

Women, Exercise & Metabolism

EXERCISE
ETC. INC.



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What is Metabolism?

- All reactions by which the body obtains and spends the energy from food



Metabolic Homeostasis

Calories in = Calories out
Weight Maintenance

Calories in < Calories out
Weight Loss

Calories in > Calories out
Weight Gain

TOTAL DAILY ENERGY EXPENDITURE (TDEE)



TDEE = Resting metabolic rate (RMR)
+ Thermic effect of food (TEF) + Thermic effect of physical activity (TEPA)

RESTING METABOLIC RATE

- Energy required for physiological homeostasis
 - organ functioning, temperature regulation, etc
- 60-75% of calorie needs per day



What Affects a Woman's RMR?



- Genetics
- Age
- Fat Free Mass
- Surface Area
- Temperature
- Caloric Restriction
- Hormones
- Menopause

Role of Genes in Metabolism

- If both parents obese
 - child has 70% chance of being obese
- One obese parent
 - 40%-50%
- Both parents lean
 - 15%-20%



Twin Studies Find That....

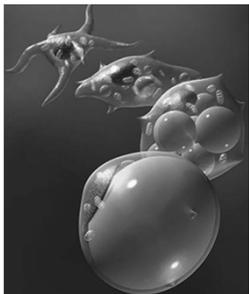


- Studies on identical twins indicate that genetics may have as much as a 60-70% role in what we weigh.
- Identical twins separated at birth tend to weigh nearly the same.

Body Types & Metabolism

- **Endomorphs**
 - softer and rounder; typical pear shape, small boned with a high fat to muscle ratio.
- **Mesomorphs**
 - medium bone structure, shorter limbs in relation to the trunk; high muscle to fat ratio
- **Ectomorphs**
 - highest metabolic rate and tend to have longer limbs in relation to their trunk.

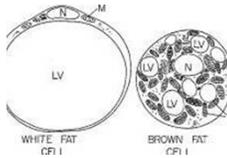
Fat Cells and Fat Storage



- Average female has ~27 billion fat cells; obese may have as many as 75 billion.
- Body adds additional fat cells at 3 critical times: last trimester in the womb, first year of life, and during puberty.
- Create new cells as old die off, obese have faster turnover. Do not add more cells, just get bigger

Alpha/Beta Receptors

- Beta-receptors are more active and give up their fat easily
 - found in greater numbers in intra-abdominal fat cells
- Alpha receptors are resistant to giving up their fat
 - found in particularly high numbers in the femoral fat stores in females



Does Metabolism Slow with Age?

- Framingham Study:
 - Average weight gain of 20 pounds between the ages of 25 and 55
- International Journal of Obesity (2003)
 - Women gained 26 lbs between 25-60 and then started to lose



Fat Free Mass (FFM)

- Decline of FFM with age due to decreasing physical activity
 - ¼ lb/yr after 40
 - oprah.com
 - 3 lb/decade after 30
 - Dr. Al Sears April 2008 – Reverse Aging
- Tufts University: a person cannot sustain life with a loss of 40% of lean tissue.

↑ Surface Area = Hotter Furnace

- Body requires more calories to maintain a larger area than it does a smaller area.
- Taller individuals have more skin and more vascular area that must be maintained.



Temperature



- Maintaining core temperature is a metabolic function
- Burn calories via sweating and vasodilation in the heat and shivering and vasoconstriction in the cold

Caloric Restriction ↓ Metabolism

- Reducing caloric intake below energy needs sets off survival mechanism which results in the metabolic rate lowering on average by 15%.



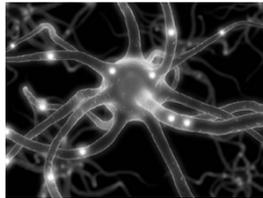
Caloric Restriction ↑ Fat Storage



- Studies show an increase in fat storage with caloric restriction
- Duetz, et al (2002)
 - Elite female gymnasts and runners with the highest body fat percentage had the lowest caloric intake

Women, Hormones & Metabolism

- Estrogen
- Progesterone
- Testosterone
- Thyroxine



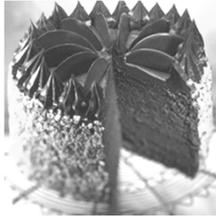
Estrogen and Fat Storage



- There are two critical times when estrogen drives fat storage in women: puberty and pregnancy.
- Estrogen encourages fat storage in the breasts, hips, thighs and buttocks

Estrogen and Sweets

- Estrogen makes females more sensitive to insulin, particularly during the post-ovulatory period
- Lower blood sugar initiates craving for sweets that many women experience during the pre-menstrual period



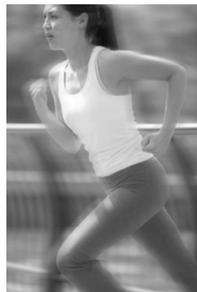
Estrogen Affects Appetite



- High estrogen and insulin levels are also associated with fluid retention.
- Enables leptin to work efficiently which helps control appetite and increase calorie burn

Progesterone ↑ Metabolism

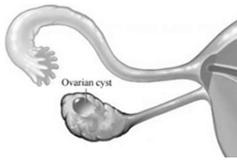
- Progesterone, which peaks following ovulation during the menstrual cycle, causes a slight increase in body temperature and an increase in metabolic rate.



Thyroxin Controls Metabolic Rate

- Acts in mitochondria-the cell's furnace
- May be low in about 20% of women
- Low levels may cause weight gain
- TSH is a screening blood test
- Medication restores to normal
- Low also associated with depression and high cholesterol

Polycystic Ovarian Syndrome



- High testosterone
- Infertility
- Acne
- Facial hair
- Weight gain

Menopause and Metabolism

- The menstrual cycle is a physiological process, which costs the body calories to perform.
- In the post-ovulatory phase (the two weeks before the menstrual flow begins) a female's metabolic rate increases about 200-300 calories per day.



Menopause & BMI

- BMI increases at a steady rate from the 3rd decade to the 7th decade with no acceleration in the perimenopausal period
- Effect of menopause is small relative to other influences especially physical activity



Menopause and Weight Gain

- No research to show that menopause causes weight gain
- Average gain of 1 pound a year between ages 42 and 50 regardless of menopausal stage
- Decline due to decreased activity leading to decreased RMR

Why Do Peri-Menopausal Women Gain Weight?

- Increase in % body fat perhaps due to the body trying to increase estrogen by having more fat in the cells (fat tissue holds estrogen which also may explain an increase of breast cancer in obese women)

Surgical Menopause

- Women who have a surgical induced menopause tend to gain more weight due to the sudden decrease in both estrogen and testosterone

Menopause & Fat Free Mass

- In a cross-sectional study comparing female athletes and sedentary women between the ages of 18-69, there was no difference in body fat percentage and fat free mass between the youngest and oldest athletes. In addition, the older athlete's metabolic rates were similar to the young athletes, not to the older, sedentary controls.

Hormone Replacement Therapy

- HRT tends to reduce weight gain in early menopause women
- User of HRT were leaner and had less abdominal fat and less % body fat
- HRT enables leptin to perform
- HRT increases sense of well being so more likely to exercise

TEF: Thermic Effect of Food

- Influenced by
 - Composition
 - Amount
 - Frequency
- About 10% of TEPA



Composition



- Protein: approximately 10 – 30 kcals per 100 kcals are burned during the digestion process
- Carbs: approximately 5 - 10 kcals per 100 kcals are burned during the digestion process
- Fat: approximately 0 - 3 kcals per 100 kcals are burned during the digestion process; the lowest TEF.

Fiber & TEF

- Fiber: slows down digestion, reduces insulin spikes and helps regulate blood sugar. High fiber foods require more calories to digest resulting in less calories absorbed. If women ate the recommended 24 grams of fiber per day instead of the 12 they currently consume, they would absorb 90 fewer kcals per day.



Amount of Food & TEF

- Varies from person to person, however too much food at one time can suppress TEF



Frequency & TEF

- Eating breakfast increases metabolic rate by 5%. Not skipping meals and eating more frequently allows for several daily increases in metabolic rate. Skipping meals results in slowdowns in metabolic rate.
- Too many meals may be counterproductive. A snack of less than 10% of daily caloric intake does *not* result in an increase of metabolic rate.

Thermic Effect of Physical Activity (TEPA)

- About 15-30% of TDEE
 - ADL: Activities of Daily Living
 - The “Fidget Factor”
 - Exercise



Activities of Daily Living

- VO2 Max is correlated to physical activity levels throughout the day.
- Walking, even at a slow pace, burns 3 times as many kcals per minute as sitting.
- Example: 150 lb female:

Activity	Kcals burned per hour
Sitting	71
Walking	214
Difference	143

Increasing Caloric Expenditure

- Standing versus sitting while talking on the phone for 1 hour each day could result in a 7 pound weight loss in a year.
- Parking inconveniently so you accumulate 30 minutes of walking each day could result in an 8 pound weight loss in a year.
- Spending 1 hour each day cooking dinner could result in a 10 pound weight loss in a year.



Fidgeting



- Approximately 1/3 of the population can overeat moderately without weight gain. It is thought to be due to non-exercise activity thermogenesis (NEAT) which is all activity in a day except that which is used for purposeful exercise.

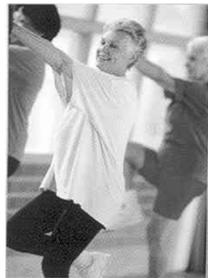
The Fidget Factor

- In one study, male & female volunteers were overfed by 1,000 kcals per day for 8 weeks. All participants increased activity intuitively, however those who fidgeted or were the most restless gained an average of only 3 pounds while the "least fidgety" gained 16 pounds.



Exercise & Metabolic Rate

- **Excess Post Oxygen Consumption (EPOC)** refers to an increase in metabolic rate following an exercise session of sufficient intensity (> 70% VO₂) and duration.



Post-Exercise Metabolism

- Metabolic rate increased by 16% for a period of 39 hours in a group of elite skiers after an intense training session. Metabolic rate decreased by 16% in one female skier who was a recovering anorexic; this demonstrates the importance of caloric intake in order to benefit from exercise induced metabolic increases.

Metabolism & Caloric Replacement

- Metabolic rate increased by 12% for a period of 9 hours following intense exercise in a group of female athletes who replaced their exercise calories. No increase in metabolic rate was shown for those who did not replace their calories.

Exercise & Metabolism



- Mode
- Intensity
- Frequency
- Duration
- Progression

Mode:

Aerobics vs. Strength Training

- Clients with an average fitness level can burn approximately 5-7 kcals per minute of aerobic exercise.
- Women performing strength training can burn between 5-8 kcals per minute.



Aerobic vs Strength Training

- Study by Miriam Nelson at Tufts showed that women who walked 1 hour a day 5 days a week for 3 months did not increase energy expenditure throughout the day but women who did ST 2x week increased energy expenditure by 15% due to increased energy levels

Aerobics vs Strength Training

- Older women who were not dieting did ST 2x per week for one year. At the end of the year they gained 3.3 lb of muscle, controls lost 1.1 pounds
- Dieters maintain more muscle but do not have enough calories to build muscle

Aerobics vs. Strength Training

- Done correctly, strength training is at a higher intensity than moderate aerobic training and studies show a greater number of calories expended and increased fat oxidation during the recovery period (EPOC). In addition, maintaining and/or increasing lean mass increases metabolic rate.



Intensity

- Females are often discouraged from working at higher intensities because “less fat is burned.”
- Even though a smaller percentage of fat is burned at higher intensities, more fat and calories are burned at higher intensities due to EPOC and a higher rate of caloric expenditure.



Energy Expenditure Calculations

- **Walking** (< 4.5 mph):
weight (lbs) X speed (mph) = kcal/min div by 100
Example: 150 lbs. X 3.5 mph = 525 div by 100 = 5.25 Kcal/min



- **Running** (> 4.5 mph):
weight (lbs) X .72 = Kcal per mile
Example: 150 lbs. X .72 = 108 Kcals per mile



Caloric Comparison: Walking & Running

<i>Exercise time</i>	<i>Activity</i>	<i>Total kcals expended</i>	<i>Fat kcals expended</i>
60 minutes	Walking: 3.5 mph	315 (5.25 X 60)	221 (70% fat)
60 minutes	Running: 5.0 mph	540 (150 X .72)	270 (50% fat)

REMINDER

- Do not worry about the substrate that is used; weight is determined by calories in vs. calories out

Frequency & Duration: ACSM Recommendations



- Optimal fat loss is achieved with weekly caloric expenditures of 1,500-2,000 kcals.
- Exercise sessions should strive to burn between 300-500 kcals.
- Fitness Professionals should use a variety of frequencies, durations and intensities, based on client preferences, to achieve these goals.

How Frequency & Duration Affect Caloric Expenditure

<i>Frequency</i>	<i>Duration</i>	<i>Intensity</i>	<i>Kcals burned per session</i>
3 days per week	≥ 60 minutes	moderate	500
4 days per week	45 minutes	moderate	400
5 days per week	30 minutes	moderate	300

Progression & Fitness Level

- Caloric expenditure and fat oxidation improve with fitness level.
- Sedentary, untrained women burn approximately 50% carbohydrate and 50% fat at rest; they take approximately 20-30 minutes to mobilize fat from adipose tissue during physical activity.

Fat Burning in Trained Women

- Utilize ~ 70% fat at rest, sparing glucose stores
- Burn a higher percentage of fat at any given intensity compared to untrained women
- Mobilize fat sooner and more efficiently during exercise



Calculating A Woman's (BMR)

- Start with: 655
- Add: + (9.6 x BW in kg)
- Add: + (1.85 x Height in cm)
- Subtract: - (4.7 x Age)

**Example:
Calculating A Woman's (BMR)**

Female: 125 lbs.; 65 inches; age 40

Pounds to kg: 125 divided by 2.2 = 57;

Inches to centimeters: 65 x 2.54 = 165

$$655 + 547 (9.6 \times 57) + 305 (1.85 \times a65) - 188 (4.7 \times 40) = 1319 \text{ BMR}$$

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