

# Secret Life of a Fat Cell

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## Today's Goal: Address Concepts of Fat Exercise Professionals Want to Know?

- I. Fat: Nature's energy savings account! Visceral (checking account) vs. Subcutaneous (Savings account)
  - A. Lipids (oils and fats): Oil=liquid, fat=solid, 95% in body are triglycerides (TG)
  - B. Fats are organic compounds of hydrogen, carbon and oxygen
  - C. Three basic roles of fat
    1. Fuel source: 9 kcals per gram, about 100,000 kcals stored in body
    2. Provide essential fatty acids: linoleic acid (omega-6), alpha-linolenic acid (omega-3)
    3. Flavor and texture of foods we eat
  - E. Seven functions of fat: cell membrane, energy, lipoproteins, organ protection, thermal regulation, vitamin carrier, nerve transmission
  - F. Lipoproteins: lipids in protein packages. Chylomicrons deliver fatty acids (FA) to adipose tissue  
VLDL-C (FA to muscle and heart), HDL-C (scavenger), LDL-C (mostly cholesterol);  
What does density refer to? lower density = increased fat (TG)
  - G. Jeukendrup et al. (1998): Store about 2216 Kcals of CHO and >100,000 Kcals of Fat (enough fat energy to run 25 marathons. Horowitz 2003).
  - G. Fuel comparisons: 4 kcals/gram for CHO and Protein versus 9 kcals/gram for fat
  - G. Saturated: coconut oil, palm kernel oil, chocolate, milk, beef, palm oil, chicken
  - H. Monounsaturated: canola oil, poultry without skin, olive oil, almonds, peanuts
  - I. Polyunsaturated: soft margarine (most), sesame oil, mayonnaise, corn oil, salmon
  - J. Most fats are a combination of all types of fatty acids: Example from U.S. Dept. of Agr. Nut. Data Base
- II. Fat, blood cholesterol, fatty acids and health
  - A. Saturated are sticky molecules; very un-reactive which harden in arteries
  - B. Introducing Frank Sacks, M.D. World renowned researcher on diet, blood pressure, lipids and wt loss.  
Sacks, F. (2017) The heart of the matter. Nutrition Action Healthletter, 44(9), 3-9.
  - C. Saturated increases cholesterol (<10% in diet)
  - D. Monounsaturated fat decreases cholesterol when replacing saturated fats (10% in diet)
  - E. Polyunsaturated fat decreases cholesterol when replacing saturated fats (10% in diet); polyunsaturated fats are considered the healthiest of all fats
  - F. Why so much emphasis on reducing saturated fat? Cardiovascular Disease (CVD). "The evidence that saturated fat caused atherosclerosis and heart disease is compelling." Sacks 2017
  - G. "Saturated fat increases LDL—or low-density lipoprotein cholesterol. And LDL cholesterol is a cause of heart disease. It's not a risk factor. It's a direct, absolute cause." Sacks 2017
  - H. Are large LDL particles safer than small LDL? "No...if you have a lot of big LDL, it's no better than a lot of little LDL." In fact, big LDL is probably worse, because it's loaded up with more cholesterol."
  - I. Do high triglyceride (TG) levels cause heart disease? "The evidence linking TG to heart disease is getting stronger." High TG means high VLDL, which do not carry as much cholesterol. Sacks 2017
  - J. Is low HDL a risk, since HDL takes cholesterol out of the arteries? "We know that people who have low levels of HDL-C have higher rates of heart disease...as a risk factor, it's totally solid. But if you raise HDL levels, can you increase cholesterol removal from the artery wall and reduced heart disease? That's where the HDL story breaks down." Sacks 2017
  - K. HDL cholesterol is referred to as a negative risk factor because it NEGATES the CVD risk
- III. Transport of fat in the body and hormonal interactions
  - A. Chewing
  - B. Stomach is temporary holding tank for fat
  - C. Small intestines where fat breakdown initiates

1. Bile: emulsify (breaks fat into smaller particles)
  2. Pancreatic lipase: disassembles TGs into free fatty acids and glycerol
- D. Absorption (villi and microvilli) into micelle cells; and transportation in chylomicrons
- E. Lipoprotein lipase (LPL) lines capillary membrane: extracts fat from lipoproteins
- F. Female thigh adiposity: alpha receptors (inhibit lipolysis); beta receptors (stimulate lipolysis); women have more alpha receptors in hips/thighs/buttocks and more LPL in hips/thighs
- IV. Fat metabolism in muscle
- A. Hormone sensitive lipase (HSL) story in initiating lipolysis (breakdown of fat) via cAMP (fat mobilizing hormones are epinephrine, norepinephrine, glucagon, and growth hormone): albumin in the protein transport of free fatty acids in the blood stream; fat enters cells with 3 proteins (FABP, FAT, FATP)
  - B. Cell-Mitochondrion (fat burning furnace of cell); from aerobic exercise can make 35% bigger and increase in size 15-50%
  - C. Metabolism review: TCA cycle (metabolic grindstone)
  - D. Electron transport chain is where the greatest amount of ATP is synthesized
  - E. Fat kilocalorie yield explanation; follow the hydrogen atoms
  - F. Why does the body prefer carbohydrate (CHO) for fuel, if fat yields more ATP?
    1. Fat has a 30% to 40% slower breakdown
    2. Mobilization, lipolysis, beta oxidation all take more time than CHO breakdown
  - G. Does exercise improve fat burning capability? Original study investigating this topic is by Hurley, B.F. et al. (1986). Muscle triglyceride utilization during exercise: effect of training. *Journal of Applied Physiology*. 60, 562-567. (Most cited article on topic)
  - H. Trials: Fuel source utilization before and after 12-week training program (9 men doing a 2-hour bout of exercise at 60% VO<sub>2</sub>max). Did 3 days a week of interval training for 40 min and 3 days a week of continuous training for 40 min: TG went from 20-40%; carbohydrate went from 71-37%
- V. How do we maintain our fat balance with exercise and fat utilization
- A. Factors that encourage people to develop fat: age, gender, positive energy balance, physical inactivity, RMR, TEF, ratio of fat to fat-free mass, LPL, behavior factors (also genetics)
- VI. Special Topics on Fat and Fat Burning
- A. How much fat-free mass is lost in 'diet only' programs: 30%
  - B. Understanding the respiratory exchange ratio (RER): VCO<sub>2</sub>/VO<sub>2</sub>
  - C. ACSM Guidelines for Exercise and Weight Loss: For weight loss (200-420 minutes/wk; can accumulate in ≥10 min bouts; 'Somewhat Hard' intensity); To prevent weight gain: 150-250 minutes/wk; Best practices suggest 250-300 minutes/week
  - D. What is the BEST kept secret about resistance training and 'fat loss'? Post workout fat oxidation!
- VII. I've heard if I do cardio first thing in the morning I will burn more fat. Is this true?
- Paoli et al. (2011). *Int. J. of Sports Nutrition and Exercise Metabolism*, 21, 48-54
- A. Fed or Fast Study: 8 exercise-trained men (27 yrs), 36-min treadmill run under 2 conditions separated by 1 week; Breakfast either BEFORE OR AFTER run, Breakfast-Mediterranean (25% protein, 53% carbohydrate, 22% fat); did 12 and 24-hour oxygen consumption and respiratory exchange ratio (RER): FED burned more calories and more fat calories!

### **Len's Favorite Fat and Calorie Burning Workouts**

#### **1) HVIT: High Volume Interval Training** (Perry et al., 2008)

**Protocol:** Subjects completed 10 exercise intervals lasting 4 minutes interspersed with 2-minute rest intervals (option; no exercise or self-selected light exercise).

**Intensity:** The subjects in this study were at 95% of their actual heart rate max during the 4-minute

intervals, which would be analogous to a 17-18 on the RPE scale. (Reminder, modify intensity appropriately for clients.)

**Duration:** This total workout takes close to one hour to complete.

## **2) SIT: Sprint Interval Training** (Burgomaster et al. 2008)

**Protocol:** Subjects did 4-6 sprint intervals lasting 30 seconds interspersed with 4.5 min self-selected pace recovery

**Intensity:** The subjects in this study performed at an all-out effort, which would suggest about a 18-20 RPE rating. Reminder, this workout involves a very forceful effort bout, which can easily be modified to a much less vigorous exertion for clients not prepared for that rigorous of a stimulus. Self-selected 4.5 minute recovery 8-9 RPE

**Duration:** This total workout takes 20 to 30 minutes for the 4-6 sprint intervals, respectively.

## **3) HITT with Variable Recovery** (Seiler & Hetlelid, 2005).

**Protocol:** The subjects did 4-minute bouts of exercise (can do on any mode) at near maximal intensity with alternating recovery intervals of 1, 2 and 4 minutes

**Intensity:** Near-maximal interval hard to very hard, or 17-18 on the RPE scale. The recovery is self-selected

## **4) Multi-Mode Interval Play** (Kravitz, 2009)).

Slow, medium and fast training over a variety of times/distances

No set structure other than the workout is 20-60 minutes (i.e., ACSM guidelines)

Use multiple exercise modes

Mix it up with: light, somewhat hard, hard and very hard exercise of different CV modes (randomly)

## **5) Long Duration Interval Cycling Plus Running** (Sandbakk et al, 2012)

**Protocol:** The subjects did two 10-minute intervals at cycle race pace with 5 to 7-min recovery; After completion of two intervals subjects did a 20 to 30 min low intensity treadmill run

**Intensity:** The near-maximal interval was hard to very hard, or around 17-18 on the RPE scale. The recovery interval self-selected. **Duration:** This total duration can vary to individual goals

## **6) HILL Training HIIT** (adapted from Wisloff et al. 2009))

**Protocol:** Set treadmill at incline of 5%-8% and speed at 3mph (walking first to get used to incline).

Then, increase the speed to 5-6.5mph, while keeping incline at 5%-8%. Work interval is 1 min.

**Self-selected speed rest:** Let client adjust speed during rest period for 2 min but keep the 5%-8% incline

**Duration:** 3-6 intervals

## **7) Weighted Vest Workout: Elliptical or Treadmill** (Tiumil, 2011)

**Protocol:** Five, 1-min bouts on treadmill followed by 2-min recovery walking while wearing 5-7% body weight vest; then did a 30-min jog with no vest

**Intensity:** Sprints are very hard intensity; recovery is very light; 30-min jog is 60% HRmax

**Duration:** With intervals and continuous jog this is a 45-min workout

## **8) 30/30 HIIT Training** (Moriarty et al. 2017)

Warm-up: 5-10 min of light intensity exercise; Mode: Treadmill with no grade

Work: 30 seconds at 90% VO<sub>2</sub>max (RPE =Very Hard); Relief Interval: 30 seconds at 35-40% VO<sub>2</sub>max (Walk, RPE=Light); Work/Rest Ratio: 1 to 1 ratio.

**9) Step-Wise 30/30 HIIT Training** (Moriarty et al. 2017)

After each interval increase treadmill grade 2-3% and keep for work and relief interval

Can complete on any mode increasing work with each interval

**10) Short Sprint HIIT Training from Australia** (Boutcher 2011)

**Warm-up:** 5min of light exercise; **Workout:** 8 seconds sprint followed by 12 seconds recovery (20-30 rpm) on cycle; light resistance on cycle; progressed to 20 minutes and then started adding load in 0.5 kg increments. Maintained 20 min duration and completed 3times/week.

**Recommended Readings on Len's WEB site: [drlenkravitz.com](http://drlenkravitz.com); Go to 'Publications Link'**

Deyhle, Mermier & Kravitz (2014). The physiology of fat loss. IDEA Fitness Journal, 11(1), 36-44.

Kravitz, L. (2009). Calorie burning: It's time to think "outside the box." IDEA Fitness J, 6(4), 32-38

Kravitz, L. (2009). Too much sitting is hazardous to your health. IDEA Fitness Journal, 6(9), 14-17.

Kravitz, L. (2006). A NEAT "new" strategy for weight control. IDEA Fitness Journal, 3(4), 24-25.

Vella, C. A. & Kravitz, L. (2004). Exercise After-burn: A research update, IDEA Fitness Journal, 1(5), 42-47.