**CORE STRANDS and Standards**

**STRAND 6 Students will explore the fundamentals of body composition and diseases and disorders related to body issues.**

**Standard 1** Describe basic body composition.

* + - Define body composition.
    - Compare and contrast the most common methods for analyzing body composition.
      * Hydrostatic
      * Bod Pod
      * Calipers
      * Bio-Impedance Analysis (BIA)
      * BMI
    - Describe the parameters of safe weight loss and weight gain.

**Standard 2** Recognize disorders associated with nutrition.

* + - Identify signs, symptoms, and effects of Anorexia Nervosa.
    - Identify signs, symptoms, and effects of Bulimia Nervosa.
    - Identify signs, symptoms, and effects of Bigorexia.
    - Identify signs, symptoms, and effects of the Female Athlete Triad.

Strand 6 – Body Composition

Nutrition Lecture Notes

1. **Body Composition**
   1. Body composition refers to all of the components that make up the body
   2. Body composition is usually divided into 2 main categories:
      1. Fat mass
         1. All adipose tissue in and surrounding your organs
      2. Fat-free or lean body mass
         1. Includes muscles, bones, organs and extracellular and intercellular water (bodily fluids)
      3. Most athletes are interested in the ratio of fat mass to total body mass which is commonly expressed as **percent body fat**.
   3. **Essential fat** is the minimum amount of fat necessary for proper physiological function
      1. Fat is used for: nerve conduction, vitamin storage, insulation, energy storage
      2. Essential fat for males = no less than 3% of body weight
      3. Essential fat for females = no less than12% of body weight
         1. Of this 12% approximately 9% is considered sex-specific fat
            1. This is fat needed for proper hormonal and reproductive functions
      4. Body composition that drops below these levels interferes with normal body function
   4. Body Fat norms are as follows:
      1. Females: < 13 Caution, 14-18 Excellent, 19-23 Good, 24-29 Average, 30-36 Over fat, > 36 obese
      2. Males: <5 Caution, 6-11 Excellent, 12-16 Good, 17-23 Average, 24-29 Over fat, >29 Obese
2. **Measuring Body Fat**
   1. Errors
      1. It should be noted that body fat cannot be directly measured except by chemical analysis of human cadavers
      2. All other methods “estimate” or “predict” body composition using data from the direct chemical analysis of relatively limited number of human cadavers
      3. All methods also have potential technical error in the assessment method itself
   2. **There are five common methods to estimate percent body fat:**
      1. **Body Max Index (BMI)**
         1. BMI does not measure body composition but is a common method used to measure “fitness” associated with weight
         2. BMI is used as a quick screening tool for physicians to screen for chronic disease risk associated with obesity
         3. It assumes that adult height is stable and that any increase in scale weight is a result of an increase In body fat
         4. This is not an accurate test to calculate body composition
            1. Athletes typically have more than average muscle mass which leads to inaccurate findings
         5. Ex: an athlete whose’ height is 6’ 3” and weighs 240 lbs has a BMI of 30 and is classified as obese!
         6. BMI is defines as a person’s height (measured in meters) divided by the square of the persons weight (measured in kilograms)
            1. This gives a unit of kg/m2 but units are usually not included
         7. BMI criteria are as follows:
            1. Underweight = 18.5
            2. Healthy = 18.5-24.9
            3. Overweight = 25-29.9
            4. Obese = >30
         8. See “Body Mass Index Table” for a quick way to calculate BMI
      2. **Hydrostatic (Underwater) Weighing**
         1. Traditionally has been considered to be the most accurate method.
         2. The subject exhales all of the air in their lungs and is then weighed while submerged in a tank of water.
            1. This technique does not measure body fat, rather it measures body density.
            2. This density measurement translates mathematically into percent body fat.
         3. Errors with underwater weighing include:
            1. Not completely exhaling all of the air in your lungs

As little as 2 cups of air can affect body fat measurements by as much as 3-5%.

* + - * 1. The equipment may not have the precise weighing systems which are more accurate.
        2. Skill of the technician
    1. **Plethysmography (Bod Pod)** 
       1. Measures displacement of air to determine body volume
       2. The subject sits in an air-tight enclosure while the amount of air displaced by the subject’s body is sensed by a special diaphragm and pressure transducer
       3. Once body volume is determined, body density can be calculated and body fat estimated
       4. Errors include air pockets in clothing
          1. Tight fitting clothing and swim cap can reduce this error
    2. **Skinfold calipers,** which are more convenient and still relatively accurate.
       1. Calipers are large “pinchers” that measure the thickness of the fat layer on specific body sites.
          1. Common sites are abdomen, triceps, scapula, hip, and thigh
       2. Poorly calibrated calipers or imprecise location of the specific body sites may cause errors in measurement.
    3. **Bioelectrical impedance analysis (BIA)**
       1. An imperceptible electrical current is sent through the body via electrodes
          1. Current typically flows up one leg and down the other
          2. The flow of the current is affected by the amount of fat that is encountered
       2. Inaccurate readings may occur if the subject is dehydrated, pre-menstrual, has undigested food in the stomach, or is improperly positioned during the test.
          1. Error may also come due to fat carried throughout other sites on the body through which the current does not pass

1. **Weight Gain & Loss**
   1. In order to gain or lose weight, proper exercise and diet must be combined in the right ways.
   2. **Weight Gain**
      1. Theoretically, in order to gain 1 pound of body weight per week, the consumption of an additional 500 calories per day is needed.
      2. The extra calories should primarily come from extra carbohydrates
         1. Carbohydrates fuel muscle so the muscles can perform intense muscle-building exercise.
         2. However it is recommended that protein intake increase by 14grams per day to provide necessary amino acids for muscle growth
      3. Finding the time to eat can be the biggest challenge to boosting caloric intake.
         1. Pack portable snacks
         2. Eat frequently throughout the day
         3. Eat an extra snack
         4. Eat larger than normal portions at mealtime
         5. Eat higher calorie foods.
      4. Taking the prescribed 500-1000 additional calories per day should cause some weight gain.
         1. It is vital to include muscle-building resistance exercise (weight workouts) to promote muscular growth rather than just fat deposits.
   3. **Weight Loss**
      1. Understanding body composition is an important component of weight loss
         1. Muscle weighs more than fat
         2. When an individual begins an exercise program in an effort to lose weight he or she may find that the scale is not showing significant weight loss
            1. However, it is likely that body composition is changing

Fat may be decreasing while muscle is increasing

* + - 1. For this reason some form of body composition analysis should be utilized rather that body weight itself
    1. **Body fat is stored energy**
       1. In order to decrease body fat one must burn more calories that he or she eats which forces the body to use these energy stores (fat)
       2. Quite simply, the equation to lose excess body fat is to burn more calories than you take in (eat less and exercise more)
       3. It should be noted that every human body is different and fat is stored at different rates for each person
          1. Storing fat can be effected by genetics, emotion, health, etc
          2. Therefore, while the equation seems simple, it can be quite difficult
    2. To lose weight healthfully, and successfully keep it off:
       1. Pay attention to the quantity of food eaten
       2. Pay attention to when food is eaten (eat big breakfasts, rather than big dinners).
       3. Pay attention to why food is eaten
          1. i.e.: boredom, stress, loneliness, or actually hungry
       4. Studies show that eating 5-6 small meals per day is an effect method to loss body fat
    3. Theoretically, 1lb. per week should be lost if 500 fewer calories per day is eaten than normally
    4. It is recommended that only 2 pounds per week be lost for safety reasons.
    5. Eat slowly! The brain needs about 20 minutes to receive the signal that food has been eaten.
    6. Exercise regularly, but do not over-exercise.
  1. **Rapid weight loss is sports**
     1. Sports that have weight categories because differences in body size make it impossible for all athletes to fairly compete among one another are at risk for unhealthy weight loss tactics
        1. Examples include wrestling, boxing, martial arts, and lightweight rowing
     2. Other sports in which weight must be moved or that physical appearance may be judged may also be at risk
        1. Examples include gymnastics, figure skating, horse racing, and cheerleading
     3. Weight loss tactics include calorie restriction, excessive exercise, fluid restriction, or a combination (exercising in rubber suits, spitting in a cup, etc)
     4. These tactics have serious risks and should never be condoned.
        1. Most health risks are associated with prolonged energy deprivation (see eating disorder section below) or dehydration (see hydration section above)
        2. There are several documented cases of deaths due to these tactics
        3. Other side effects include frequent nose bleeds, headache, dizziness, nausea, etc
        4. Studies are also showing that the weight “cycling” of these athletes is leading to lowered metabolic rate as aging occurs and an increase likelihood of being overweight later on in life
        5. Many states are implementing rules to limit such tactics in order to create a safer environment for the athletes
           1. In 2006 the National Federation of State High School Associations instituted rule changes that include:

A body fat assessment no lower than 7% in males and 12% in females

A monitored weight-loss program that does not exceed 1.5% loss of body weight per week

A specific gravity of urine not to exceed 1.025

1. **Eating Disorders**
   1. Eating disorders affect more that 8 million Americans at any given time
   2. All forms of eating disorders can be fatal
      1. 1 in 10 people will die as a direct result of their eating disorder
   3. Males can get eating disorders but the vast majority are females
   4. Signs to look for include:
      1. Social isolation.
      2. Lack of confidence in performance.
      3. Ritualistic eating behaviors, such as cutting food into small pieces and playing with it.
      4. Obsession with calories.
      5. Obsession with weight.
      6. Distorted body image.
      7. Wearing layers of baggy clothing to hide thinness.
      8. Nervous at mealtime, avoidance of eating in public.
      9. Patterns of leaving the table directly to go to the bathroom.
      10. Running water in the bathroom after meals to hide the sound of vomiting.
      11. Significant weight loss.
      12. Obsession with grades.
      13. Obsession with organization of personal space.
      14. High emotions; tearful, uptight, overly sensitive, restless.
      15. Signs of malnutrition.
      16. Menstrual irregularities.
      17. Loss of hair.
      18. Light-headedness.
      19. Blood-shot eyes.
      20. Inability to concentrate.
      21. Chronic fatigue.
      22. Hyperactivity – compulsive exercise beyond normal training.
      23. Decrease in performance.
      24. Recurrent overuse injuries and stress fractures.
      25. Depression.
   5. **Anorexia Nervosa**
      1. People with anorexia restrict their caloric intake for long periods of time and deliberately starve themselves, resulting in loss of body weight of at least 15%.
      2. They have an intense fear of becoming obese as well as a distorted body image.
      3. Weight loss is achieved by avoiding food, frenzied exercise, or both.
      4. The following signs and symptoms are used by the American Psychiatric Association to define Anorexia Nervosa:
         1. Intense fear of gaining weight or becoming fat, even though they are already under-weight.
         2. Disturbance in the way a person experiences his or her body (i.e., claiming to “feel fat” even when emaciated), with an undue influence of body weight or shape on self-perception.
         3. Weight loss to less than 85% of normal body weight.
         4. Refusal to maintain body weight over a minimal normal weight for age and height.
         5. Denial of the seriousness of the current weight loss.
         6. Absence of at least three consecutive menstrual cycles.
      5. Anorexia is a life-threatening condition if left untreated.
   6. **Bulimia Nervosa**
      1. A cyclical pattern of binge-eating associated with some type of purging
         1. Purging takes on different forms: fasting, self-induced vomiting, excessive exercising, or the use of enemas or diuretics.
      2. The definition used by the American Psychiatric Association includes:
         1. Recurrent episodes of binge eating, characterized by both of the following:
            1. Eating an unusually large amount of food in a discrete period of time (the amount eaten is larger than most people would eat during a similar time period and under similar circumstances).
            2. Feeling out of control during the eating episode and unable to stop eating or control what and how much is eaten.
         2. Compensating for the food binge to prevent weight gain, such as inducing vomiting; misusing laxatives, enemas, or other medications; fasting; or exercising excessively.
         3. Binge eating and purging, on average, at least twice a week for three months.
         4. Evaluating self-worth according to body shape and weight.
      3. Bulimic behavior can cause stomach rupture, tooth decay, inflammation of the mucous lining of the mouth and throat, and can eventually cause heart and liver damage.
   7. **Bigorexia or Muscle Dysmorphia**
      1. Bigorexia or muscle dysmorphia, is a disorder that causes a person to constantly obsess and/or worry about being too small, underdeveloped and/or underweight
      2. Warning signs
         1. Distorted self-image
         2. Missing social events, skipping work, and canceling plans to work out
         3. Never being satisfied with one’s muscle mass
         4. Working out despite an injury
         5. Maintaining extreme workout methods
         6. Maintaining a strict, high protein and low-fat diet
         7. Using excessive amounts of food supplements
         8. Steroid abuse, unnecessary plastic surgery, and even suicide attempts
   8. **The Female Athlete Triad**
      1. A term used to describe three interrelated conditions that can occur in competitive women athletes:
         1. **Low energy availability** which may be caused by disordered eating
            1. This may be the result of simply trying to prevent any added fat in order to keep body weight low

This athlete may or may not have the same psychological risk as a similar athlete with disordered eating

* + - * 1. Can occur in sports in which a low body weight is desirable

Gymnastics, ballet, distance running, etc

* + - * 1. The low energy availability coupled with the energy demands of the sport brings the athlete into energy deficit
        2. This can be worsened in the adolescent athlete do to the energy demands of growth and development
        3. Energy deficits force the body to adapt and begin to suppress physiological functions that are associated with normal growth and development
      1. **Amenorrhea**
         1. The absence of menstruation for 3 or more consecutive months
         2. Caused by high energy expenditure and can be coupled with low energy intake

This alters the secretion of luteinizing hormone (LH) and estrogen which control the menstrual cycle

* + - 1. **Osteoporosis**
         1. Low bone mineral density
         2. Low estrogen secretion interferes with the females ability to store calcium in the bones

one of estrogens’ functions is to protect against calcium loss from bone

* + - * 1. this increases the athletes susceptibility to fractures; especially stress fractures
        2. studies show that amenorrhea that lasts longer than six months will likely have a negative effect on the athletes’ bone mineral density
        3. because this bone loss is typically occurring at a vital time when bone density should be increasing as the athlete matures
        4. This causes a significant increase in the susceptibility of problems due to osteoporosis in the athlete in later years of life
    1. If not treated, the energy deficit can result in the following sever health problems (this list is not exhaustive):
       1. Long term osteoporosis
       2. Cardiac arrest
       3. Electrolyte imbalance
       4. Severe dehydration
       5. Suicide
    2. Prevention begins with preventing persistent energy deficits
       1. A healthy goal should be established for a desired training weight of the athlete
          1. This goal should be such that will be beneficial to the athletes performance yet not compromise health
          2. Use of body composition analysis to establish a minimum is useful
          3. Input from exercise physiologist, dieticians, or physicians may be recommended
       2. A training and diet plan can be established that provides the adequate energy and nutrients for the athletes energy expenditure
    3. Treatment involves decreasing energy expenditure and increasing energy intake until symptoms resolve
       1. Menstruation will return when energy balance is achieved
       2. Depending on the length and severity of the osteoporosis there may be long term effects associated with bone health especially in the post menopausal years
  1. Any victim of an eating disorder must be approached and handled extremely carefully. Referral for medical treatment is essential!
  2. **Prevention of Eating Disorders**
     1. Many athletes think – or feel pressured to believe – that by restricting their food intake to lose weight they will exercise better, look better, and enhance their overall performances.
     2. Ironically, restricting food in an attempt to improve performance can actually result in depleted fuel stores, amenorrhea, stress fractures, fainting, weakness, fatigue, and ultimately impaired performance.
     3. Some athletes may manage to do well for a while without an obvious decline in performance, but then injuries and lack of energy will catch up with them.
     4. Eating disorders would fade if people could learn to love their bodies. As a society we must:
        1. Dispel the myth that thinness equals happiness and success.
        2. Discourage the notion that the thinnest athlete is the best athlete.
        3. Love our bodies for what they are, rather than hate them for what they are not.
        4. Emphasize fit and healthy as more appropriate goals than slender and skinny.