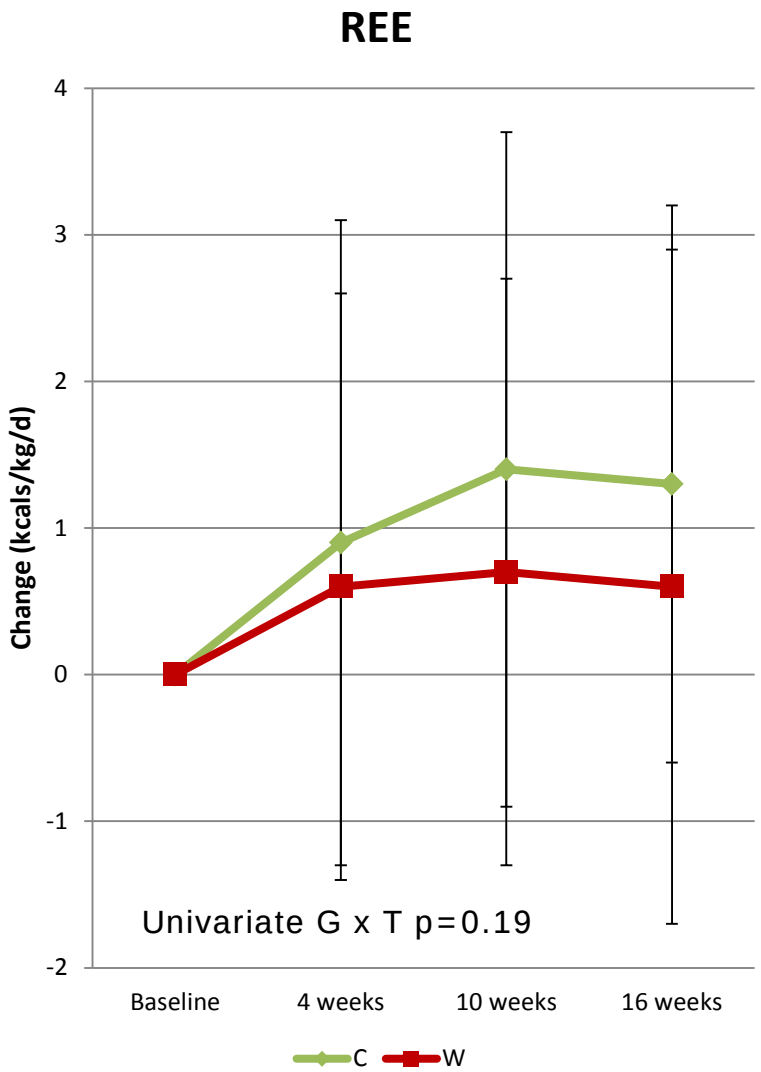


Fat Free Mass



Mardock, et al., JISSN, 8(Suppl 1):P4, 2011

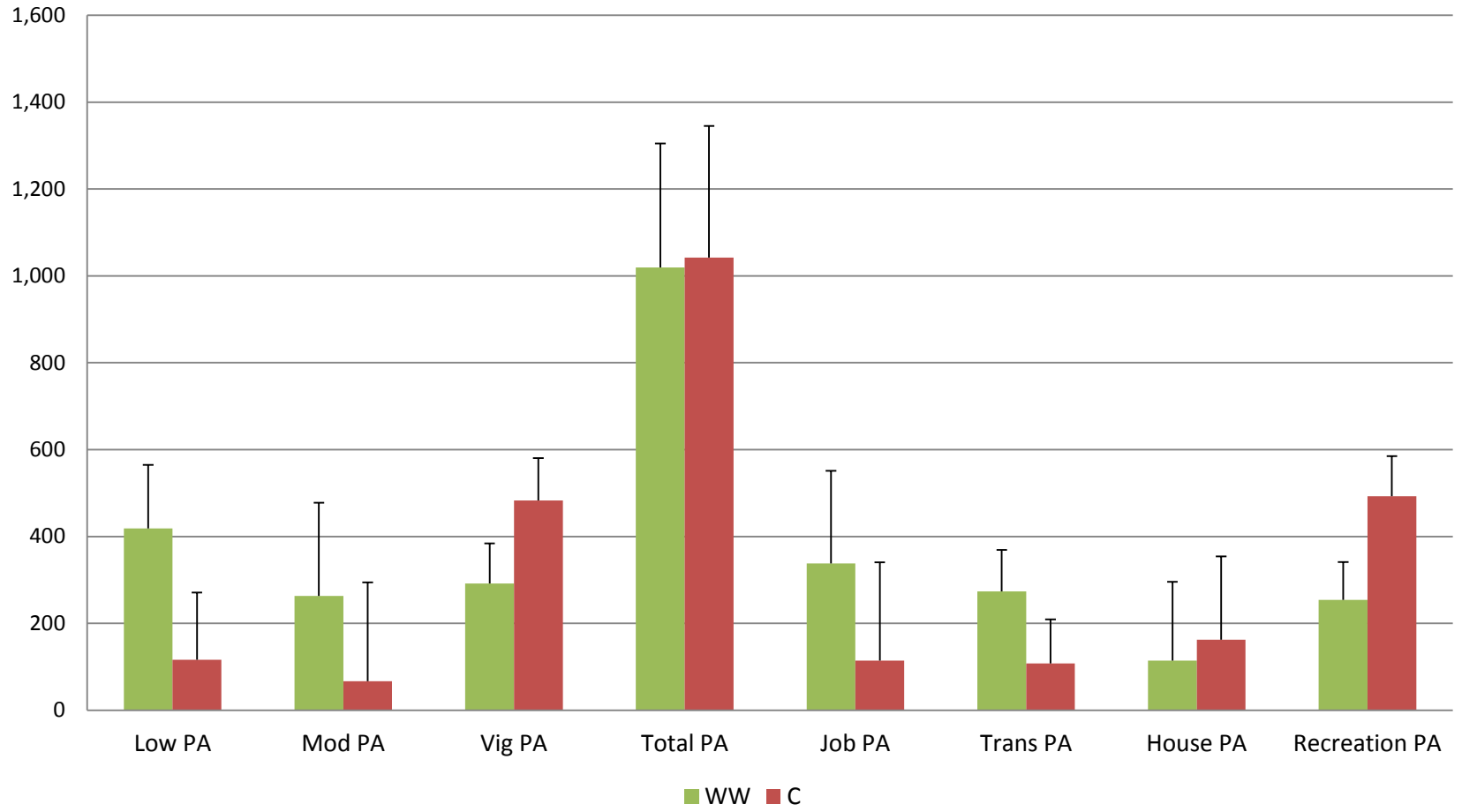




Mardock, et al., JISSN, 8(Suppl 1):P4, 2011

Physical Activity

(MET mins/wk)



Mardock, et al., JISSN, 8(Suppl 1):P4, 2011

Comparative Effectiveness Trial III

No Diet or Exercise Control; Curves Complete® 90-day Challenge (CC) with 30:45:25 C:P:F, Weight Watchers® Points Plus (WW), Jenny Craig® (JC), or Nutrisystem® Advance Select™ (NS)

N=126
44±12 yr
44.8±5% fat
35.4±6 kg/m²

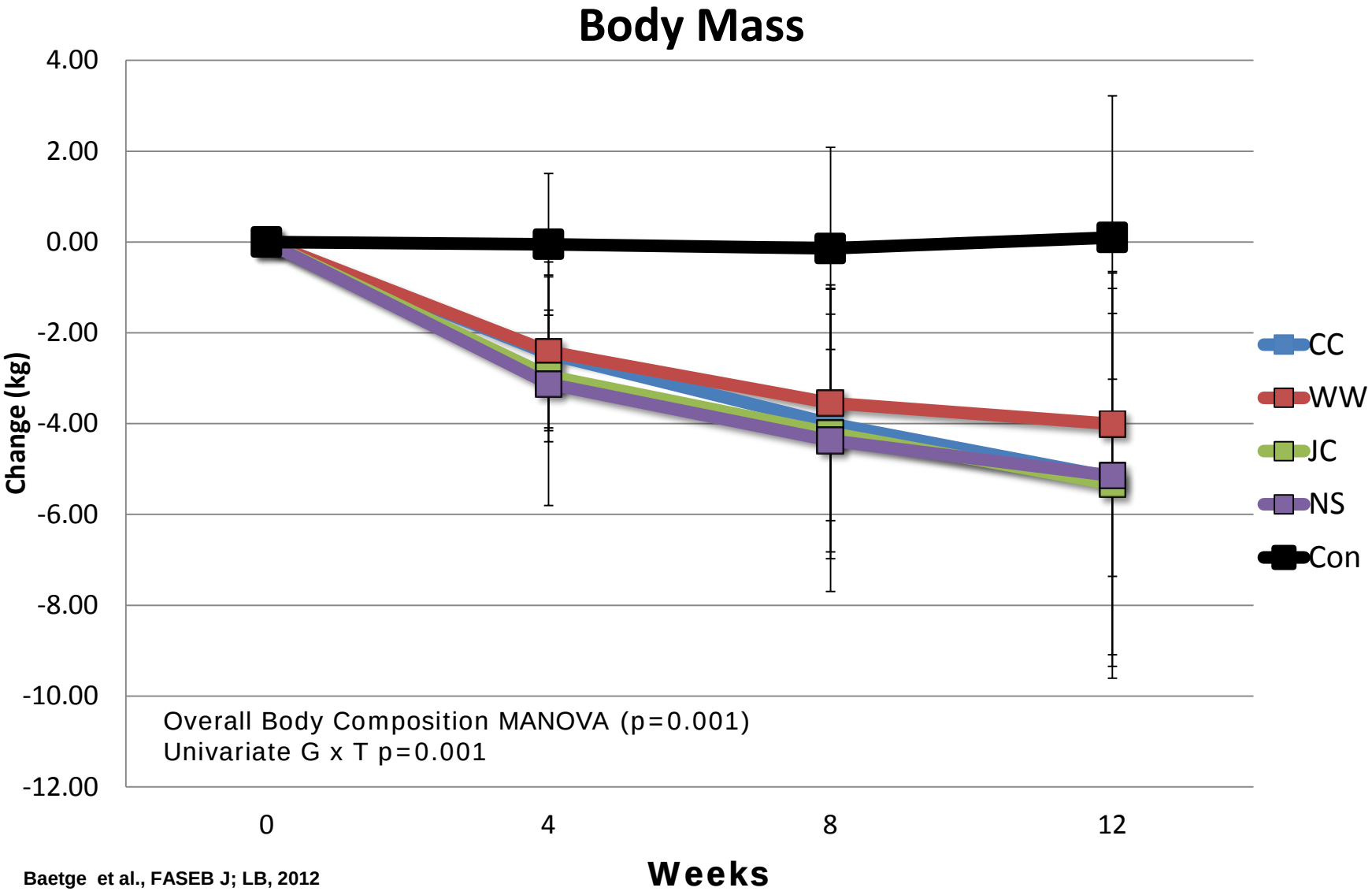
- At ***0, 4, 8, 12 W***:
  - ***Dietary Records*** (4-d)
  - ***Psychometric Tests***
  - ***IPAQ***
  - ***Body Composition/Bone Density*** (DEXA)
  - ***Total Body Water*** (BIA)
  - ***Hip & waist measurement***
  - ***Resting HR & BP***
  - ***Fasting Blood Samples*** (12h)
  - ***Resting Energy Expenditure*** (REE)

- At ***0 & 12W:***
  - ***Maximal Stress Test***
  - ***1RM Bench Press***
  - ***80% of 1RM on Bench Press***
  - ***1RM Leg Press***
  - ***80% of 1RM on Leg Press***
- Side effects were monitored by an RN on a weekly basis

Baetge et al., FASEB J; LB, 2012

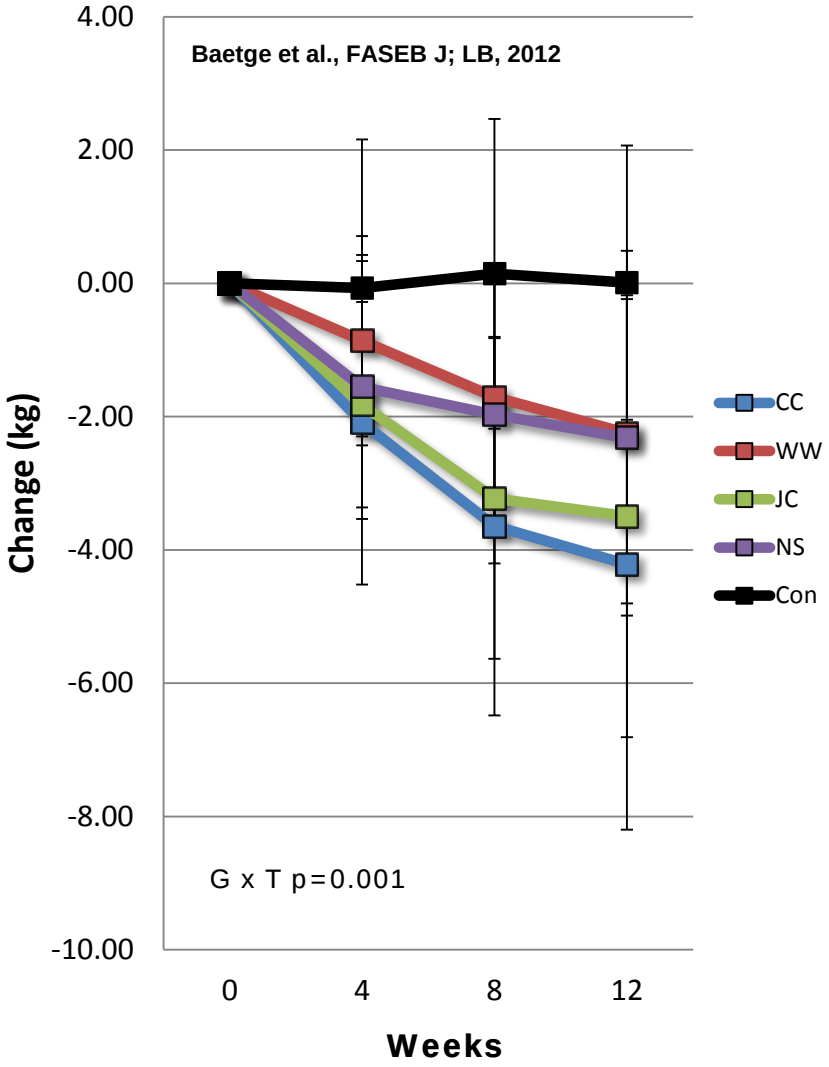
Diet Comparison

	Control	Weight Watchers	Nutrisystem	Jenny Craig	Curves
Diet	No	Point Plus Program	Advance Select Online Program	Online Program	Curves Complete
Food Provided	No	No	Yes	Yes	No
Counseling	No	Weekly Group Meetings	Online Support Available	Online Support Available	Weekly Individual Progress Checks
Exercise Program	No	Encouraged but not supervised	Encouraged but not supervised	Encouraged but not supervised	Curves Circuit Training with Zumba
Cost	None	~ $135	~ $1,200 - $1,500	~ $1,200 - $1,500	$199

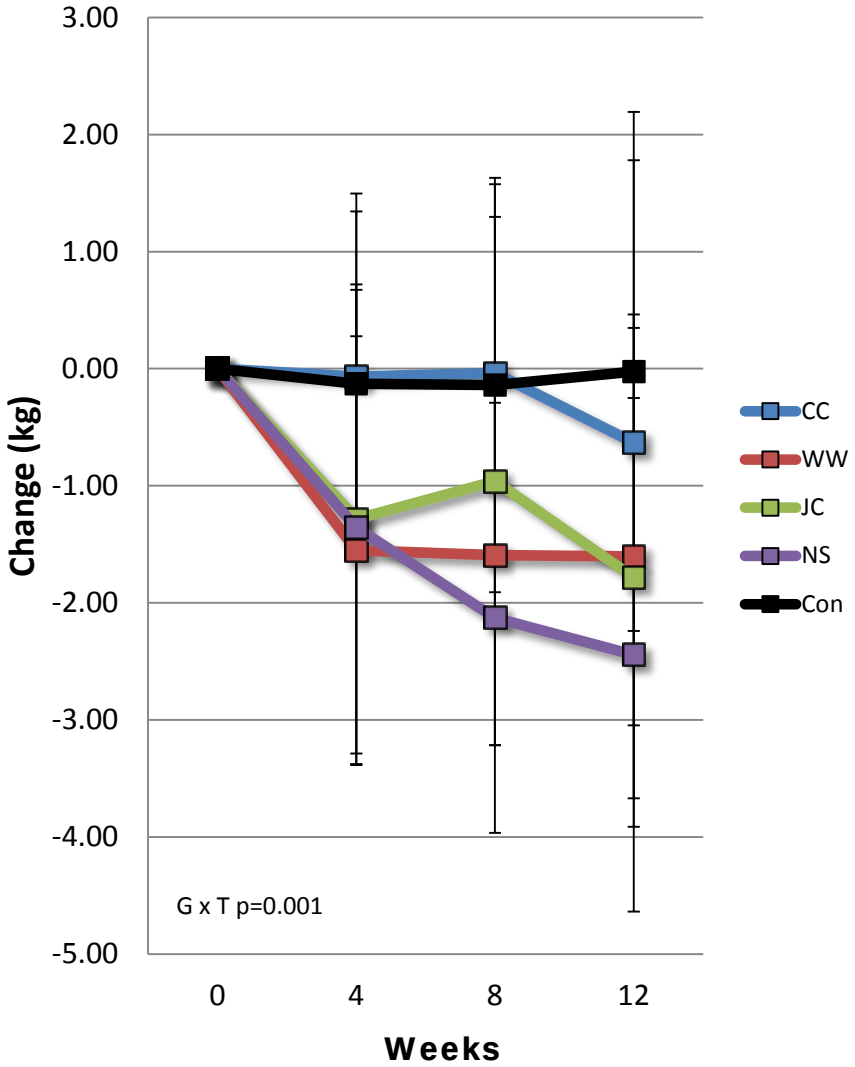


Baetge et al., FASEB J; LB, 2012

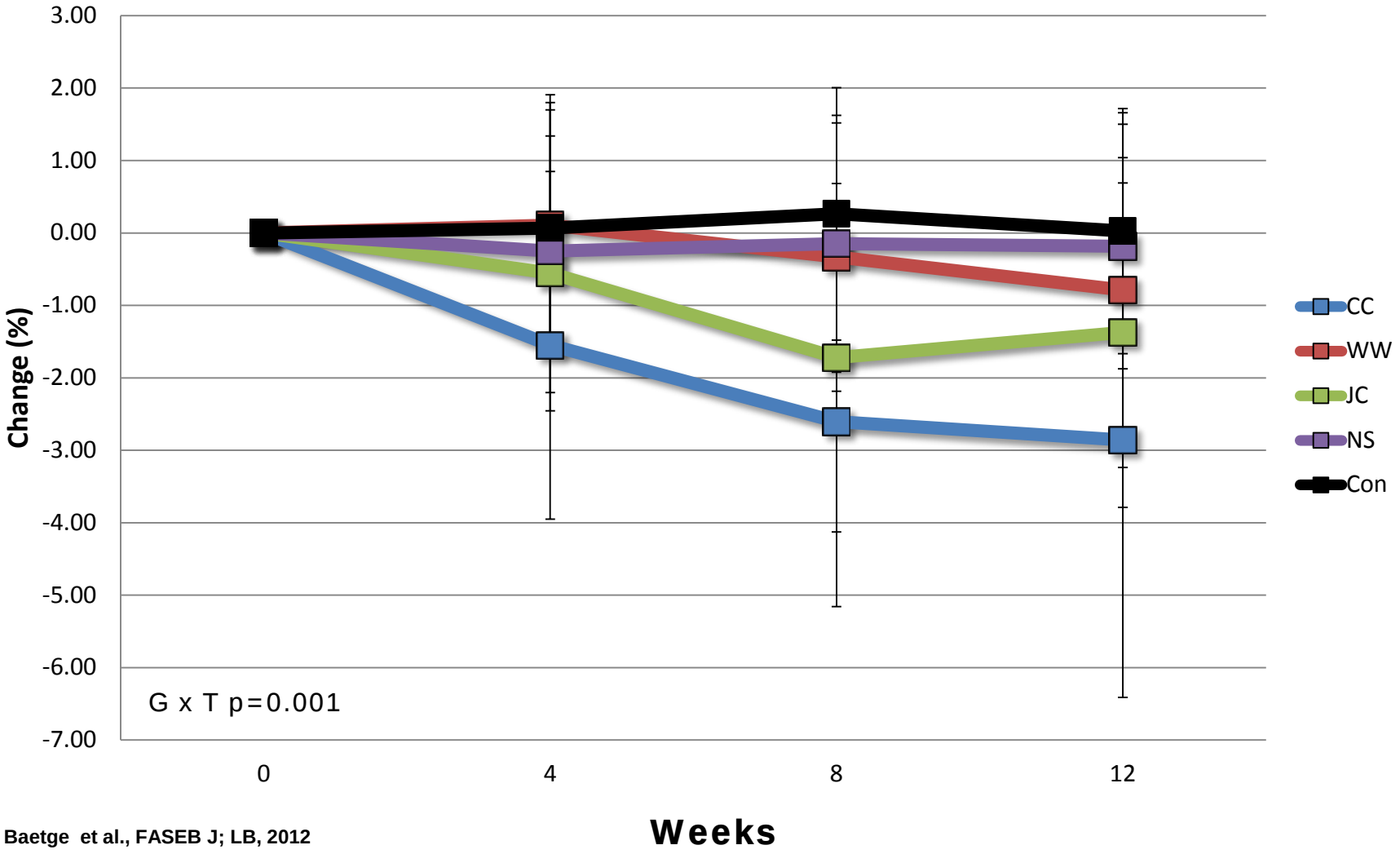
Fat Mass



Fat Free Mass



Body Fat



Baetge et al., FASEB J; LB, 2012

Current Research

Are there markers that can predict weight loss success on different diets?

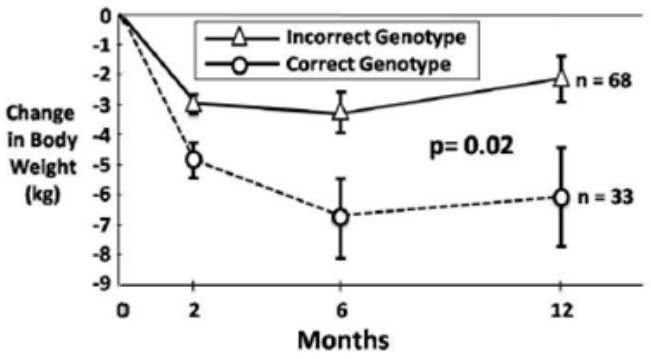
Variability of Body Composition Results

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
Body Mass	HP	373	-4.28	3.56	.18	-4.64	-3.91	-16.56	6.01
	HC	293	-3.43	4.03	.23	-3.90	-2.97	-35.61	4.76
Fat Mass	HP	373	-3.23	3.72	.19	-3.61	-2.85	-50.39	10.65
	HC	293	-2.48	3.02	.17	-2.83	-2.13	-23.97	9.97
FFM	HP	373	-.78	2.03	.10	-.99	-.57	-9.89	5.78
	HC	293	-.60	2.08	.12	-.84	-.36	-12.97	7.31

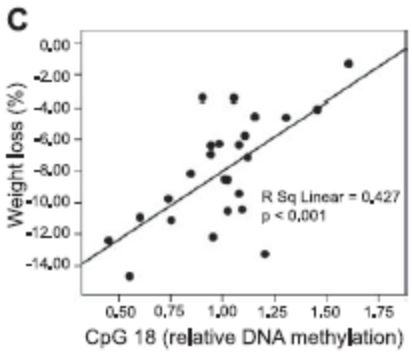
Why is there so much variation in weight loss success when women adhere to the same exercise and diet intervention?

Effects of a Carbohydrate Restricted, High Protein, High Fat Diet on Weight Loss and Health Outcomes in Women Participating in the Curves Fitness & Weight Loss Program

- We have not compared Curves diets to a higher fat diet (e.g., Atkins, South Beach)
- Recent research from Stanford suggests that stratification of participants to baseline genes (i.e., fatty acid binding protein 2 [FABP2] Ala54Thr; peroxisome proliferator-activated receptor-gamma [PPARG or γ] Pro12Ala; β2 adrenergic receptor (ADRB2) Arg16Gly and Gln27Glu; and β3 adrenergic receptor (ADRB3) Arg64Trp) better predicts success to weight loss programs.
- DNA methylation assessment has also been proposed to help predict weight loss success.



Dopler Nelson et al. AHA, 2010



Milagro et al. FASEB J. 25, 1378–1389, 2010

Effects of a Carbohydrate Restricted, High Protein, High Fat Diet on Weight Loss and Health Outcomes in Women Participating in the Curves Fitness & Weight Loss Program

- Purpose of the study is to determine:
  - whether a higher fat, more CHO restricted diet may be an effective alternative to our current HP curves diet;
  - whether baseline gene expression and/or DNA methylation correlate to success on different diets; and,
  - how these diets affect inflammatory gene expression and cytokines
- 100 overweight and sedentary women will participate in a 24-week weight loss study.
- Participants will be matched and randomly assigned to one of four groups including: 1.) a non-exercise, no diet intervention control group; 2.) an AHA recommended high carbohydrate, low protein, and low fat diet (55%, 15%, 30%) intervention group (HC-LF); 3.) the Curves Complete moderate carbohydrate, high protein, low fat diet (30%, 45%, 25%) (CC-I); or, 4.) the Curves Complete carbohydrate restricted, high protein, moderate fat diet (20%, 45%, 35%) and supervised resistance-based exercise program (CC-II).
- Dieting groups will consume 1,400 kcals/d for 1-week and 1,500 kcals/d at the prescribed macronutrient intakes for 23 weeks.

Overview

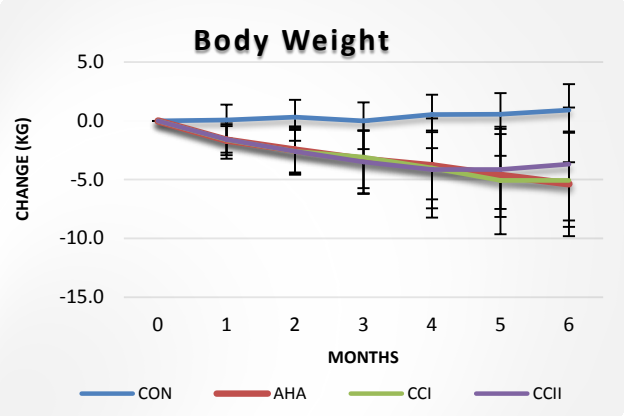
Familiarization	Baseline (T1)	4 Weeks (T2)	8 Weeks (T3)	12 Weeks (T4)	16 Weeks (T5)	20 Weeks (T6)	24 Weeks (T7)
Familiarization Session Complete Paperwork Review Medical history Physical Exam Fasting Blood Determination of Qualifications to Participate Randomized Group Assignment (n=100): 1. Control 2. AHA 3. CC-I 4. CC-II Phase I – 1,400 kcals/d for 1 week Phase II – 1,500 kcals/d for 23 weeks	Diet Record Review IPAQ[a] Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[b] and HR[c] DEXA[c] Scan/BIA Fasting Blood Fat-related Genes DNA Methylation Inflammatory Gene expression & Cytokines Maximal Cardiopulmonary Exercise Test 1RM[e] and 80% 1RM Isotonic Leg Press and Bench Press Measures Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Gene Expression DNA Methylation Maximal Cardiopulmonary Exercise Test 1RM[e] and 80% 1RM Isotonic Leg Press and Bench Press Measures Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Gene expression & Cytokines Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Gene Expression DNA Methylation Maximal Cardiopulmonary Exercise Test 1RM[e] and 80% 1RM Isotonic Leg Press and Bench Press Measures Survey Completion[f]

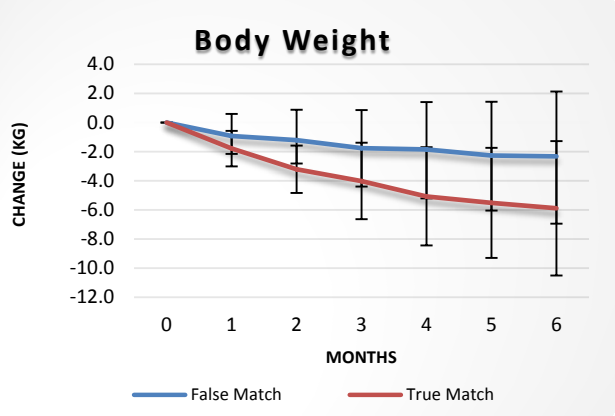
[a]International Physical Activity Questionnaire; [b]Blood Pressure; [c]Heart Rate; [d]Dual Energy X-ray Absorptiometry; [e]Repetition Maximum
[f]Standardized quality of life (SF-36), body image, self-esteem, and eating satisfaction inventories

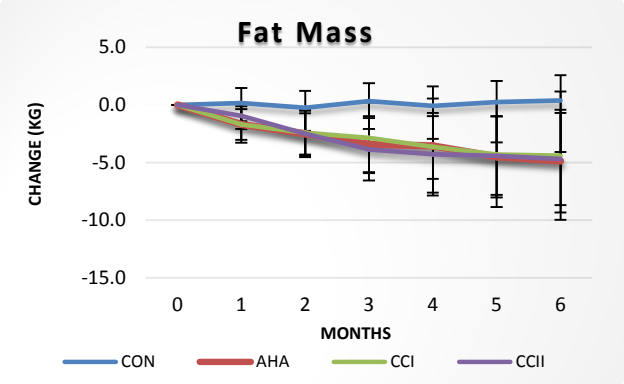
Control – No diet or exercise group
AHA – American Heart Association Recommended Diet (Phase I 1,400 kcals/d, Phase II 1,500 kcals/d at 55% C, 15% P, 30% F) and Exercise Program
CC-I - Curves Complete Diet I (Phase I 1,400 kcals/d, Phase II 1,500 kcals/d at 30% C, 45% P, 25% F) and Exercise Program
CC-II - Curves Complete Diet II (Phase I 1,400 kcals/d, Phase II 1,500 kcals/d 20% C, 45% P, 35% F) and Exercise Program

INFLUENCE OF METABOLIC GENOTYPING ON WEIGHT LOSS AND BODY COMPOSITION IN WOMEN PARTICIPATING IN A 6 MONTH DIET AND EXERCISE PROGRAM: PRELIMINARY FINDINGS

Sanchez et al., The FASEB Journal. vol. 29 no. 1 Supplement LB240

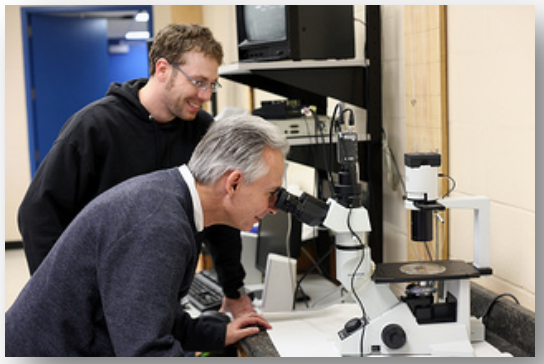






Effects of Diet Type Selection Based on Response to a Carbohydrate Intolerance Questionnaire and Genetic Screening on Success to a Weight Loss and Exercise Program

- Purpose is to determine whether assignment of participants to Curves diets based on baseline responses to the INS-CIQ and ILG genetic screening promotes greater adaptations to the Curves exercise and diet interventions.
- 80 sedentary and overweight women will undergo pre-participation screening and gene assessment.
- Participants will be assigned to the following groups based on baseline testing:1.
  - +CIQ , GEN-HC
  - +CIQ, GEN-HP
  - -CIQ, GEN-HC
  - –CIQ, GEN-HP
- Diets will be 1,400 kcal/d (1-wk) and 1,500 kcals/d (23 wks) on CC-I (30%C, 45%P, 25%F) or CC-II (20%C, 45%P, 35%F)



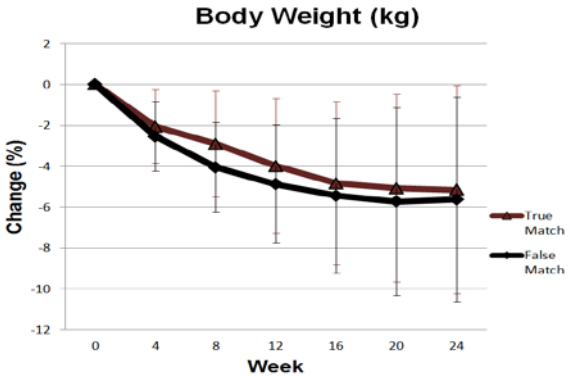
Overview

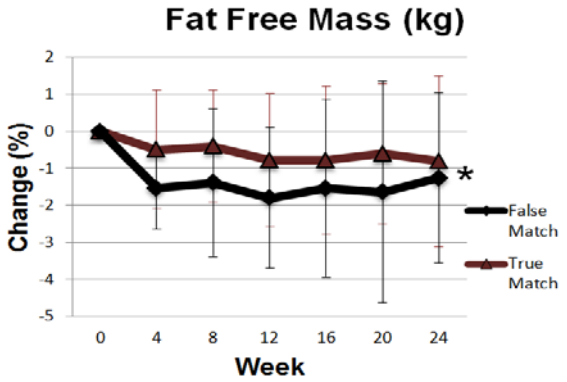
Familiarization	Baseline (T1)	4 Weeks (T2)	8 Weeks (T3)	12 Weeks (T4)	16 Weeks (T5)	20 Weeks (T6)	24 Weeks (T7)
Familiarization Session Complete Paperwork Review Medical history Physical Exam Fasting Blood Genetic Screening Determination of Qualifications to Participate Group Assignment: 1. +CIQ , GEN-HC 2. +CIQ, GEN-HP 3. –CIQ, GEN-HC 4. –CIQ, GEN-HPI Randomized Diet Assignment CC-I (30%C, 45%P, 25%F) CC-II (20%C, 45%P, 35%F) Phase I – 1,400 kcals/d for 1 week Phase II – 1,500 kcals/d for 23 weeks	Diet Record Review IPAQ[a] Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[b] and HR[c] DEXA[c] Scan/BIA Fasting Blood ILG Gene Assessment DNA Methylation Inflammatory Gene Expression & Cytokines Maximal Cardiopulmonary Exercise Test 1RM[e] and 80% 1RM Isotonic Leg Press and Bench Press Measures Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Gene Expression DNA Methylation Maximal Cardiopulmonary Exercise Test 1RM[e] and 80% 1RM Isotonic Leg Press and Bench Press Measures Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Survey Completion[f]	Diet Record Review IPAQ Body Weight Hip and Waist Measurements Resting Energy Expenditure Resting BP[a] and HR[b] DEXA[c] Scan/BIA Fasting Blood Inflammatory Gene Expression & Cytokines Maximal Cardiopulmonary Exercise Test 1RM[e] and 80% 1RM Isotonic Leg Press and Bench Press Measures Survey Completion[f]

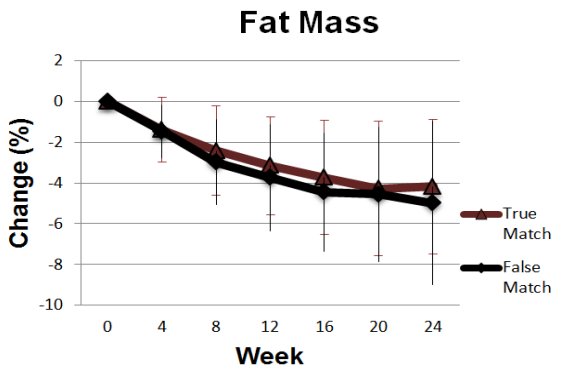
[a]International Physical Activity Questionnaire; [b]Blood Pressure; [c]Heart Rate; [d]Dual Energy X-ray Absorptiometry; [e]Repetition Maximum;
[f]Standardized quality of life (SF-36), body image, self-esteem, and eating satisfaction inventories
CIQ – Carbohydrate Intolerance Questionnaire (+ or – for carbohydrate intolerance)
GEN– Genetic Screened (High Carbohydrate [HC] or High Protein [HP] recommended diet)
CI – Curves Complete Diet I (Phase I 1,400 kcals/d, Phase II 1,500 kcals/d at 30% C, 45% P, 25% F)
CII – Curves Complete Diet II (Phase I 1,400 kcals/d, Phase II 1,500 kcals/d at 20% C, 45% P, 35% F)

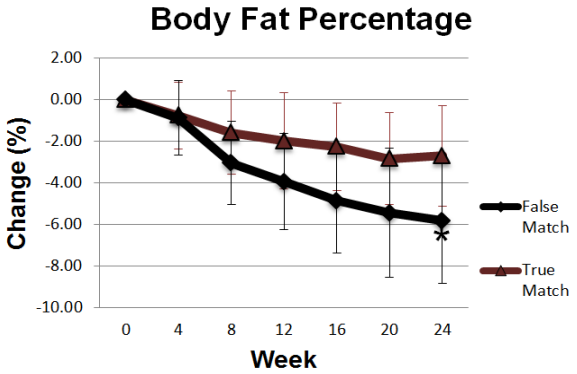
Effects of matching diet type to obesity-related genotype on body composition changes in women during a six-month resistance exercise training and walking program

Coletta et al., JISSN, 2015, 12(Suppl 1):P16









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Translation of Science into Practice

Exercise & Sport Nutrition

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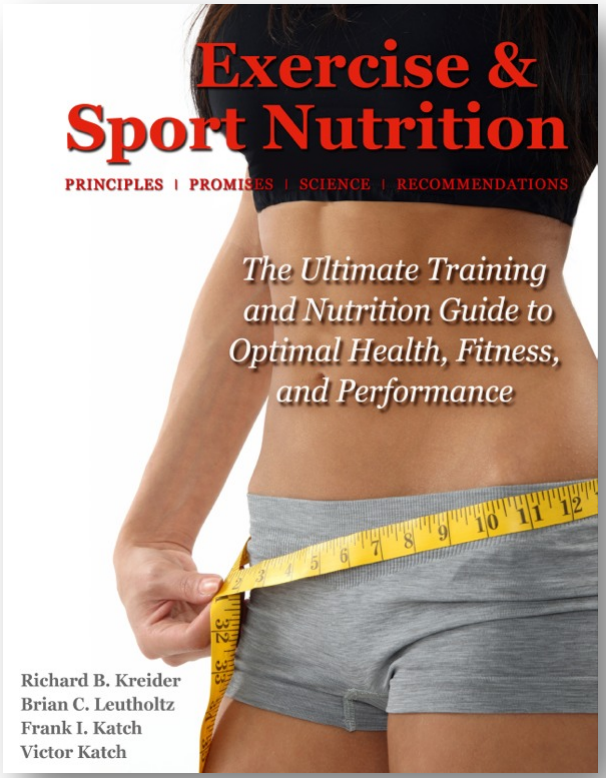

www.ExerciseAndSportNutrition.com

Kreider et al. Journal of the International Society of Sports Nutrition 2010, 7:7
http://www.jissn.com/content/7/1/7

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journal of the international society of sports nutrition

REVIEW Open Access

ISSN exercise & sport nutrition review: research & recommendations

Richard B Kreider[1*], Colin D Wilborn[2], Lem Taylor[2], Bill Campbell[3], Anthony L Almada[4], Rick Collins[5], Mathew Cooke[6], Conrad P Earnest[7], Mike Greenwood[8], Douglas S Kalman[9], Chad M Kerksick[10], Susan M Kleiner[11], Brian Leutholtz[8], Hector Lopez[12], Lonnie M Lowery[13], Ron Mendel[14], Abbie Smith[10], Marie Spano[15], Robert Wildman[16], Darryn S Willoughby[8], Tim N Ziegenfuss[17], Jose Antonio[18]

Abstract

Sports nutrition is a constantly evolving field with hundreds of research papers published annually. For this reason, keeping up to date with the literature is often difficult. This paper is a five year update of the sports nutrition review article published as the lead paper to launch the JISSN in 2004 and presents a well-referenced overview of the current state of the science related to how to optimize training and athletic performance through nutrition. More specifically, this paper provides an overview of: 1.) The definitional category of ergogenic aids and dietary supplements; 2.) How dietary supplements are legally regulated; 3.) How to evaluate the scientific merit of nutritional supplements; 4.) General nutritional strategies to optimize performance and enhance recovery; and, 5.) An overview of our current understanding of the ergogenic value of nutrition and dietary supplementation in regards to weight gain, weight loss, and performance enhancement. Our hope is that ISSN members and individuals interested in sports nutrition find this review useful in their daily practice and consultation with their clients.

www.jissn.com/content/7/1/7

Exercise & Sport Nutrition

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Journal of the International Society of Sports Nutrition

BioMed Central

Commentary

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International Society of Sports Nutrition position stand: creatine supplementation and exercise

Thomas W Buford, Richard B Kreider*, Jeffrey R Stout, Mike Greenwood, Bill Campbell, Marie Spano, Tim Ziegenfuss, Hector Lopez, Jamie Landis and Jose Antonio

Address: International Society of Sports Nutrition, 600 Pembrook Drive, Woodland Park, CO 80863, USA

Email: Thomas W Buford - thomas_buford@baylor.edu; Richard B Kreider* - Richard_Kreider@baylor.edu; Jeffrey R Stout - jrstout@ou.edu; Mike Greenwood - Mike_Greenwood@baylor.edu; Bill Campbell - Campbell@coedu.usf.edu; Marie Spano - mariespano@comcast.net; Tim Ziegenfuss - tim@ohioresearchgroup.com; Hector Lopez - hlopezmd@gmail.com; Jamie Landis - jlandis@lakelandcc.edu; Jose Antonio - exphys@aol.com
* Corresponding author

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This article is available from: http://www.jissn.com/content/4/1/6

A Position Statement and Review of the Literature

Position Statement: The following nine points related to the use of creatine as a nutritional supplement constitute the Position Statement of the Society. They have been approved by the Research Committee of the Society.

1. Creatine monohydrate is the most effective ergogenic nutritional supplement currently available to athletes in terms of increasing high-intensity exercise capacity and lean body mass during training.

2. Creatine monohydrate supplementation is not only safe, but possibly beneficial in regard to preventing injury and/or management of select medical conditions when taken within recommended guidelines.

3. There is no scientific evidence that the short- or long-term use of creatine monohydrate has any detrimental effects on otherwise healthy individuals.

4. If proper precautions and supervision are provided, supplementation in young athletes is acceptable and may provide a nutritional alternative to potentially dangerous anabolic drugs.

5. At present, creatine monohydrate is the most extensively studied and clinically effective form of creatine for use in nutritional supplements in terms of muscle uptake and ability to increase high-intensity exercise capacity.

6. The addition of carbohydrate or carbohydrate and protein to a creatine supplement appears to increase muscular retention of creatine, although the effect on performance measures may not be greater than using creatine monohydrate alone.

7. The quickest method of increasing muscle creatine stores appears to be to consume ~0.3 grams/kg/day of creatine monohydrate for at least 3 days followed by 3–5 g/d thereafter to maintain elevated stores. Ingesting smaller amounts of creatine monohydrate (e.g., 2–3 g/d) will increase muscle creatine stores over a 3–4 week period, however, the performance effects of this method of supplementation are less supported.

8. Creatine products are readily available as a dietary supplement and are regulated by the *U.S. Food and Drug Administration (FDA)*. Specifically, in 1994, U.S. President Bill Clinton signed into law the Dietary Supplement Health and Education Act (DSHEA). DSHEA allows manufacturers/companies/brands to make structure-function

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Journal of the International Society of Sports Nutrition

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Commentary

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International Society of Sports Nutrition position stand: protein and exercise

Bill Campbell[1], Richard B Kreider*[2], Tim Ziegenfuss[3], Paul La Bounty[4], Mike Roberts[5], Darren Burke[6], Jamie Landis[7], Hector Lopez[8] and Jose Antonio[9]

Address: [1]Exercise and Performance Nutrition Laboratory, Dept. of Physical Education and Exercise Science, University of South Florida, 4202 E. Fowler Avenue, PED 214, Tampa, FL 33620, USA, [2]Exercise and Sport Nutrition Laboratory, Dept. of Health, Human Performance, and Recreation, Baylor University, One Bear Place 97313, Waco, TX 76798-7313, USA, [3]Ohio Research Group of Exercise Science & Sports Nutrition, Wadsworth Medical Center, 323 High St, STE 103A, Wadsworth, OH 44281, USA, [4]Exercise and Sport Nutrition Laboratory, Dept. of Health, Human Performance, and Recreation, Baylor University, One Bear Place 97313, Waco, TX 76798-7313, USA, [5]Applied Biochemistry and Molecular Physiology Laboratory, Department of Health and Exercise Science, University of Oklahoma, 1401 Asp Avenue, Norman, OK 73019, USA, [6]Exercise Science Laboratory, Dept. of Human Kinetics, St. Francis Xavier University, P.O. Box 5000 Antigonish, Nova Scotia, B2G 2W5, Canada, [7]Department of Biology, Lakeland Community College, 7700 Clocktower Drive, Kirtland, Ohio 44094-5198, USA, [8]Northwestern University Feinberg School of Medicine, Department of Physical Medicine and Rehabilitation, Rehabilitation Institute of Chicago, 345 East Superior Street, Chicago, IL 60611, USA and [9]Department of Exercise Science and Health Promotion, Florida Atlantic University, 2912 College Avenue, Davie, FL 33314, USA

Email: Bill Campbell - campbell@coedu.usf.edu; Richard B Kreider* - Richard_Kreider@baylor.edu; Tim Ziegenfuss - tim@ohioresearchgroup.com; Paul La Bounty - Paul_La_Bounty@baylor.edu; Mike Roberts - Mike_Roberts@ou.edu; Darren Burke - dburke@stfx.ca; Jamie Landis - jlandis@lakelandcc.edu; Hector Lopez - hlopezmd@gmail.com; Jose Antonio - exphys@aol.com
* Corresponding author

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Abstract

Position Statement: The following seven points related to the intake of protein for healthy, exercising individuals constitute the position stand of the Society. They have been approved by the Research Committee of the Society. 1) Vast research supports the contention that individuals engaged in regular exercise training require more dietary protein than sedentary individuals. 2) Protein intakes of 1.4 – 2.0 g/kg/day for physically active individuals is not only safe, but may improve the training adaptations to exercise training. 3) When part of a balanced, nutrient-dense diet, protein intakes at this level are not detrimental to kidney function or bone metabolism in healthy, active persons. 4) While it is possible for physically active individuals to obtain their daily protein requirements through a varied, regular diet, supplemental protein in various forms are a practical way of ensuring adequate and quality protein intake for athletes. 5) Different types and quality of protein can affect amino acid bioavailability following protein supplementation. The superiority of one protein type over another in terms of optimizing recovery and/or training adaptations remains to be convincingly demonstrated. 6) Appropriately timed protein intake is an important component of an overall exercise training program, essential for proper recovery, immune function, and the growth and maintenance of lean body mass. 7) Under certain circumstances, specific amino acid supplements, such as branched-chain amino acids (BCAA's), may improve exercise performance and recovery from exercise.

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Exercise & Sport Nutrition

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Journal of the International Society of Sports Nutrition

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Review

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International Society of Sports Nutrition position stand: Nutrient timing

Chad Kerksick*[1,2], Travis Harvey[3], Jeff Stout[1], Bill Campbell[4], Colin Wilborn[5], Richard Kreider[6], Doug Kalman[7], Tim Ziegenfuss[8], Hector Lopez[9], Jamie Landis[10], John L Ivy[11] and Jose Antonio[12]

Address: [1]Department of Health and Exercise Science, University of Oklahoma, Norman, OK 73019, USA, [2]Endocrinology and Diabetes Section, Department of Pediatrics, University of Oklahoma Health Sciences Center, Oklahoma City, OK 73104, USA, [3]Center for Physical Development Excellence, Department of Physical Education, United States Military Academy, 727 Brewerton Road, West Point, NY 10996, USA, [4]School of Physical Education & Exercise Science, University of South Florida, Tampa, FL 33620, USA, [5]Exercise & Sport Science Department, University of Mary-Hardin Baylor, Belton, TX 76513, USA, [6]Department of Health & Kinesiology, Texas A&M University, College Station, TX 77843, USA, [7]Nutrition/Endocrinology Division, Miami Research Associates, Miami, FL 33143, USA, [8]Division of Sports Nutrition and Exercise Science, The Center for Applied Health Sciences, Fairlawn, OH 44333, USA, [9]Department of Physical Medicine and Rehabilitation, Northwestern University Feinberg School of Medicine, Chicago, IL 60611, USA, [10]Department of Biology, Lakeland Community College, Kirtland, OH 44094, USA, [11]Department of Kinesiology & Health Education, University of Texas, Austin, TX 78712, USA and [12]Farquhar College of Arts and Sciences, Nova Southeastern University, Fort Lauderdale, FL 33314, USA

Email: Chad Kerksick* - Chad_Kerksick@ou.edu; Travis Harvey - Travis.Harvey@usma.edu; Jeff Stout - jrstout@ou.edu; Bill Campbell - Campbell@coedu.usf.edu; Colin Wilborn - cwilborn@umhb.edu; Richard Kreider - rkreider@hlkn.tamu.edu; Doug Kalman - dkalman@miamiresearch.com; Tim Ziegenfuss - Tziegenfuss@wadsnet.com; Hector Lopez - hlopezmd@gmail.com; Jamie Landis - jlandis@lakelandcc.edu; John L Ivy - johnivy@mail.utexas.edu; Jose Antonio - ja839@nova.edu

* Corresponding author

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Abstract

Position Statement: The position of the Society regarding nutrient timing and the intake of carbohydrates, proteins, and fats in reference to healthy, exercising individuals is summarized by the following eight points: 1.) Maximal endogenous glycogen stores are best promoted by following a high-glycemic, high-carbohydrate (CHO) diet (600 – 1000 grams CHO or ~8 – 10 g CHO/kg/d), and ingestion of free amino acids and protein (PRO) alone or in combination with CHO before resistance exercise can maximally stimulate protein synthesis. 2.) During exercise, CHO should be consumed at a rate of 30 – 60 grams of CHO/hour in a 6 – 8% CHO solution (8 – 16 fluid ounces) every 10 – 15 minutes. Adding PRO to create a CHO:PRO ratio of 3 – 4:1 may increase endurance performance and maximally promotes glycogen re-synthesis during acute and subsequent bouts of endurance exercise. 3.) Ingesting CHO alone or in combination with PRO during resistance exercise increases muscle glycogen, offsets muscle damage, and facilitates greater training adaptations after either acute or prolonged periods of supplementation with resistance training. 4.) Post-exercise (within 30 minutes) consumption of CHO at high dosages (8 – 10 g CHO/kg/day) have been shown to stimulate muscle glycogen re-synthesis, while adding PRO (0.2 g – 0.5 g PRO/kg/day) to CHO at a ratio of 3 – 4:1 (CHO: PRO) may further enhance glycogen re-synthesis. 5.) Post-exercise ingestion (immediately to 3 h post) of amino acids, primarily essential amino acids, has been shown to stimulate robust increases in muscle protein synthesis, while the addition of CHO may stimulate even greater levels of protein synthesis. Additionally, pre-exercise consumption of a CHO + PRO supplement may result in peak levels of protein synthesis. 6.) During

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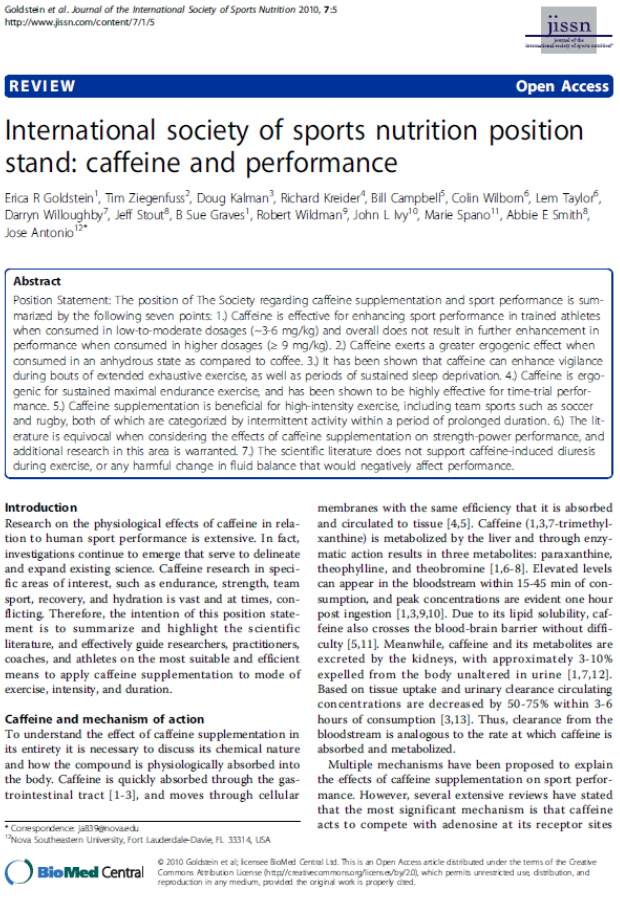

Goldstein et al. Journal of the International Society of Sports Nutrition 2010, 7:5
http://www.jissn.com/content/7/1/5

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REVIEW

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International society of sports nutrition position stand: caffeine and performance

Erica R Goldstein[1], Tim Ziegenfuss[2], Doug Kalman[3], Richard Kreider[4], Bill Campbell[5], Colin Wilborn[6], Lem Taylor[6], Darryn Willoughby[7], Jeff Stout[8], B Sue Graves[1], Robert Wildman[9], John L Ivy[10], Marie Spano[11], Abbie E Smith[8], Jose Antonio[12]*

Abstract

Position Statement: The position of The Society regarding caffeine supplementation and sport performance is summarized by the following seven points: 1.) Caffeine is effective for enhancing sport performance in trained athletes when consumed in low-to-moderate dosages (~3-6 mg/kg) and overall does not result in further enhancement in performance when consumed in higher dosages (≥ 9 mg/kg). 2.) Caffeine exerts a greater ergogenic effect when consumed in an anhydrous state as compared to coffee. 3.) It has been shown that caffeine can enhance vigilance during bouts of extended exhaustive exercise, as well as periods of sustained sleep deprivation. 4.) Caffeine is ergogenic for sustained maximal endurance exercise, and has been shown to be highly effective for time-trial performance. 5.) Caffeine supplementation is beneficial for high-intensity exercise, including team sports such as soccer and rugby, both of which are categorized by intermittent activity within a period of prolonged duration. 6.) The literature is equivocal when considering the effects of caffeine supplementation on strength-power performance, and additional research in this area is warranted. 7.) The scientific literature does not support caffeine-induced diuresis during exercise, or any harmful change in fluid balance that would negatively affect performance.

Introduction

Research on the physiological effects of caffeine in relation to human sport performance is extensive. In fact, investigations continue to emerge that serve to delineate and expand existing science. Caffeine research in specific areas of interest, such as endurance, strength, team sport, recovery, and hydration is vast and at times, conflicting. Therefore, the intention of this position statement is to summarize and highlight the scientific literature, and effectively guide researchers, practitioners, coaches, and athletes on the most suitable and efficient means to apply caffeine supplementation to mode of exercise, intensity, and duration.

Caffeine and mechanism of action

To understand the effect of caffeine supplementation in its entirety it is necessary to discuss its chemical nature and how the compound is physiologically absorbed into the body. Caffeine is quickly absorbed through the gastrointestinal tract [1-3], and moves through cellular membranes with the same efficiency that it is absorbed and circulated to tissue [4,5]. Caffeine (1,3,7-trimethylxanthine) is metabolized by the liver and through enzymatic action results in three metabolites: paraxanthine, theophylline, and theobromine [1,6-8]. Elevated levels can appear in the bloodstream within 15-45 min of consumption, and peak concentrations are evident one hour post ingestion [1,3,9,10]. Due to its lipid solubility, caffeine also crosses the blood-brain barrier without difficulty [5,11]. Meanwhile, caffeine and its metabolites are excreted by the kidneys, with approximately 3-10% expelled from the body unaltered in urine [1,7,12]. Based on tissue uptake and urinary clearance circulating concentrations are decreased by 50-75% within 3-6 hours of consumption [3,13]. Thus, clearance from the bloodstream is analogous to the rate at which caffeine is absorbed and metabolized.

Multiple mechanisms have been proposed to explain the effects of caffeine supplementation on sport performance. However, several extensive reviews have stated that the most significant mechanism is that caffeine acts to compete with adenosine at its receptor sites

* Correspondence: ja839@nova.edu
[12]Nova Southeastern University, Fort Lauderdale-Davie, FL 33314, USA

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Supreme
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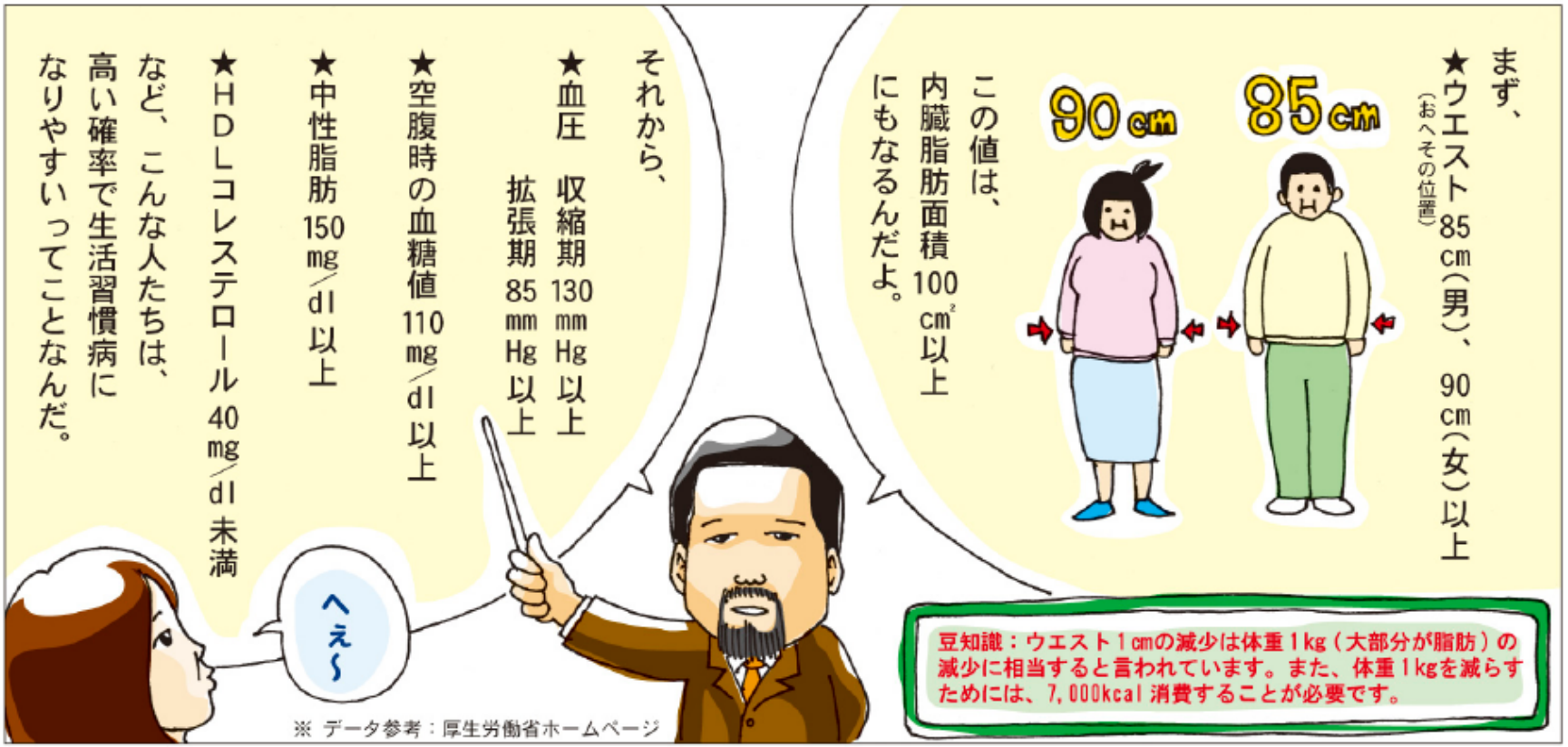


"What if there was
one prescription
that could
prevent and treat
dozens of diseases,
such as diabetes, hypertension
and obesity?

Would you prescribe it to your patients?

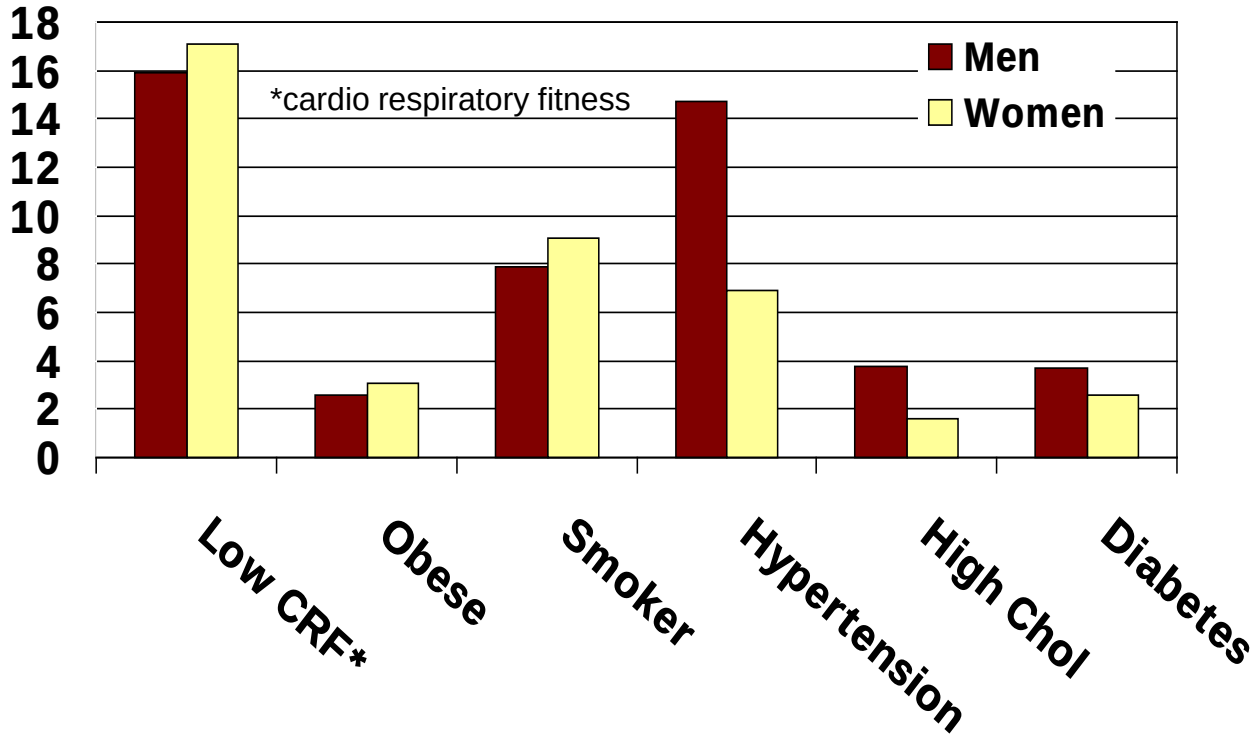
Certainly!

-Robert E. Sallis, M.D., FACSM,
Exercise is Medicine™ Task Force Chairman

Effect of Fitness (CRF) on Mortality

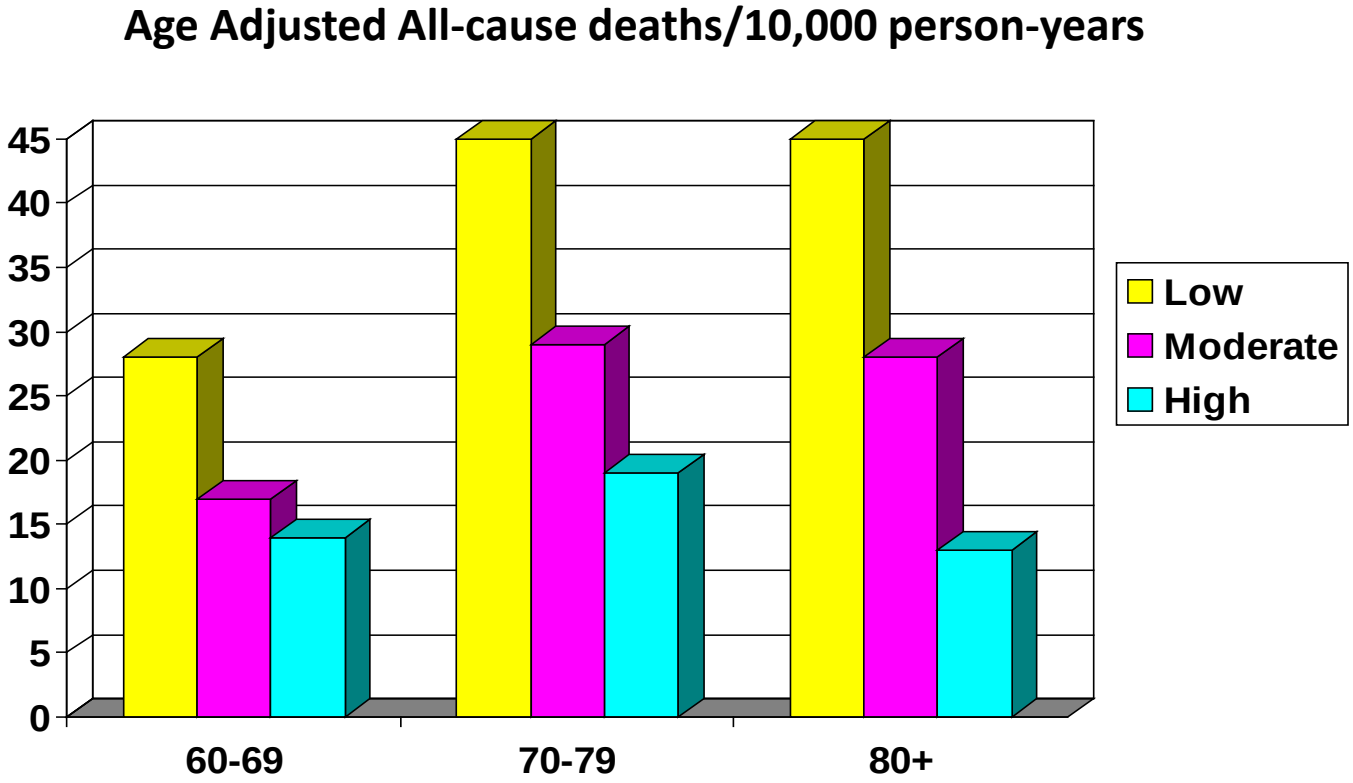
Attributable Fractions (%) for
All-Cause Deaths

40,842 Men & 12,943 Women, ACLS



Blair SN. Physical inactivity: the biggest public health problem of the 21st century. *Br J Sports Med* 2009; 43:1-2.

CRF and All-Cause Mortality,
4060 Women and Men ≥60 Years of Age, 989 Deaths



Sui X et al. *J Am Geriatrics Soc* 2007; 55:1940-7

Lifestyle-related Risk Factors and Risk of Future Nursing Home Admissions; 6462 Adults

Risk Factor	45-64 years Hazard Ratio (95% CI)
Smoking	**1.56 (1.23-1.99)**
Physical Inactivity	**1.40 (1.05-1.87)**
BMI ≥30.0	**1.35 (0.96-1.89)**
High BP	**1.35 (1.06-1.73)**
High Cholesterol	**1.14 (0.89-1.44)**
Diabetes	**3.25 (2.04-5.19)**

Valiyeva E et al. *Arch Int Med* 2006; 166:985

U.S. Physical Activity Guidelines

150 minutes per week of moderate-intensity physical activity

- Choose your own schedule
- For example: 30 minutes of moderate-intensity exercise, five days per week OR three 10-minute sessions per day, five days per week

Age	No Chronic Conditions	Chronic Conditions
Children & Adolescents (6-17)	60 minutes or more of physical activity every day (moderate*- or vigorous**-intensity aerobic physical activity). Vigorous-intensity activity at least 3 days per week. Muscle-strengthening and bone-strengthening activity at least 3 days per week.	Develop a physical activity plan with your health care professional. Avoid inactivity. Refer to the Your Prescription for Health series.
Adults (18-64)	150 minutes a week of moderate-intensity, or 75 minutes a week of vigorous-intensity aerobic physical activity Muscle-strengthening activities that involve all major muscle groups performed on 2 or more days per week.	Develop a physical activity plan with your health care professional. Be as physically active as possible. Avoid inactivity Refer to the Your Prescription for Health series.
Older Adults (65+)	Follow the adult guidelines, or be as physically active as possible. Avoid inactivity. Exercises that maintain or improve balance if at risk of falling.	Develop activity plan with health care professional. Refer to the Your Prescription for Health series.

From the 2008 Physical Activity Guidelines for Americans

For more information on these guidelines, visit www.acsm.org/physicalactivity.

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Summary & Future Directions

Summary

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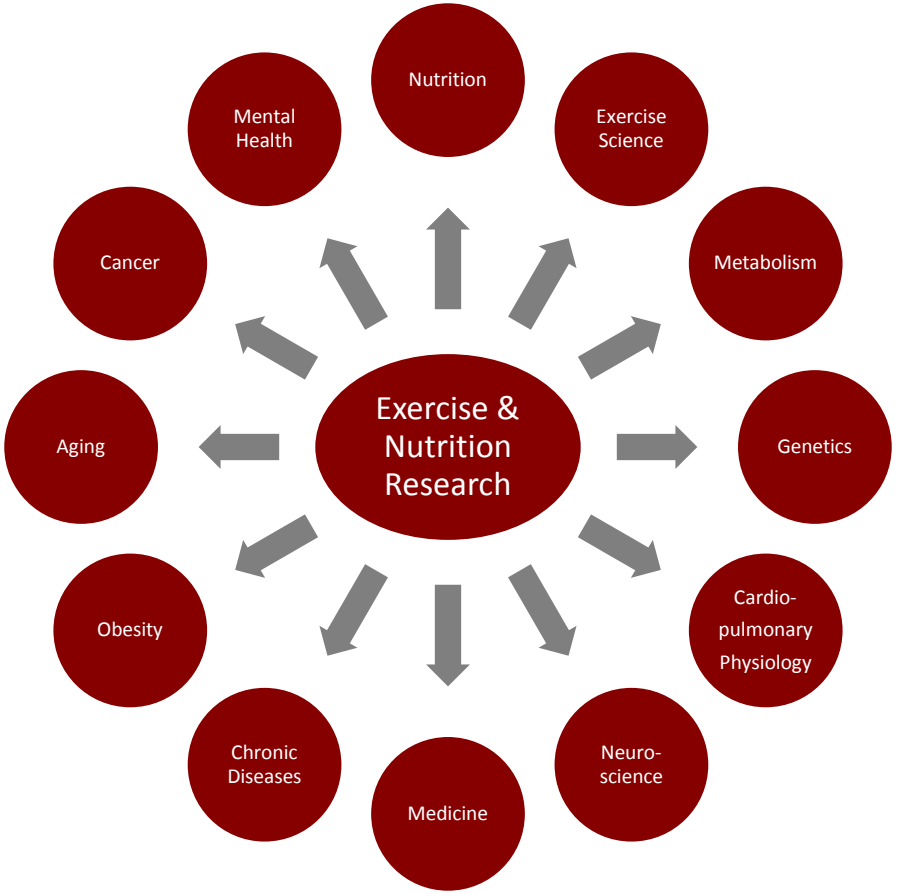
- Exercise and nutrition play an integral role in optimizing health and well-being
- Only beginning to understand the influence of exercise and nutrition on health, disease, & performance
- Need to understand the genetic and molecular adaptations to exercise and implications of physical inactivity to disease pathology
- Potential for utilizing exercise and nutrition to influence gene expression, physiological adaptations, and health in apparently healthy and diseased populations



Future Directions

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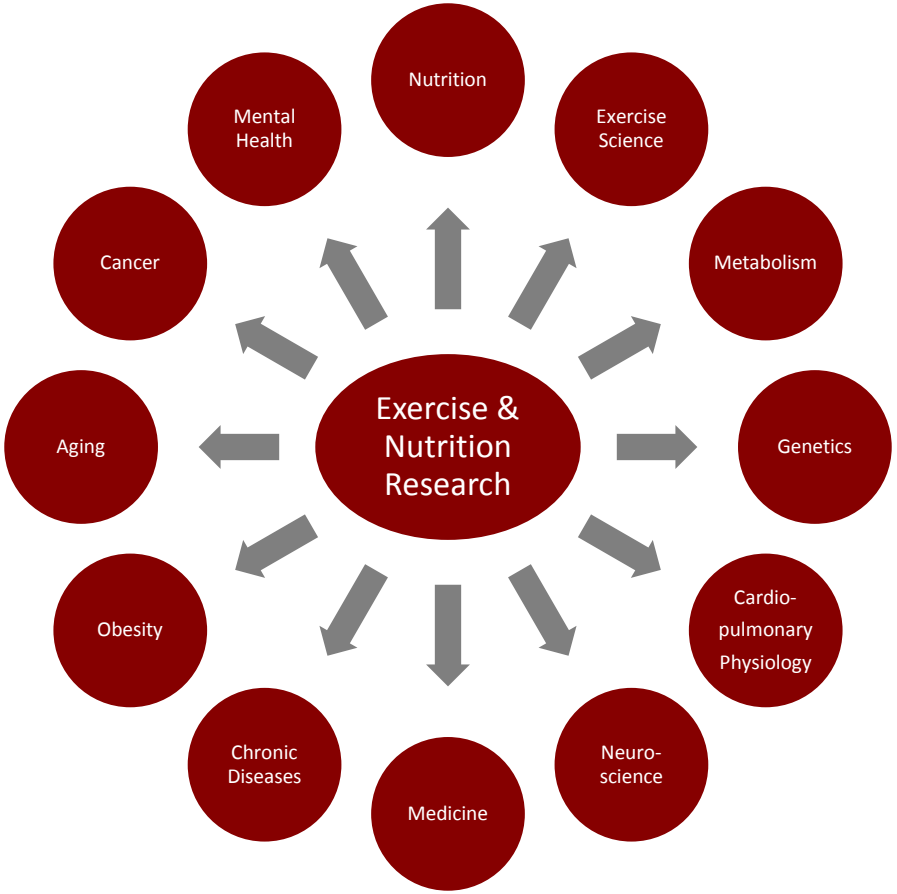
- Assessment of role of exercise and nutrition on disease pathology, prevention, & management
- More application to clinical populations
- Transdisciplinary biomedical and behavioral research focus
- Translation of basic research to clinical practice, community health interventions, & public health education and policy
- Nutrigenomics; nutraceutical; bioactives added to foods; and, individualized exercise, nutritional, and/or pharmaeutical prescriptions



Students

Old Dominion University

- Jen Bozarth, PhD
- Eric Burton, MS
- Bart Drinkard, MS, PT
- Tracey Drews, MS
- Gary Miller, PhD
- Victor Miriel, PhD
- Mary Mitchell-Beaton, MS
- Sherri Parker, PhD
- Debbie Schenck, MS
- David Tulis, PhD

University of Memphis

- Darren Bullen, MS
- Patty Cowan, PhD
- Maria Ferreira, MS, RD
- Pamela Grindstaff, MS
- Shonteh Henderson, MS, DPT
- Chad Kerksick, MS
- Pauline Koh-Banerjee, MS, DSci
- Stacy Lancaster, MS, PhD
- Jen Lundberg, MS
- Charlie Melton, MS
- Leigh Ramsey, MS
- John Ransom, BS
- Chris Rasmussen, MS
- Mike Starks, MS, PhD
- Mike Wilson, MS
- Larry Wood, MS

Baylor University

- Kristen Beavers, PhD
- Jackie Beckham-Dove, PhD
- Thomas Buford, PhD
- Jen Wismann-Bunn, PhD
- Brian Brabham, PhD
- Bill Campbell, PhD
- Rehka Chandran, MD
- Matt Cooke, PhD (Post-Doc)
- Julie Culbertson, MS
- Terry Magrans-Courtney, PhD
- Erika Dieke, PhD
- Maria Ferreira, PhD
- David Fogt, PhD (Post-Doc)
- Melyn Galbreath, NP, PhD
- Jean Jitomir, PhD
- Travis Harvey, PhD
- Gregory Hudson, PhD
- Mike Iosia, PhD (Post-Doc)
- Chad Kerksick, PhD
- Paul La Bounty, PhD
- Rui Li, PhD
- Brandon Marcello, PhD
- Jen Moreillon, PhD
- Chris Mulligan, MS
- Erika Nassar, PhD
- Adam Parker, PhD
- Mike Roberts, MS, PhD
- Dan Rhol, MS
- Monica Serra, PhD
- Kathy Sharp, MS
- Brian Shelmadine, PhD
- Lem Taylor, PhD
- Anthony Vacanti, MS
- Colin Wilborn, PhD

Texas A&M University

- Felix Ayadi, MS
- Mike Byrd, MSEd, MBA
- Claire Baetge, PhD
- Major Nick Barringer, RD, PhD
- Jeremy Carter, MS
- Minye Cho, MS
- Adriana Coletta, MS, RD
- Blaise Collins, MS
- Ryan Dalton, MS
- Elfego Galvin, RD, PhD
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- Peter Jung, MS
- Deepesh Khanna, MS, MPH
- Majid Koozehchian, MS
- Julie Culbetson-Kresta, PhD
- Kyle Levers, PhD
- Brittanie Lockard, PhD
- Major Michelle Mardock, PhD
- Jonathan Oliver, PhD
- Abigail O'Conner, MS
- Amiee Reyes, MS
- Brittany Sanchez, MS
- Sunday Simbo, PhD
- Ryan Sowinski, BS
- Sammy Springer, MS

Research Network

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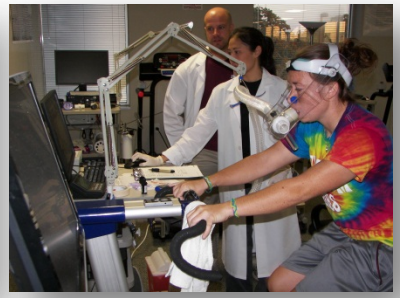
- ***Anthony L. Almada, MSc*** (President & Chief Scientific Officer, ImagiNutrition)
- ***Claude Bouchard, PhD*** (Pennington Biomedical Research Center, Texas A&M TIAS Faculty Fellow)
- ***Patti Cowan, PhD, RN*** (College of Nursing, University of Tennessee)
- ***Stephen Crouse, PhD*** (Director, Applied Exercise Science Lab, Texas A&M University)
- ***Nicholaas Deutz, MD, PhD*** (Director, Center for Translational Aging and Longevity, Texas A&M University)
- ***Valter di Salvo, PhD*** (Aspire Academy, Qatar)
- ***Conrad Earnest, PhD*** (Nutribolt, Bryan, TX)
- ***Jim Fluckey, PhD*** (Muscle Biology Lab, Department of Health & Kinesiology, Texas A&M University)
- ***Paul Greenhaff, PhD*** (Department of Biomedical Sciences, Queen's Medical Centre, Nottingham, ENGLAND)
- ***Lori Greenwood, PhD, ATC, LAT*** (Department of Health & Kinesiology, Texas A&M University)
- ***Mike Greenwood, PhD, FACSM, FISSN, FNSCA*** (Department of Health & Kinesiology, Texas A&M University)
- ***Roger Harris, PhD, FISSN*** (Retired, formerly, University of Chichester, UK)
- ***David Huston, MD*** (Director, Clinical Science and Translational Research Institute. College of Medicine, Texas A&M Health Science Center)
- ***Gilbert Kaats, PhD*** (Integrative Health Technologies, San Antonio, TX)
- ***Richard Linnehan, DVM*** (NASA - Johnson Space Center - TAMUS)
- ***Timothy Lightfoot, PhD*** (Director, Huffines Institute for Sports Medicine and Human Performance, Texas A&M University)
- ***Sarkis Meterissian, MD, CM*** (Cedars Breast Centre, McGill University Health Center, McGill University, Quebec, CANADA)
- ***Peter Murano, PhD*** (Institute for Obesity Research & Program Evaluation, Texas A&M University)
- ***Steven Riechman, PhD*** (Human Countermeasures Lab, Department of Health & Kinesiology, Texas A&M University)
- ***Catherine Sabiston, PhD*** (Health Behavior & Emotion Lab, Department of Kinesiology & Physical Education, McGill University, Quebec, CANADA)
- ***Lori Sigrist, PhD, RD, CSSD*** (Center for the Intrepid, Brooks Army Medical Center, San Antonio, TX)
- ***Susanne Talcott, PhD*** (Department of Nutrition and Food Science, Texas A&M University)
- ***Mark Tarnopolsky, MD, PhD, FRCP(C)*** (Faculty of Health Sciences, McMaster University, Ontario, CANADA)
- ***Per Tesch, PhD*** (Mid Sweden University & Karlinska Institute, SWEDEN)
- ***Robert Wolfe, PhD*** (Vice-Chair of Center for Translational Research, Professor, Department of Geriatrics, Reynolds Institute of Aging, University of Arkansas Reynolds Institute on Aging)

Exercise, Nutrition and Health Research: Translation of Science into Practice





Richard B. Kreider, PhD, FACSM, FISSN, FACN
Professor & Head, Department of Health & Kinesiology
Thomas A. & Joan Read Endowed Chair for Disadvantaged Youth
Director, Exercise & Sport Nutrition Lab
Texas A&M University

rbkreider@tamu.edu
ExerciseAndSportNutritionLab.com

Disclosures: Receive industry sponsored research grants and serve as a scientific and legal consultant. Serve as scientific consultant to Nutrabolt Inc. (Bryan, TX)