Metabolic Conditioning with 9 Invincible Workouts (Session 714)
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Len Kravitz, PhD. (lkravitz@unm.edu)

Description: Join Len for a comprehensive review of the metabolic and physiological processes that drive physical exercise and athletic performance. He will introduce several new ways to train the body, all based on research studies—several from Len's Lab—that are time efficient and highly effective. Move over extreme conditioning—the next generation of training protocols has arrived. Every exercise professional will leave with nine research-based, invincible training programs that your clients will relish with excitement.

I. What does cardiometabolic health mean? Cardiometabolic health is a relatively new term that encompasses cardiovascular and metabolic diseases, including type 2 diabetes and metabolic syndrome.

Key Take-Away Message #1: Evolving view of resistance training: Resistance training is an 'Exercise Therapy Program' (Strasser, B. 2011. Evidence of resistance training as a treatment therapy in obesity. Journal of Obesity. Mang et al. 2019. Metabolic effects of resistance training, IDEA Fitness Journal). Facts to consider. Aging: highly associated with loss of muscle mass

Emerging research suggests muscle strength & muscle mass are very important in mitigating metabolic risk factors. New Term: Dynapenia: Loss of muscle strength**.** Skeletal muscle is a key regulator of resting metabolic rate**.** Strong evidence that maintenance of large muscle mass reduces metabolic risk factors including type 2 diabetes, abnormal cholesterol, obesity.

Metabolic effects of resistance training include: Favorably improves A1C levels for type 2 diabetes prevention; Improves systolic and diastolic blood pressure in hypertensives; Increases resting metabolic rate; Has a high E.P.O.C. (exercise after burn); Decreases visceral adipose tissue; Maintains lean body mass during caloric restriction; Reduces oxidative stress and lowers homocysteine (risk factor for heart disease); Favorably effects blood cholesterol; Key take away message: increasing a person's muscle mass and strength are key factors for improving Clinical Metabolic health.

Key Take-Away Message #2: Increasing a person's muscle mass and strength are key factors for improving cardiometabolic health.

II. The mighty mitochondria

A. Muscle cells have 400 to 2000 mitochondria

B. Mitochondria is only site in the human body where fat is completed oxidized (burned)

C.TCA Metabolism review: TCA cycle (this is analogous to a metabolic grindstone at work)

E. Electron transport chain (ETC) is where the greatest amount of ATP is synthesized (this is like a metabolic conveyor belt)

F. Cell-Mitochondrion (fat burning furnace of cell); from aerobic exercise can make 35% bigger and increase in size 15-50% (NOTE: muscle cells have 400 to 2000 mitochondria per muscle cell)

G. Master switch in muscle is PGC-1alpha. This protein turns on the following: increase in fat oxidative capacity, increase in GLUT4 and glycogen metabolism, increase in mitochondrial density (which means increase in size and number), increase in slow twitch muscle fibers function. The CaMK pathway from steady state exercise and the AMPK pathway from HIIT activate PGC-1alpha

III. Resistance Training and Mitochondria

Lim et al 2019: 30% of 1-RM to failure (3 sets of 30 reps) elicited significant changes in the mitochondria over the course of 10 weeks.

Groennebaek and Vissing 2017: "Fatiguing low-load and high-volume resistance exercise has been shown to produce greater ATP turnover compared to traditional high-load resistance exercise."

Practical Application #1: Periodize a 1-2 week block of training. Perform sets of all exercises to a 30-RM (i.e., fatigue on rep #30) [30%-40% 1-RM is range]

Practical Application #2: Perform drop sets for all exercises for 1-2 weeks.
1) First set of 8-12 reps to fatigue
2) Drop load by ~25% (no rest)
3) 2nd set of 8-12 reps to fatigue
4) Drop load b ~25% (no rest
5) 3rd set of 8-12 reps to fatigue

Special Note: Please individualize and modify all workouts for your clients' fitness levels.

What is an Invincible Workout? A workout that shows impressive physiological and/or metabolic outcomes from one or more studies.

Peripheral Heart Action (PHA) Training

Developed by Arthur Steinhaus, PhD in the 1940s. Popularized by 'Mr. America,' Bob Gajda, in the 1960's (he did PHA with his clients). Dr. Steinhaus hypothesized that for optimal health from resistance exercise, one should keep the blood circulating. His method to do this was by alternating lower body and upper body exercises in a workout. Exercises should move fluidly in a circuit, with little to no rest between exercises.

First and only published study at this time (Steinhaus never tested his hypothesis)

Piras, et al. (2015). Peripheral heart action (PHA) training as a valid substitute to high intensity interval training to improve resting cardiovascular changes and autonomic adaptation. Eur J Appl Physiol (2015) 115:763–773.

Peripheral Heart Action (PHA) Workout Design Template:

1. Lower body
2. Upper body
3. Lower body
4. Upper body
5. Lower body
6. Upper body
   - 10-15 reps per exercise (55-60% of 1RM)
   - No rest between exercises
   - 3-4 rounds (or circuits)
   - 1-2minute rest between rounds

PHA #1	**PHA #2**	**PHA #3**
Hex-bar dead lift	Goblet squat	Sumo dead lift
Chest press	Shoulder press	Inverted row
Calf (Heel) raise	Hamstring curl	Single arm press (R)
Seated row	Lat pull down	Step back lunge (R)
Squat or Leg press	Hip thrust	Single arm press (L)
Biceps curl	Triceps pushdown	Step back lunge (L)

Reciprocal Super Setting (RSS) Template (Note: repeating supersets)

Kelleher, A.R. (2010) The metabolic costs of reciprocal supersets vs. traditional resistance exercise in young recreationally active adults. Journal of Strength and Conditioning Research, 24(4), 1043-1051.

Compared to traditional resistance training sets, reciprocal supersets produced greater energy expenditure during the workout, and higher blood lactate (i.e., metabolic stress) and EPOC after the workout. Reciprocal super setting took 20% less time to complete (36 min versus 30 min). EPOC was 33% greater with reciprocal supersetting and participants were burning 30% more calories per minute with this technique.

A1: Lower body Anterior
A2: Lower body Posterior (*Repeat A1 and A2, 3-4 tim*es)

B1: Upper body Push
B2: Upper body Pull (*Repeat B1 and B2, 3-4 tim*es)
C1: Upper body Push
C2: Upper body Pull (*Repeat C1 and C2, 3-4 tim*es)

- 8-15 reps per set (in study participants worked at 70% of 1RM); modify for clients' fitness levels.
- 3-4 reciprocal super sets (RSS)
- 60-second rest between RSS

RSS #1	**RSS #2**
A1: Goblet squat	A1: Dead lift
A2: Hip thrust	A2: Knee extension
One-minute rest	*One-minute rest*
Repeat A1 & A2 3-4 times	*Repeat A1 & A2 3-4 times*
B1: Push-up	B1: DB bench press
B2: Inverted row	B2: Lat pull down
One-minute rest	*One-minute rest*
Repeat B1 & B2 3-4 times	*Repeat B1 & B2 3-4 times*
C1: DB lateral raise	C1: DB push press
C2: Straight arm pull down	C2: Biceps curl
One-minute rest	*One-minute rest*
Repeat C1 & C2 3-4 times	*Repeat C1 & C2 3-4 times*

Theoretically, the combination of Reciprocal Super Setting (i.e., repeating super sets) and Peripheral Heart Action training (i.e., upper body alternating with lower body) is potentially a very effective physiological stimulus for the body. There is NO research on this yet! Let's look at some practical options.

Reciprocal Super Setting + Peripheral Heart Action Training Template

A1: Lower body

A2: Upper body (*Repeat A1 and A2: 3-4 tim*es)

B1: Lower body

B2: Upper body (*Repeat B1 and B2: 3-4 tim*es)

C1: Lower body

C2: Upper body (*Repeat C1 and C2: 3-4 tim*es)

10-15 Reps per set

3-4 reciprocal super sets (RSS)

60-second rest between RSS

RSS + PHA #1	**RSS + PHA #2**
A1: Romanian dead lift	A1: Step back lunge (Right)
A2: Chest press	A2: Lat pull down
One-minute rest	*One-minute rest*
Repeat A1 & A2: 3-4 times	*Repeat A1 & A2: 3-4 times*
B1: Goblet squat	B1: Step back lunge (Left)
B2: Standing cable row	B2: TRX inverted row

One-minute rest *Repeat B1 & B2: 3-4 times* C1: Calf (heel) raise C2: Dumbbell front raise *One-minute rest* *Repeat C1 & C2: 3-4 times*	*One-minute rest* *Repeat B1 & B2: 3-4 times* C1: Squat C2: Dumbbell shoulder press *One-minute rest* *Repeat C1 & C2: 3-4 times*

RSS + PHA #3	**RSS + PHA #4**
A1: Barbell squat jump A2: Spiderman push-up *One Minute rest* *Repeat A1 & A2: 3-4 times* B1: Physioball lunge (Right and Left) B2: Triceps dips on physioball *One Minute rest* *Repeat B1 & B2: 3-4 times* C1: KB dead lift C2: Side plank row (Right and Left) *One Minute rest* *Repeat C1 & C2: 3-4 times*	A1: Dumbbell split squat (R & L) A2: TRX reverse flye *One Minute rest* *Repeat A1 & A2: 3-4 times* B1: Plyometric box jump B2: Plyometric Bosu push-up *One Minute rest* *Repeat B1 & B2: 3-4 times* C1: TRX single leg hamstring curl (R & L) C2: Physioball plan with directional forces *One Minute rest* *Repeat C1 & C2: 3-4 times*

Continuous Circuit Training from: Gotshalk, L.A., Berger, R.A., and Kraemer, W.J. (2004). Cardiovascular responses to a high-volume continuous circuit resistance training protocol. Journal of Strength and Conditioning Research, 18(4), 760-764.
Nine Exercises: Incline leg press, chest press, lat pulldown, biceps curl, shoulder press, triceps extension, upright row, knee extension, seated row. All participants did a Max VO2 to determine aerobic capacity.
Protocol: 1 sec concentric/1 sec eccentric with 2-5 seconds rest between sets
All exercises performed at 40% of 1RM and 10 repetitions per exercise
5 continuous circuits making it a 20minute workout: MAJOR FINDING: Training at 50% of VO2max!

Some clients are really pressed for time to get a time-efficient workout completed. Any options? How about a modified Tabata protocol.

McRae, G., et al. (2012). Extremely low volume whole-body aerobic resistance training improves aerobic fitness and muscular endurance in females. Applied Physiology, Nutrition, and Metabolism, 37, 1124-1131
Participants: 22 physically active females (20 yrs) randomly divided into 3 groups
Endurance training 4x a week for 30min at 85% of Heart Rate Max
Tabata protocol 4x a week for 4min: 20seconds of ONE exercise each workout (burpee, jumping jack, mountain climber, squat thrust) separated by 10 seconds rest; **Control:** No training
Modified Tabata Protocol used in the McRae et al (2012) study

a) Select ONE total body movement (burpee, jumping jack, mountain climber, squat thrust)
b) 8 sets (Tell client to do as many repetitions as possible with good form)
c) 20 second 'on' (Note: all exercises were performed 80% of heart rate max); 10 sec 'off'

Variable	**30min Endurance**	**Modified (4min) Tabata Protocol**	**Control**
VO2 Max	+7%	+8%	NC

Leg Extension Endurance**	NC	+40%	NC
Leg Curl Endurance***	NC	NC	NC
Push-up Endurance*	NC	+135%	NC
Curl-up Endurance*	NC	+64%	NC
Back Extension Endurance*	NC	+75%	NC

*Endurance was measured by repetitions. Note: NC means no change.
**Leg extension endurance was completed with 85% of participant's body weight
***Leg curl endurance was completed with 75% of participant's body weight

Multi-Exercise Tabata #1	**Multi-Exercise Tabata #2**	**Multi-Exercise Tabata #3**
Squat to shoulder press Med ball roll over floor slam Alt. lunge move KB under legs 20 sec work, 10 sec rest Rotate through exercises (ABC, ABC, ABC) Complete up to 5 rounds	Kettlebell swings Star plank hold for 20 sec Zercher lunge with barbell 20 sec work, 10 sec rest Rotate through exercises (ABC, ABC, ABC) Complete up to 5 rounds	TRX atomic push-up KB dead lift & high row pull Jumping jack press with med ball 20 sec work, 10 sec rest Rotate through exercises (ABC, ABC, ABC) Complete up to 5 rounds

THANK YOU FOR COMING TO THIS SESSION!