

The Female Training Advantages 2017

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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) improved

III. Women's health update: insulin resistance, metabolic syndrome, N.E.A.T. Update, stand and work; 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)

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 fat loss and muscular fitness improvement 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. 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. 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
2. Standing workstations update. Ognibene, G.T., J. (2015) Occupational & Envir. Med: 46 men and women with low back pain had less pain after a 3-month intervention using a sit-stand workstation. 78% more likely to report a pain-free day.
3. Sit-Stand study results: improved perceptions of energy and health, happiness at the worksite, improved productivity, less bodily soreness, less shoulder, elbow and wrist pain
4. Things to consider when choosing an alternative workstation. Comfort/fit, cost, footwear, electrical power access, durability and maintenance, insurance if get hurt while in use, clothing to wear, noise, space. GREAT WEBSITE: juststand.org

F. Statistics Update:

1. 11% of women have been diagnosed with diabetes in U.S.: 86 million Americans (1 in 3) with pre-diabetes; nearly 90% of these individuals don't know have it. If untreated, 15-30% of pre-diabetes will develop diabetes within 5 years. American Diabetes Association (2016)
2. Obesity in Women in the U.S.: Currently 28% of women are obese (BMI >30kg/m²)

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

1. 50% chance of dying on first heart attack; 80% are preventable...with lifestyle changes
2. 46% of women disabled after heart attack
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

H. Adult female obesity mechanism

1. Challenged situation=norepinephrine 'fight' hormone; loss of control=epinephrine 'flight/anxiety' hormone; chronic stress=cortisol cascade
2. Cortisol cascade: release fatty acids in blood (precursor to heart disease), relocate fat to deep abdomen (visceral obesity), enhances fat deposition: Review of Cortisol Cascade
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."
3. Best intervention: resistance exercise, aerobic exercise, mind-body programs, healthy working environment, & NEAT: Special note: during non-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

I. Special Question: How does menopause affect substrate use during rest and exercise performance? Isacco, L. (2012). *Sports Medicine*, 42(4), 327-342.

1. The decline in estrogen and progesterone leads to a decrease in fat utilization and decrease in fat-free mass.
2. Average decrease in RMR of about 100 kcals/day: NOTE, very active menopausal women gain less weight
3. How can I boost my client's metabolism? N.E.A.T. and resistance training

IV. Hormones 101: Altering cell function

- A. Endocrine means hormone secreting; comes from Greek root meaning 'impetus'
- 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. It is well know 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.
- L. 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).

V. 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

VI. 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).

- 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. Is there a gender difference in fat utilization? BIG DEBATE! Most comprehensive research concludes YES; 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)
 - 2. Incorporate FAST continuous training (increase total fat metabolism)
 - 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

VII. 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 (then 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. What training systems are recommended (from the published research)?

Block vs. weekly undulating periodized resistance training programs in women (Bartolomei et al., 2015). *Journal of Strength and Conditioning Research*, 29(10), 2679-2687.

Block developed in 1970's by Verhoshansky with Soviet athletes

WUD originally develop in 1960's by Matveev

17 recreationally trained women (age=25); 9 in BLOCK group; 8 in WUD group; 3 days per week for 10 weeks; matched the total work; Exercises for Monday: squat, countermovement jump, bench press, leg curl; Wednesday: deadlift, prone barbell row, lat pull-down, preacher curl; Friday: sumo deadlift, leg extension, incline bunch press, triceps extension

RESULTS: 1. Block and WUD both showed significant improvements in strength and power, 2. Lower body strength significantly better in WUD; 3. Both groups improved in arm hypertrophy, 3. Only WUD group showed size improvement in thigh

Peripheral heart action (PHA) training. Developed in 1940's by Dr. Arthur Steinhaus; popularized in 1960's by legendary body builder (Bob Gajda, Mr. America title holder);

*Goal of PHA is to keep blood circulating through the body during the entire workout; typically alternates one exercise for the upper torso and one for the lower extremities with no rest between exercises;

*New research (Piras et al. 2015. *European J. Appl Physiol.*) utilizing a bench press, leg extension, lat pull, leg curl, shoulder press, calf raise sequence

*9 men, 9 women (24yr, recreationally active) in a 12-week study; 3x/week: 15 reps at 55-60% of 1RM; Did four circuits and rested 1min after each circuit:

*Results showed in crease in VO₂max by 8% and improvement in several cardiovascular variables

Thank you very much!