

Session 4101: The Female Training Advantages 2019

By Len Kravitz, Ph.D., University of New Mexico, lkravitz@unm.edu

I. Benefits of resistance training for women

- A. Increase in bone mineral density, increase in fat-free mass, increase in muscular strength and muscular endurance, increase in glucose metabolism (insulin sensitivity)
- B. Increase in HDL-C (some studies), altered total cholesterol and LDL-C (some studies), RMR (7-9%), increase in psychological well-being
- C. Exercise and insulin sensitivity (aerobic and resistance exercise is best)

II. Women's health update: insulin resistance, metabolic syndrome, N.E.A.T. Update, Statistics Update, female abdominal obesity

A. Insulin resistance

- 1. Insulin binds with protein receptor on muscle cell; receptor sends a message to GLUT4 transporter protein to shuttle glucose into the cell
- 2. With insulin resistance, insulin and the receptor no longer react effectively
- 3. Aerobic exercise and resistance training independently activate the GLUT4 protein

B. Metabolic syndrome: 3 of 5 factors (due to excess food intake; too little exercise)

- 1. Waist circumference: women >35 inches, men >40 inches
- 2. Blood pressure: systolic ≥ 130 or higher OR diastolic ≥ 85 (or both)
- 3. Fasting blood sugar: ≥ 110 mg/dL (100-125 mg/dL is pre-diabetes)
- 4. Triglycerides: ≥ 150 mg/dL
- 5. HDL-C: ≤ 40 mg/dL (men) & ≤ 50 mg/dL (women)
- 6. \geq risk factors is highly associated with cardiovascular disease and diabetes
- 7. Cause: too little exercise and too much food intake

D. Glouzon et al. (2015). Muscle mass and insulin sensitivity in postmenopausal women after 6-month exercise training. *Climacteric*, 18, 846-851.

- 1. 123 sedentary postmenopausal women (50-70yr), BMI ≥ 27 kg/m²; nonsmokers, weight stable, light drinkers, no menses for ≥ 12 mon; did 3 exercise sessions/wk over 6 months; Exercise was 30 min of cardio (40% - 85% of heart rate reserve); 30 min of resistance training (total body workout), 12-15 reps at 60% of 1RM and by the end of six months were doing 5-6 reps at 85% of 1RM
- 2. Results: significant reduction in fat mass (5%), and improvement in muscle mass (2%) and improvement of several markers for insulin sensitivity
- 3. This study suggests that with postmenopausal overweight women, focus on cardiovascular exercise and resistance training to best improve markers of insulin sensitivity.”
- 4. The growing body of research is now indicating that the best intervention for improving insulin sensitivity and managing type 2 diabetes is both aerobic and resistance training

(Ishiguro, et al. (2016). In search of ideal resistance training...Meta-analysis, Sports Medicine, 46, 67-77

E. Avilla et al. (2010). Effect of moderate intensity resistance training during weight loss on body composition and physical performance in overweight adults. Euro J Appl Phys 109, 517-525.

Weight loss in resistance training (RT) programs

1. 27 male and female subjects (BMI=32kg/m²): 67 yr
2. Previously sedentary; medical clearance
3. 10-week study: randomly assigned to two groups
4. One group DASH only; 2nd group DASH-RT
5. Measured weight loss, body composition, muscle
6. Registered dietician met once a week to explain diet (DASH): all subjects on individualized diet (10% caloric restrict) based on estimated metabolic rate (Harris-Benedict equation)
7. RT= 40min RT on 3 non-consecutive days; 1 sec concentric; 1sec pause; 2-3 sec eccentric
8. 6 upper body and lower body exercises; warm-up set followed by 4 sets of 8-12 reps
9. DASH lost 2% body weight; DASH lost .2% body fat; DASH lost 2.7% muscle
10. DASH-RD lost 3.6% BW; DASH-RT lost 11.2% BF; DASH-RT gained 1.3% muscle
11. TAKEAWAY: Findings of study show a decrease in fat mass and improvement in muscle strength with resistance training with dietary intervention.

F. N.E.A.T. Update: Non-Exercise Activity Thermogenesis. Resource: Get Up by James Levine, M.D. Research denotes that daily, sustained chair-dependency is associated with shorter life spans, metabolic diseases and cardiovascular disease.

1. Most adults in the U.S. sit 9-12hrs daily (of a 16hr waking day)
2. Strong association with sitting and CV disease and all causes of mortality
3. Levine (2005). Science, 307, 584-586. More N.E.A.T. = More Weight Loss, research shows just by moving more people can burn up to 477 kcals/day by moving during the day
4. New Movement slogan: "For every 30 get your 3": For every 30 minutes of waking behavior get your 3min of movement
5. For movement ideas use this WEB site: getfit.unm.edu/

G. Statistics Update:

1. An estimated 30.3 million people of all ages—or 9.4% of the U.S. population—had diabetes in 2015 (CDC 2017 stats)
2. Obesity is BMI ≥ 30 kg/m²; Extreme obesity is BMI ≥ 40 kg/m²

H. How often does a woman in the U.S. suffer from a heart attack? Every 90 seconds

1. 64% of women have no previous symptoms
2. 80% are preventable...with lifestyle changes
3. 46% of women disabled after heart attack
4. High blood pressure, high LDL cholesterol, and smoking are key risk factors
3. Lifestyle changes: Protective behaviors: stop smoking (if smoke; 2-3 fold increased risk of CVD if smoke); lose excess fat (especially abdominal fat); aerobic exercise minimally 30 min/day;

improve HDL-C and lower LDL-C; control blood pressure; reduce stress via yoga, meditation, exercise relaxation; get regular sleep; if depressed, get support or treatment

4. Cardiac arrest is an electrical event in heart; heart attack is blocked artery circulation in heart

I. Adult female obesity mechanism: Pasquali, R. (2012). The hypothalamic-pituitary-adrenal axis and sex hormones in chronic stress and obesity: pathophysiological and clinical aspects. *Annals of the NY Academy of Sciences*, 1264, 20-35

1. Cortisol is released from the adrenal cortex via stimulation of the HPA axis

2. Newest research shows that chronic stress (or stressors) leads to a hyperactivated HPA axis: increasing appetite, anxiety/depression/apathy, activation of lipoprotein lipase (which deposits visceral fat, increase in fat and sugar in diet, decrease in fat metabolism; all leading to overweight and obesity

3. Chronic stressors include anxiety, depression, perceived levels of stress, alcohol/drug abuse, overeating, personality traits, psychosocial conditions, occupational status, smoking habits, adverse life events

4. Per Bjornstorp (1993). Obesity research. "Visceral adipocytes seem to have a high density of several steroid hormone receptors, directing steroid hormone effects particularly to these depots. The net effect of cortisol is apparently a stimulation of lipid storage."

5. Best intervention: resistance exercise, aerobic exercise, mind-body programs, healthy working environment, & NEAT: Special note: during low-stress living conditions progesterone and estrogen have anti-cortisol effects...limiting the deposition of body fat.

4. Nurses Health Study (16 years following 44,636 women); 751 CVD deaths, 1748 cancer deaths; even normal weight women face elevated CVD and cancer risk with abdominal obesity; women with largest waists are 63% more likely to develop cancer; overall, women with waistline ≥ 88 cm (35 in) saw a 79% greater risk of death from all causes

5. It is well known that excessive abdominal fat (high waist circumference values) and especially visceral adipose tissue is correlated with the development of hyperlipidemia, hypertension, insulin resistance and glucose tolerance, diabetes and heart disease. Paoli et al. (2010), *J. Sports Medicine and Physical Fitness*, 50, 43-51.

6. Therefore, it is clear that regional distribution of fat may be more important to health than total amount of body fat. Paoli et al. (2010).

III. Hormones 101: Altering Cell Function

A. Intro on negative feedback systems (loops)

B. Feedback loops are the major control mechanisms; negative feedback is most common; positive feedback also (example: nerve impulse); negative feedback works like a thermostat

C. Female hormones of interest with exercise are estrogen and progesterone

D. Estrogen and progesterone are derived from cholesterol; produced and secreted primarily by ovaries; estrogen also secreted by adrenal glands

- E. Both hormones are steroid hormones affecting development of female reproductive system
 - F. Estriol: during pregnancy most dominant in circulation
 - G. Estradiol: most biologically active estrogen; also known as 17-beta estradiol
 - H. Estrone: during menopause this is the most dominant estrogen in circulation
 - I. The Estrogen-Fat connection: estrogen helps to control the deposition of visceral fat in women. Menopausal women have more visceral fat (due to the decreased levels in estrogen during menopause. Yamatani (2013). Menopause, 20(4), 437-442.
 - J. The Estrogen-Fat connection cont. Visceral fat is highly associated to cardiovascular disease. Fat cells in the abdominal area are bigger fat cells, which easily release fatty acids into the blood stream (a precursor to heart disease).
 - K. A growing body of evidence now demonstrates that estrogen signaling can have an important role in obesity development in menopausal women. Menopausal women are three times more likely to develop obesity and metabolic syndrome abnormalities than premenopausal women. (Lizcano and Guzman. (2014). Estrogen deficiency and the origin of obesity during menopause. BioMed Research International
 - L. Special Question: How does menopause affect substrate use during rest and exercise performance? Isacco, L. (2012). Sports Medicine, 42(4), 327-342.
 - M. The decline in estrogen and progesterone leads to a decrease in fat utilization and decrease in fat-free mass.
 - N. Average decrease in RMR of about 100 kcals/day: NOTE, very active menopausal women gain less weight
 - O. How can I boost my client's metabolism: NEAT, resistance exercise, HIIT workouts
- IV. Glucose Pathways to Brain, Adipose Tissue & Muscles: Carb. Metabolism (OVERVIEW)
- A. What do we know about female use of glucose and glycogen (the stored form of glucose)?
 - B. Tarnopolsky (2008) summarizes that the research indicates that during endurance exercise, glucose appearance is lower and it has a 'slower' rate of disappearance, as compared to men
 - C. Tarnopolsky (2008) continues that inhibited carbohydrate utilization during endurance exercise observed with women will have a direct effect on fat metabolism
- V. Fat metabolism and aerobic exercise program design (overview of fat oxidation adipose/muscle): Swimming training advantage; body fat aids in buoyancy, females have less 'drag', expend 20% less energy (at same pace/distance as men) (Pendergast, 1977). Gertrude Ederle story about swimming the English Channel
- A. Fat mobilization is the releasing of fat from storage depots
 - B. Epinephrine stimulates mobilization and lipolysis (splitting of fat)
 - C. Estrogen enhances epinephrine production
 - D. Estrogen inhibits lipoprotein lipase (LPL)

- E. Estrogen stimulates growth hormone (GH) production: GH enhances fatty acid metabolism and inhibits glucose metabolism
- F. Why is there a difference in fat distribution in males and females
 - 1. Fat cells have norepinephrine receptors
 - 2. Alpha receptors inhibit lipolysis; beta receptors stimulate lipolysis
 - 3. Women have more alpha receptors in hips/thighs/buttocks
 - 4. Women have more lipoprotein lipase (LPL) in the hips and thighs (LPL deposits fat)
- G. Respiratory Exchange Ratio (RER) is the volume of carbon dioxide (CO₂) expired in relation to the volume of oxygen (O₂) inspired: it reflects what fuels utilized in exercise; RER ranges from .7 (~100% fat) to 1.0 (~100% carb.); so, if RER goes LOWER there is higher utilization of fat...if RER goes UP, there is more usage of carbohydrate
- H. Gender differences in fuel utilization during exercise; a gender difference exists in relative contribution of carbohydrate and lipids; at submax intensities (~ 60 min of exercise); women utilize more fat for fuel (17-beta estradiol); Special note: Most studies have reported higher intramyocellular lipid in women compared with men. (this is the fat used first in endurance exercise). Also, females have a slightly higher reliance of fat AFTER exercise too.
- I. Designing aerobic programs to enhance fat metabolism
 - 1. Incorporate low-to-moderate int., long-duration workouts (increase metabolic base: increase of size {35%} and number {15-50%} of mitochondria)
 - 2. Incorporate FAST continuous training (increase total fat metabolism); tell client to work at her maximal steady state pace
 - 3. Incorporate interval training (more work = increased total fat metabolism)
 - 3a. Talanian et al. (2007). J. Applied Physiol, 102, 1439-1447. HIIT study with women. In summary, seven sessions of HIIT over 2 weeks induced marked increases in whole body and skeletal muscle capacity for fatty acid oxidation during exercise in moderately active women. Several enzymes and transport proteins involved in fat metabolism were upregulated. They did a HVIT (High Volume Interval Training Program). Alternated 4-minute bouts of high intensity (~90% heart rate max; RPE 16-17) with 2-minute rest intervals (light exercise that was self-selected); 10 intervals.
 - 4. Incorporate more multi-mode for injury prevention and fat metabolism

VI. Resistance training design

- A. Females have much greater 'fatigue resistance' than males; fatigue is defined as the point during a resistance exercise set when the muscles can no longer produce sufficient force to control a given load. Hunter, S. (2016). The relevance of sex differences in performance fatigability, MSSE, 48(11), 2247-2256.
- B. Females have 23% greater fatigue resistance (than men) at task specific relative forces

- C. WHY: Lower absolute muscle mass, lower muscle oxygen demand, increased oxygen extraction and waste clearance, estrogen increases blood flow to working muscle, increased neuromuscular activation after fatiguing exercise
- D. Fatigue resistance training implications: FIT females capable of more high volume (reps x sets) workouts; FIT females require less recover time between sets (60 sec); FIT females need fewer rest days between intense ($\geq 80\%$ 1RM) workouts
- E. Any unique training methods (from the published research)?

Reciprocal Super Setting (A Super Setting Training Technique with impressive results)

Review of a different types of super sets (1 set performed and immediately perform 2nd set of a different exercise). Agonist/antagonist, opposite action, upper body/lower body, lower body only, upper body only

Introducing Reciprocal Super Setting Research: Biceps curl/triceps extension REST 1 min REPEAT up to 4 times. Kelleher, A.R. et al. (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. Study results showed reciprocal super setting elicits a significantly higher energy expenditure, blood lactate and EPOC (exercise afterburn) as compared to a traditional resistance training program design.

Thank you very much for coming to this session!