

Lecture 10 – Exercise Physiology

Body Weight

- Nearly all individuals believe that they should weigh more or less
- Both extremes are unhealthy
- Underweight – too little body fat for health; defined as having a body mass index of less than 18.5
- Overweight – too much body fat percentage; defined as a body mass index of 25.0-29.9
- Body composition – the proportions of muscle, bone, fat, and other tissue that make up a person's total body weight
- Body Mass Index (BMI) – an indicator of obesity or underweight, calculated by dividing the weight of a person by the square of the person's height

Obesity

- Health Canada tracks prevalence of obesity and underweight through national surveys
- 59% overweight – adults
- 23% obese – adults – over 70% of these suffer from at least 1 major health condition
- 1 in 5 children/teenagers overweight
- Serious health risks associated with obesity more often– hypertension, diabetes, heart disease
- Other health risks – abdominal hernias, arthritis, complications of pregnancy and surgery, kidney stones, flat feet, gallbladder disease, gout, high cholesterol and high blood lipids, liver malfunction, respiratory problems, sleep apnea, some cancers, varicose veins, higher rate of accidents, depression
- Twice as high – risk of dying from all causes after the above are taken into account

Body Fat Distribution

- Factors that affect body fat distribution:
 - Hormones - In general, women tend to store more fat in their breasts, hips and thighs. Men tend to store extra weight around their waist.
 - Menopause - hormone levels are changing - how does that affect fat distribution?
 - Alcohol intake- increase subcutaneous fat, esp. in abdomen “Beer belly”
 - Medication use - anti-psychotics, glucocorticoids, insulin, beta blockers, antidepressants, BCP
 - Physical activity - associated with reduction of central adiposity, even if weight is maintained
- Visceral fat – fat stored within the abdominal cavity with the internal abdominal organs; also called intra-abdominal fat
- Central obesity – excess fat in the abdomen and around the trunk
- Subcutaneous fat – fat stored directly under the skin

Central Obesity

- Higher risk of diabetes, stroke, hypertension, and coronary artery disease
- Visceral fat contributes more to blood lipid levels
- Subcutaneous fat does not release lipids into the blood stream as readily
- “apple” shape – central obesity
- “pear” shape – associated with women of reproductive age
- **Waist circumference – a better indicator of risk with excess weight**
 - **Men > 102 cm (40inches)**
 - **Women > 88cm (35inches)**
- Increase risk for diabetes, hypertension, heart disease with waist circ. greater than the above measurements

BMI

- <18.5 = underweight
 - 18.5-24.9 = normal weight
 - 25.0-29.9 = overweight
 - 30.0-34.9 = obese class 1
 - 35.0-39.9 = obese class 2
 - >40 = obese class 3
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- Obesity is considered a chronic disease
 - BMI is the standard measurement of body composition, both in a clinical setting and in research BUT it does not differentiate between muscle weight and fat weight - therefore many athletes & muscular people may be misclassified as overweight/obese.

Body Composition

- Better, more accurate information on fitness/fatness than BMI
- Average body composition of men and women
 - Men = 45% muscle, 25% organs, 15% fat, 15% bone
 - Women = 36% muscle, 24% organs, 27% fat, 13% bone
- How do we measure body composition?
 - Body folds – caliper measurements (anthropometry)
 - Density – underwater weighing
 - Conductivity – BIA (bioelectrical impedance)
 - Radiographic – DEXA (dual energy x-ray absorptiometry)
 - <https://youtu.be/tUBnGpe7Gd4>
- What is the ideal amount of body fat percentage?
 - Unknown and somewhat controversial. Most agreement on:
 - Men: 12-20 percent
 - Women: 20-30 percent

Cost of Obesity – social and economic

- Overweight individuals are more likely to be judged based on appearance rather than character
- Society places enormous value on thinness
 - Women – sought less for romance
 - Less often hired
 - Less often admitted to college
 - Higher insurance premiums
 - Increased cost of clothing
- Majority of overweight individuals are trying to lose weight
- Assumption that every person can and should achieve slenderness
- Maybe 5% of those who lose weight maintain their losses
- We have genetic programming to hold on to excess calories since we experienced periods of starvation and food scarcity throughout our evolutionary history

Theories on Obesity

- Fat cell number theory – determined by the number and size of adipose cells
- Set-point theory – body “chooses” a weight it wants to be and defends that weight
- Outside the body causes of obesity:
 - External cues to overeat
 - Food pricing, availability, and advertising
 - Physical inactivity

Basal Metabolic Rate

- **Basal metabolic rate** – the sum total of all of involuntary activities necessary to sustain life, including circulation, respiration, temperature maintenance, hormone secretion, nerve activity, and new tissue synthesis. Excluding digestion and voluntary activities
- Factors that affect the BMR – age, height, growth, body composition, fever, stress, environmental temperature, fasting/starvation, malnutrition, thyroxine (thyroid function)
- Voluntary activities – intentional activities such as walking, sitting, running. Conducted by voluntary muscles
- Thermic effect of food – the body's sped up metabolism in response to having eaten a meal; also called diet-induced thermogenesis

Basal Metabolic Rate

BMR FORMULAS	
 MEN	$\text{BMR} = (10 \times \text{weight [kg]}) + (6.25 \times \text{height [cm]}) - (5 \times \text{age [yrs]}) + 5$
 WOMEN	$\text{BMR} = (10 \times \text{weight [kg]}) + (6.25 \times \text{height [cm]}) - (5 \times \text{age [yrs]}) - 161$
 www.inchcalculator.com	

<https://www.calculator.net/bmr-calculator.html>

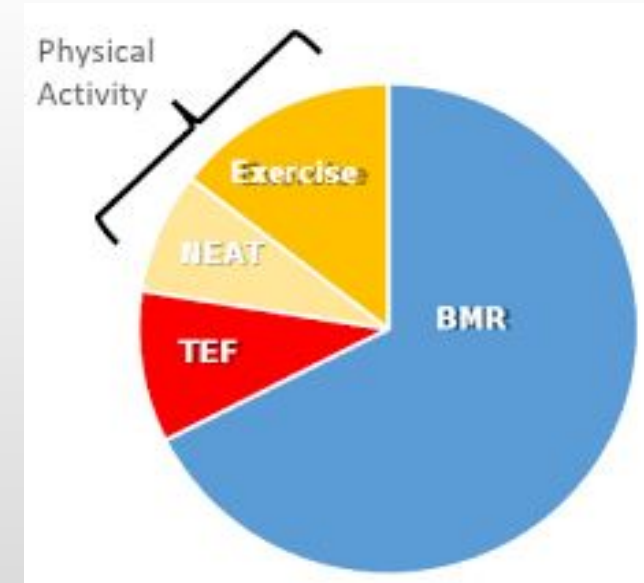
Energy Balance

- The change in energy stores equals food energy taken in minus energy spent on metabolism and muscle activities
- Change in energy stores = energy in – energy out
- Small changes in this balance compound over time
- 1 lb = approximately 3,500kcal
- **EER** -These are made for the average man and woman. It is the DRI recommendation for energy intake, accounting for age, gender, weight, height, and physical activity
www150.statcan.gc.ca & omnicalculator.com

Calculating Energy Requirements

- **EER (Estimated Energy Requirement)** – the DRI recommendation for energy intake, accounting for age, gender, weight, height, and physical activity.
- Equations
 - Women age 19 years and older:
 - $EER = 662 - 6.91 \times \text{age} + PA \times [(9.36 \times \text{wt}) + (726 \times \text{ht})]$
 - Men age 19 years and older:
 - $EER = 662 - 9.53 \times \text{age} + PA \times [(15.91 \times \text{wt}) + (539.6 \times \text{ht})]$
- Can vary by approximately 10% above and below these calculated values
- **PA (Physical Activity) Values**
 - Sedentary: 1.0 (men and women)
 - Low Active: 1.11 (men) and 1.12 (women)
 - Active: 1.25 (men) and 1.27 (women)
 - Very Active: 1.48 (men) and 1.45 (women)

TDEE

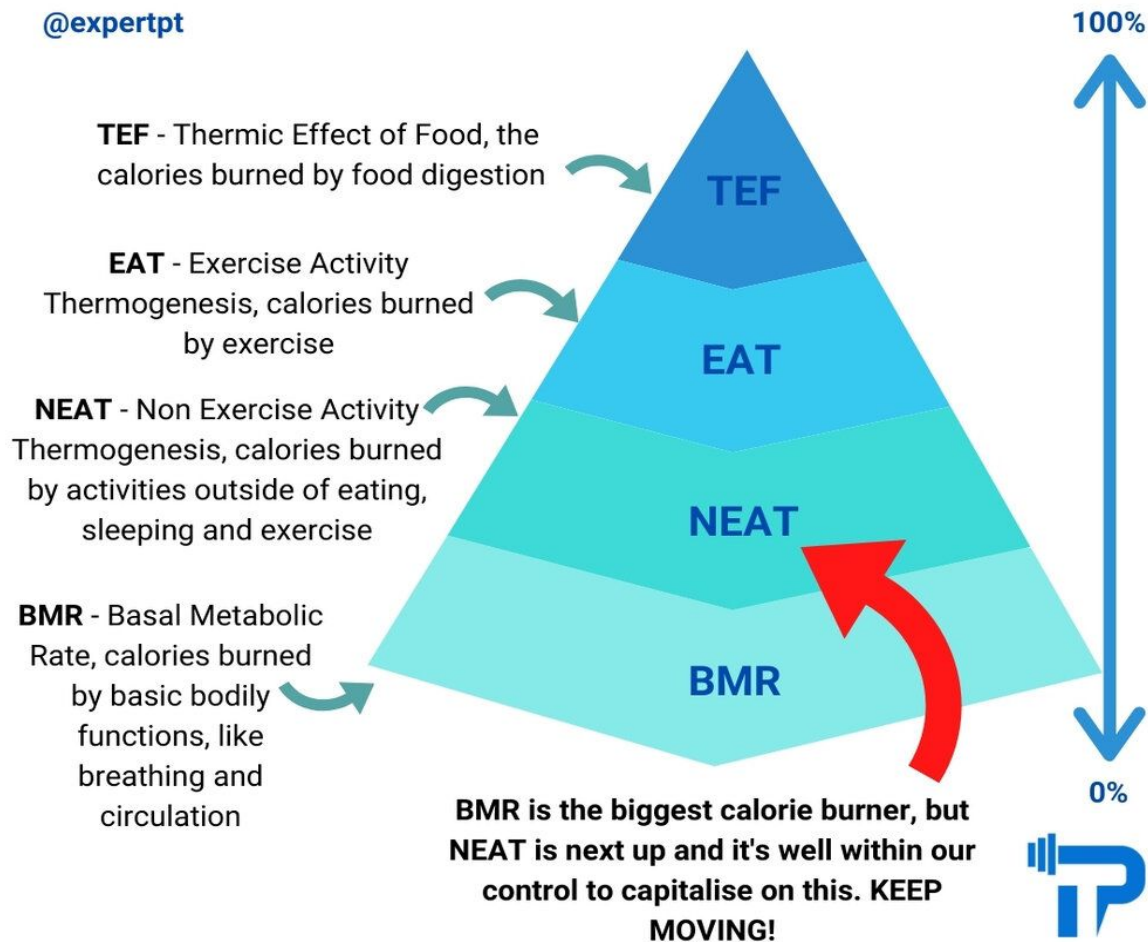


- **Total Daily Energy Expenditure**
- An estimation of how many calories you burn per day with exercise taken into account. Essentially BMR x activity multiplier.
- Theoretically, this number should be the similar as your EER. Is it?
- tdeecalculator.net

TDEE Continued

Expert PT Essential Guide: Total Daily Energy Expenditure (TDEE)

@expertpt



EAT - Exercise Activity Thermogenesis
Calories used during a dedicated exercise session
About 5% of total TDEE

NEAT - Non-exercise Activity Thermogenesis
Calories used by daily activities, including fidgeting. Studies have shown that fidgeters can have a NEAT level up to 10 times as high as non-fidgeters.
About 15% of total TDEE

TEF - Thermal Effect of Food -
Calories used in digesting and metabolising food.
About 10 % of TDEE

BMR - Basal Metabolic Rate
Calories used for basic activities of life.
About 70% of TDEE

Hunger, Appetite, Satiation, and Satiety

- Physiological influences
 - Empty stomach, gastric contractions, absence of nutrients in S.I., digestive tract hormones, endorphins (triggered by smell, sight, taste of foods that increase desire)
- Sensory influences
 - Thought, sight, smell, sound, taste
- Cognitive Influences
 - Social stimulation, perception of hunger/awareness of fullness, favourite foods, foods with special meaning, time of day, abundance of available food
- Post-ingestive influences
 - Stretch receptors in stomach, nutrients in S.I. elicit nervous and hormonal signals of fed state
- Post-absorptive influences – nutrients in blood signal brain, as nutrients dwindle so does satiety, hunger develops

Factors affecting Appetite

- Hormones
- Inborn appetites
- Learned preferences, aversion, and timings
- Customary eating habits
- Social interactions
- Disease states
- Appetite stimulants or depressants and mood-altering drugs
- Environmental conditions

Satiety

- **Leptin – satiety hormone**

- Produced in adipose (fat) tissue and in the stomach
- Suppresses appetite in between meals- “Tells your brain that your fat cells are full”
- Works on a feedback loop
- Why can’t we supplement with Leptin? It must cross the Blood-brain Barrier & so far a reliable supplement/drug had not been developed
- Vitamins A & C and the mineral Zinc - low levels have been associated with low levels of Leptin

- **Ghrelin - hunger hormone**

- Stimulates food intake, fat deposition, & growth hormone release
- Produced by the stomach, small intestine, pancreas & brain

<https://youtu.be/u5ae6hw-F7s>

Putting It All Together- Practicing the Math

- **Practice Questions:** Could you figure all this information out?
 - Danielle is a 23 year old, 150 lbs, low activity level, female who is 5'5" tall.
 - How many calories does she need for fuel to maintain her weight?
 - What percentage of her diet should come from CHO, protein, lipids?
 - How many calories of each will she need to consume to reach her caloric limit?
 - How many grams of each will she need to consume?
 - Part 2: Danielle eats a sandwich consisting of 2 slices rye bread, 1 Tbsp butter, and 1 oz of turkey breast meat.
 - How many grams of CHO, pro, fat are in this meal?
 - What percentage of the meal is CHO, pro, fat?
 - Part 3:
 - Describe digestion of the CHO, pro, and lipids found in this sandwich
 - Describe Absorption of each nutrient
 - Describe metabolism of each nutrient in both the fed and fasted states