Body Weight pp. 385-410, 419-427, 436-465, 501-508

Objectives

Understand the various components of body composition.

Techniques used to assess body composition

Mechanisms of body mass regulation

Weight and performance

Weight restricted sports

Gaining lean body mass

Why so much fuss about physique?

Body size, structure & composition

May be a combination of self-selection for a particular sport & adaptation to training

Body Composition, Weight, and Performance

Many accept that some elements of physique are not modifiable

Can’t change limb length or where tendons insert

Interrelationship between mass/strength/speed

Mass may be among the most important and malleable factor (e.g., sumo wrestling, ski jumping)

High power-to-weight ratio important for explosive power

Low percentage body fat may be beneficial if weight must be moved

To measure or not to measure...

Situations when body comp could be monitored:

Track effectiveness of training program or eating program

Screen and monitor those with disordered eating

ID appropriate weight class \*\*\*

Components of body

Carbon, hydrogen, oxygen, nitrogen

Ca, Phos, Fe, Mag and more

Densities of four major body components

Density = mass ÷ volume [g/ml or g/cc²]

Body water (Density = 1.0)

Total body fat (Density = 0.9)

Fat free mass (Density = 1.1)

Bone mineral (Density = 1.3 – 1.4)

Body composition

Total body fat

Essential fat

Males (3%)

Females (12-15%)

Storage fat

Subcutaneous fat

Visceral fat

“Fat-free mass”

Protein, minerals and water

“Lean body mass”

Includes essential fat

Assessing body composition

Direct analysis

Chemical extraction

Indirect analysis

All techniques currently used with living humans are indirect

All techniques are subject to measurement error

Standard error of measurement (SEM): 2-6.5%

Two, Three, and Four Compartment Models of Body Composition

Hydrostatic weighing

Based on Archimedes’ principle

Buoyancy of water displacement

Density =

Previously was the *gold standard*

SEM ~ 2-2.5%

Air Displacement Plethysmography (ADP)

Based on air displacement

More comfortable than underwater measurements

Reliable method for testing same subject over time

SEM ~2.7-3.7%

Skinfold Measurement

Measure of subcutaneous fat at various sites

Skinfold calipers

SEM ~3-4%

Use population-specific formulae

Good practical method

Used by NCAA for wrestlers

Bioelectrical Impedance Analysis (BIA)

Based on the principle of resistance to an electrical current

Lower resistance = greater water content

SEM ~4.6-6.4%

Larger SEM for individuals with very low or high BMI.

Dual Energy X-ray Absorptiometry (DXA;DEXA)

Computerized X-ray

Concurrent measures

Bone mineral

Body fat

Fat-free mass

Some contend it is the gold standard

SEM ~1.8%

Energy balance and body weight Short and long-term wt stability

Body weight and performance

Lose excess body fat:

More energy efficient

Improve appearance

May lose strength and power

Gain lean mass:

Increase power

Increase stability

Improve appearance

May impair energy efficiency

Keep in mind, body composition is only one factor impacting sport performance

Lightweight Sports: Pushing the Biological Envelope

Goal is low body weight with sufficient muscularity/power

Some athletes are naturally lightweight

Some athletes use extraordinary measures to “make weight”

Semi-starvation diets

Dehydration techniques

Excessive exercising

Safe minimum body weight can be calculated

Calculation of a Target Body Weight

Pan American Games 1995  Mar Del Plata, Argentina

Excessive/rapid weight loss  & physical performance

Excessive and/or rapid

Excessive dehydration

Diuretics and laxatives

Starvation-type diets

Proper weight-loss programs

Gradually lose mainly fat

Prevent hypoglycemia

Prevent dehydration

Weight Cycling in Athletes

Repeated weight loss and weight gain

May be part of a sport’s culture

Athletes may believe that weight cycling is necessary

Studies have found:

Short-duration, high-intensity exercise not impaired

RMR not decreased

Expected performance improvements did not occur

Negative mental changes (anger, tension, fatigue)

Medical consequences

Hypohydration and hyperthermia (potentially fatal)

Headaches, nosebleeds, tachycardia

Possible predisposition to obesity later in life

Weight Gain

*Muscles are hard to get and easy to lose, fat is easy to get and hard to lose.*

“0.5-1.0 lb LBM/wk is optimistic”

1 lb = 454 g

Muscle tissue = 70% H2O, 22% protein + 8% CHO, fat, minerals & vitamins

Need an additional 400-500 kcals & 14 g protein/d (over RDA) + strength training

\*\*Using protein factor for strength trained athletes has additional protein built in

Prudent protein intakes in grams per kilogram body weight for sedentary and physically active individuals

Nutrient timing for weight gain

Consuming protein after (and maybe before) resistance exercise may alter messenger-RNA expression to promote muscle hypertrophy, inhibit protein breakdown, and allow net muscle protein accretion.

High-quality protein (milk, egg, whey) consumed within 1-2 hours before or immediately after exercise

1-1.5 g CHO/kg + 0.1-0.3 g protein/kg (ignore ratios)

20 grams intact protein may maximize muscle protein-synthesis rates during the first hours of post-exercise recovery.

Leucine appears to be more efficient at stimulating muscle protein synthesis

Weight gain with resistance training

Muscle hypertrophy: Major mechanism for increased muscle size

Increased size of myofibrils

Increased number of myofibrils

Increased connective tissue

Increased glycogen and water

Muscle hyperplasia: Minor role

Bone density may increase

“I want to gain 5 lbs of muscle and lose 5 lbs of fat”

Anabolism and catabolism at the same time??

Usually more benefit to increase muscle mass first

When under consuming kcals, may need 1.8 g protein/kg to mitigate LBM losses