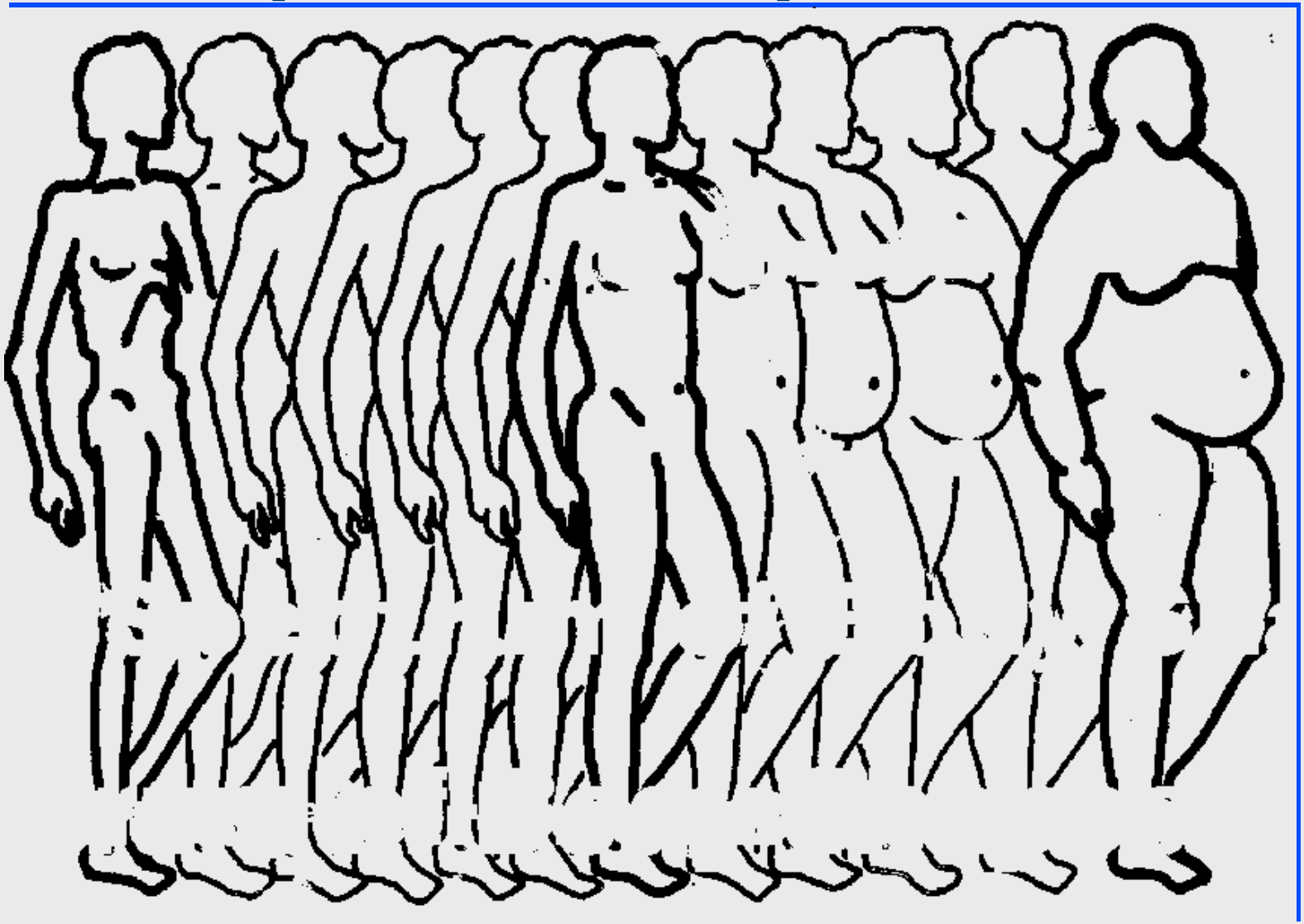
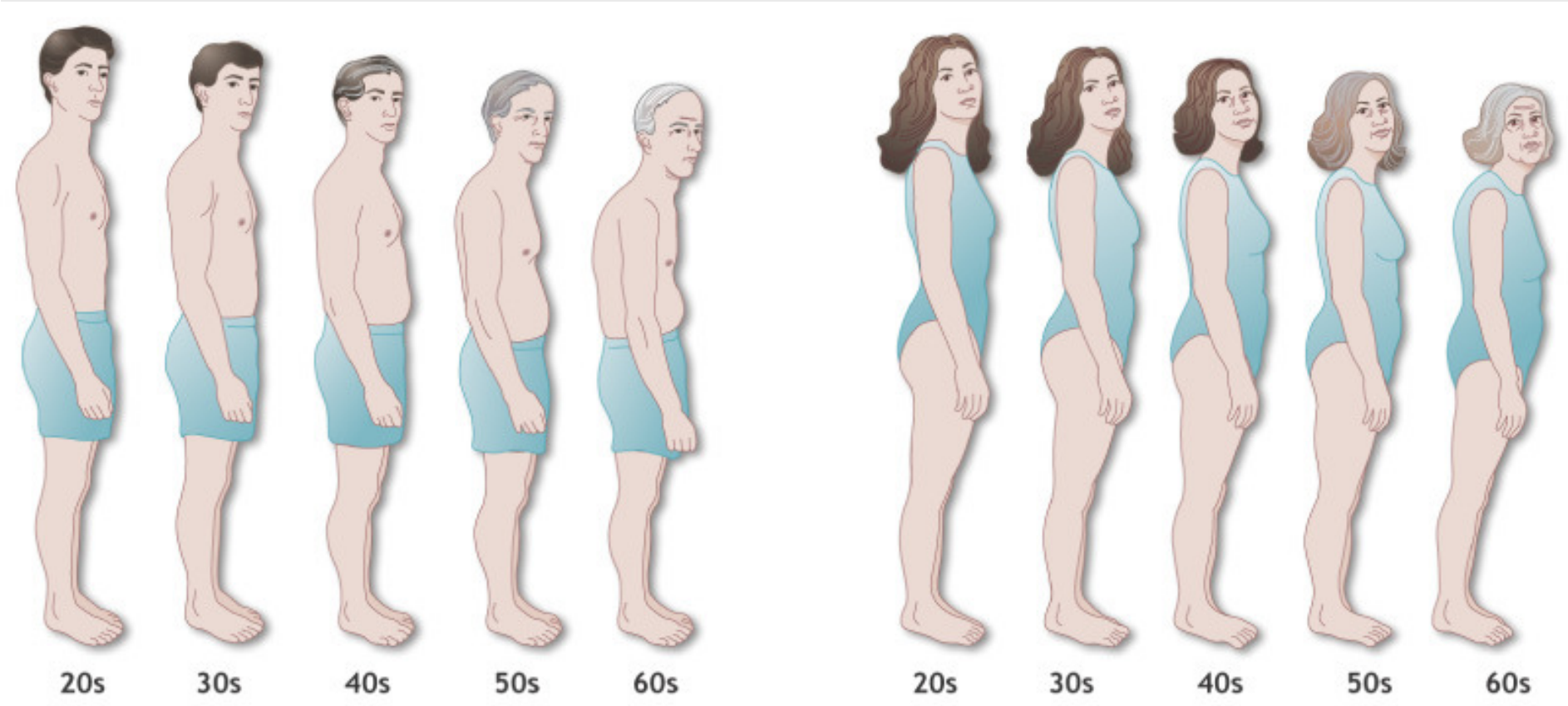
Body Composition

Chapter 6

The Spectrum of Body Size, Shape and Composition



We All Change in Many Ways



What are the different ways to look at human body composition?

- ✓ **Medical (health)**
- ✓ **Anthropological**
- ✓ **Performance**
- ✓ **Appearance**

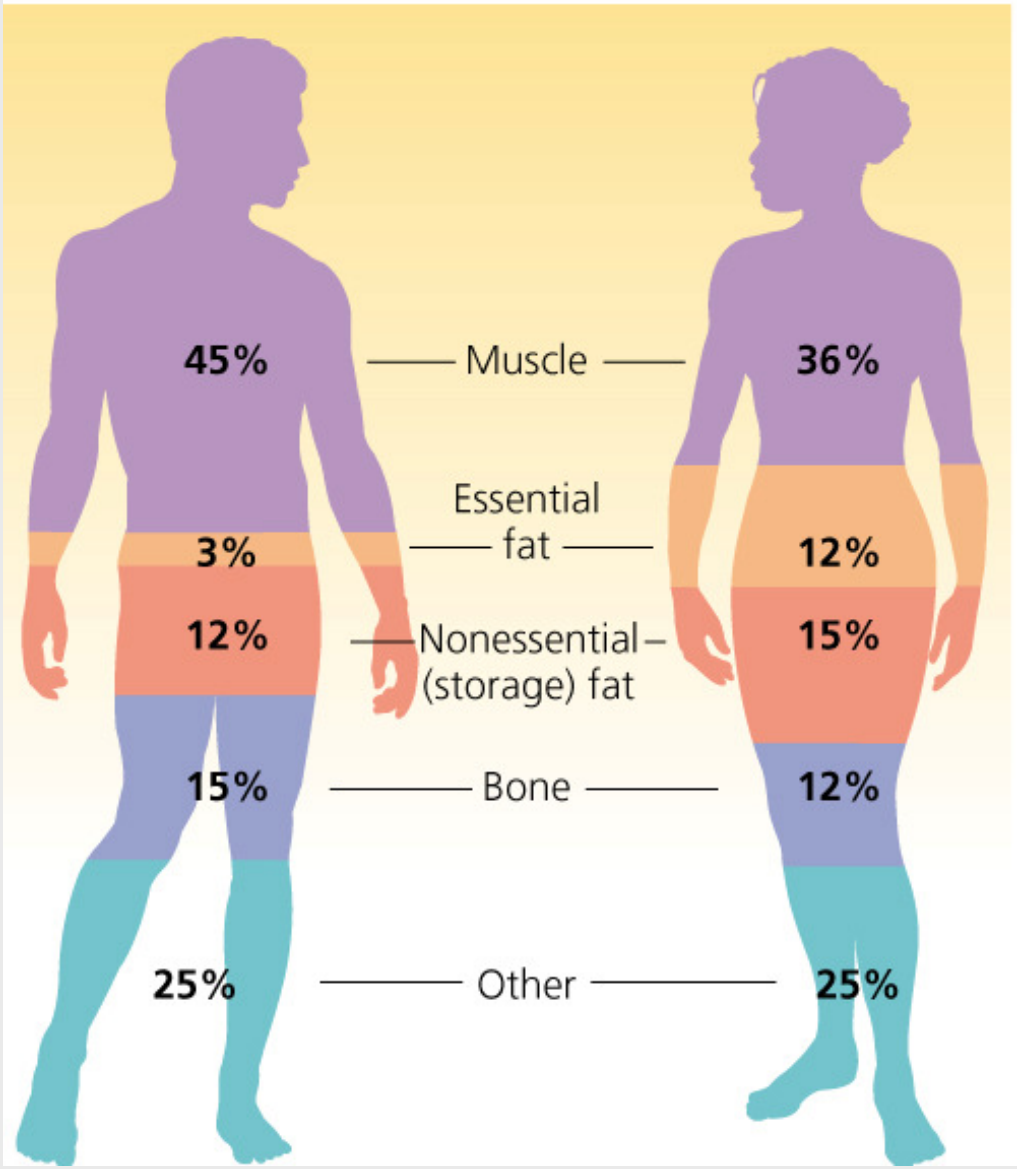
Why is knowledge of body composition so important?

- ✓ **Health and Disease**
- ✓ **Performance**
- ✓ **Appearance**
- ✓ **Longevity**

What Is Body Composition?

- Body composition = the body's relative amounts of fat mass and fat-free mass (bone, water, muscle, connective and organ tissues, teeth)
- Essential fat = crucial for normal body functioning
  - 3–5% of total body weight in males
  - 8–12% of total body weight in females
- Nonessential fat = adipose tissue

Typical Body Composition



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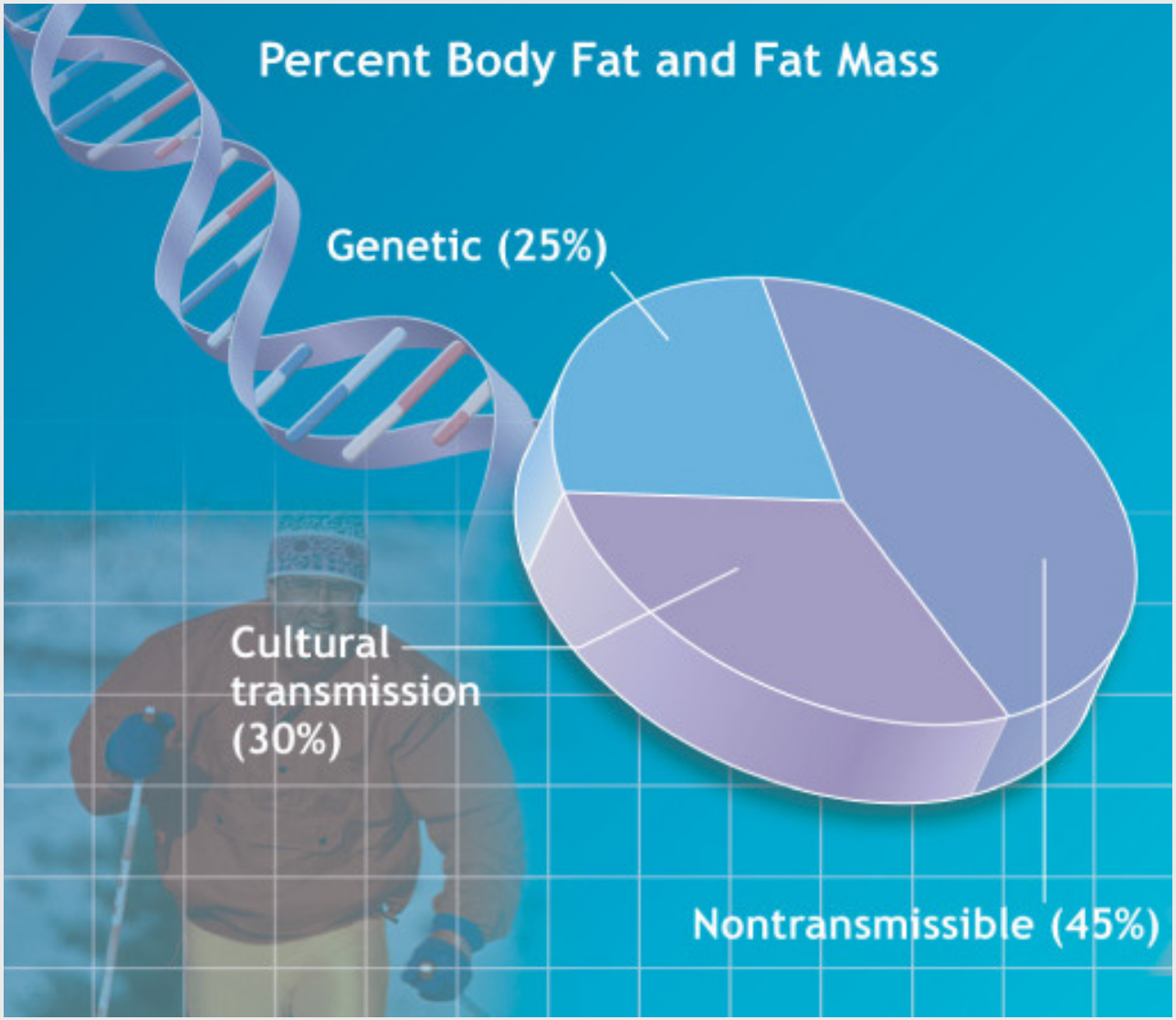
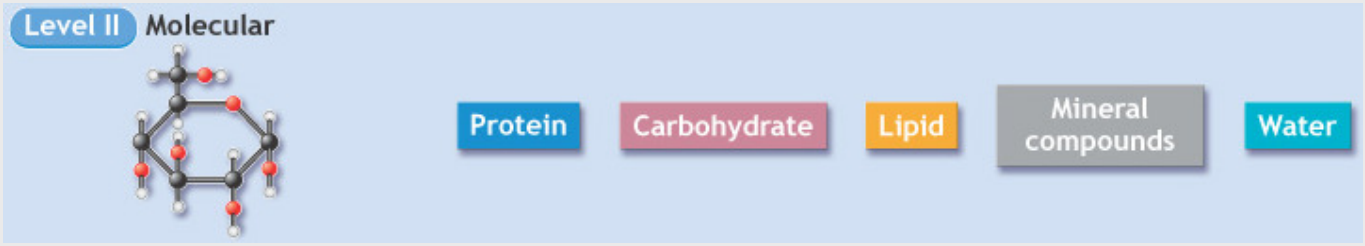
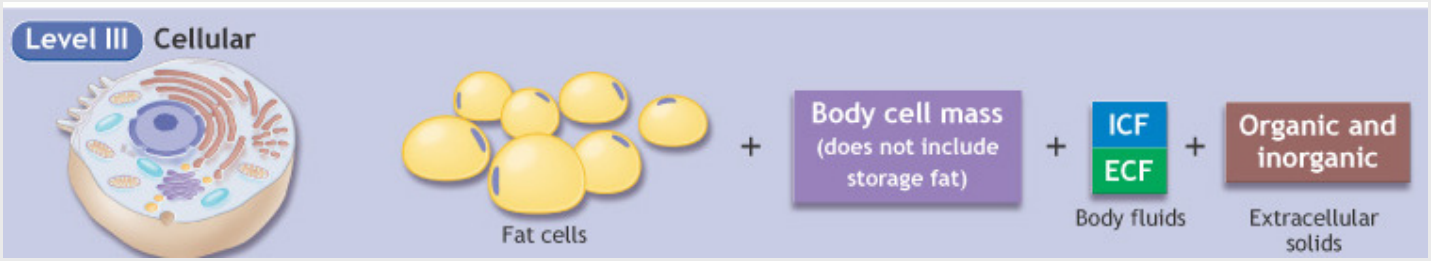
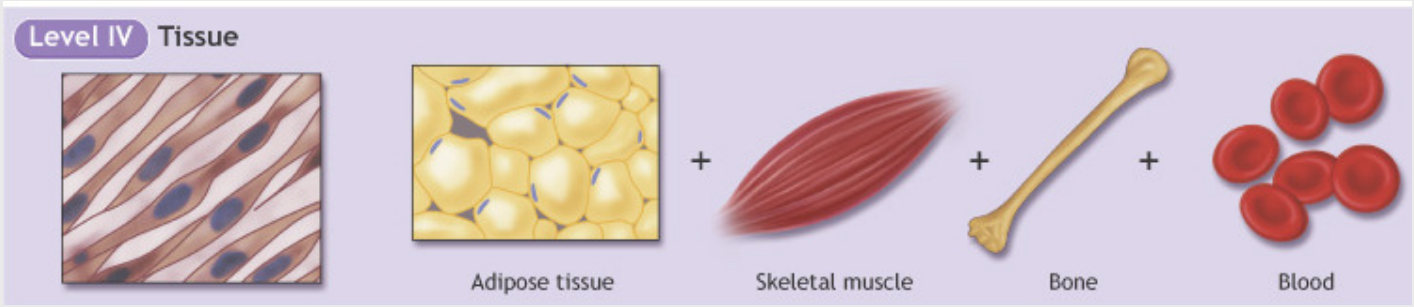
Genetics and Body Composition

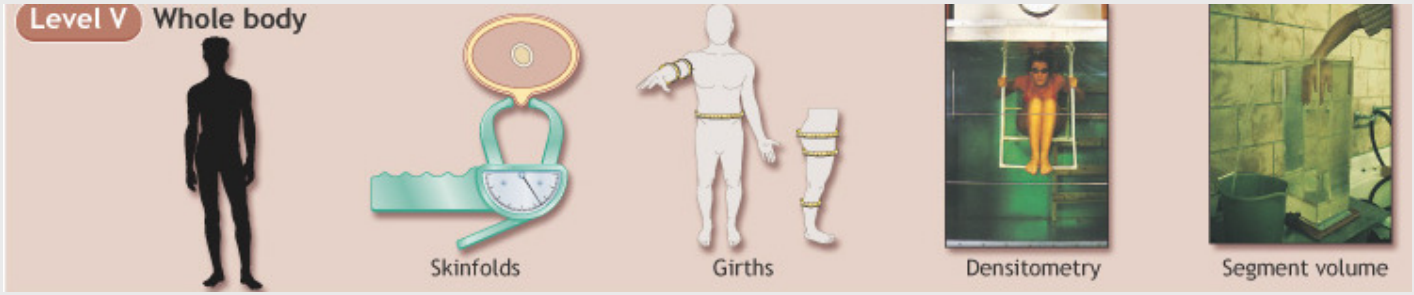


Different Levels of BC Measurement

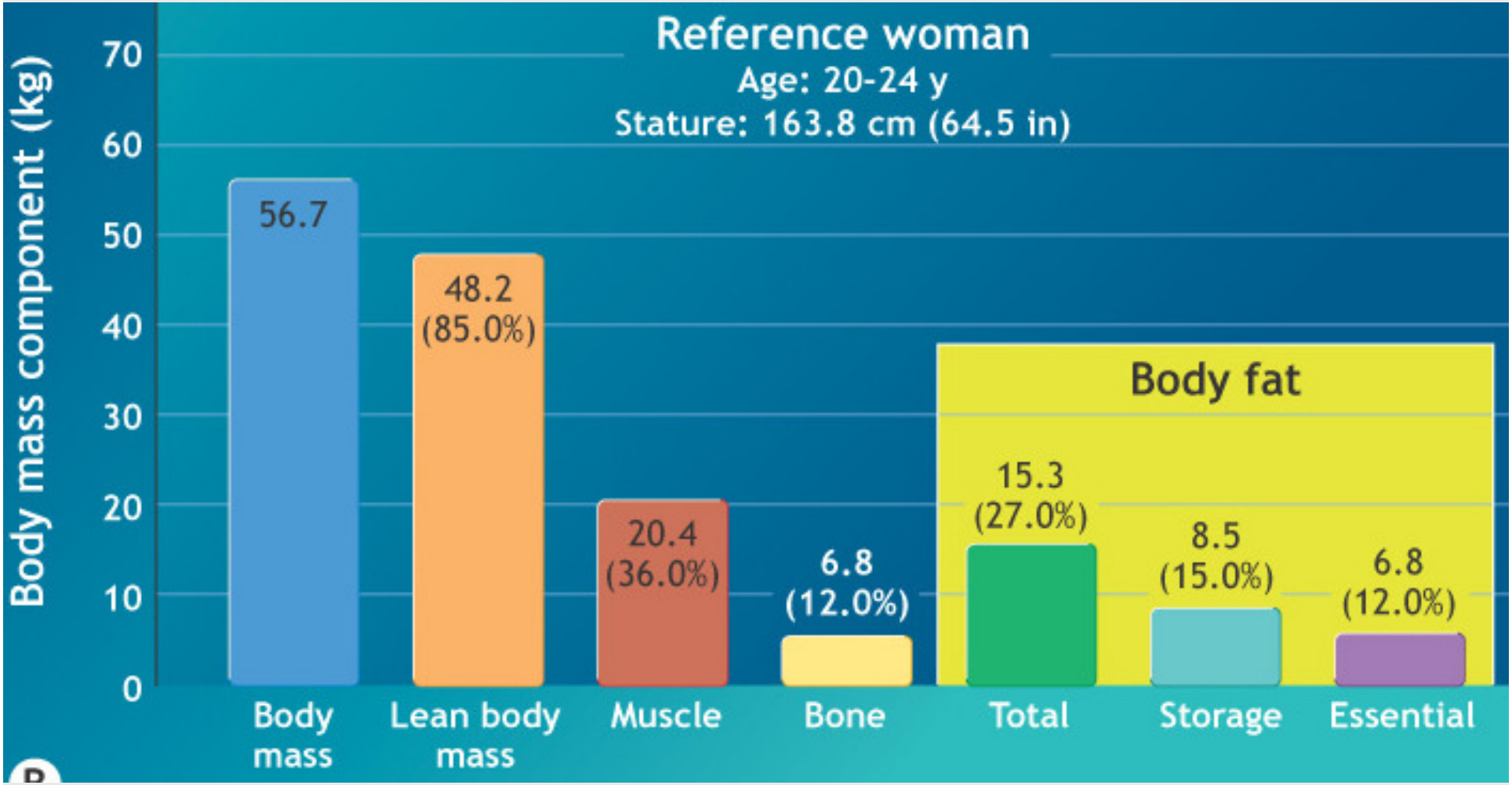




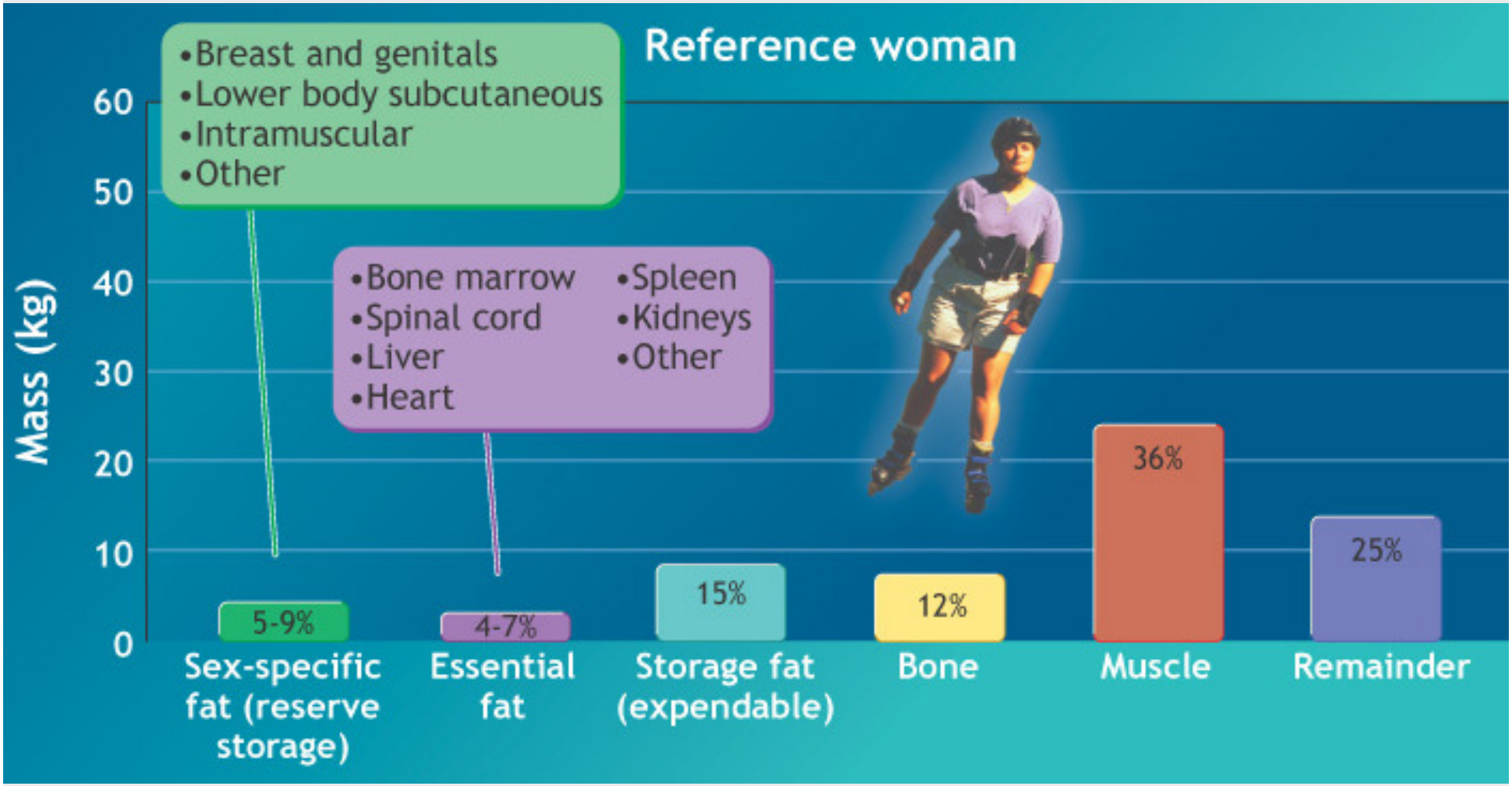




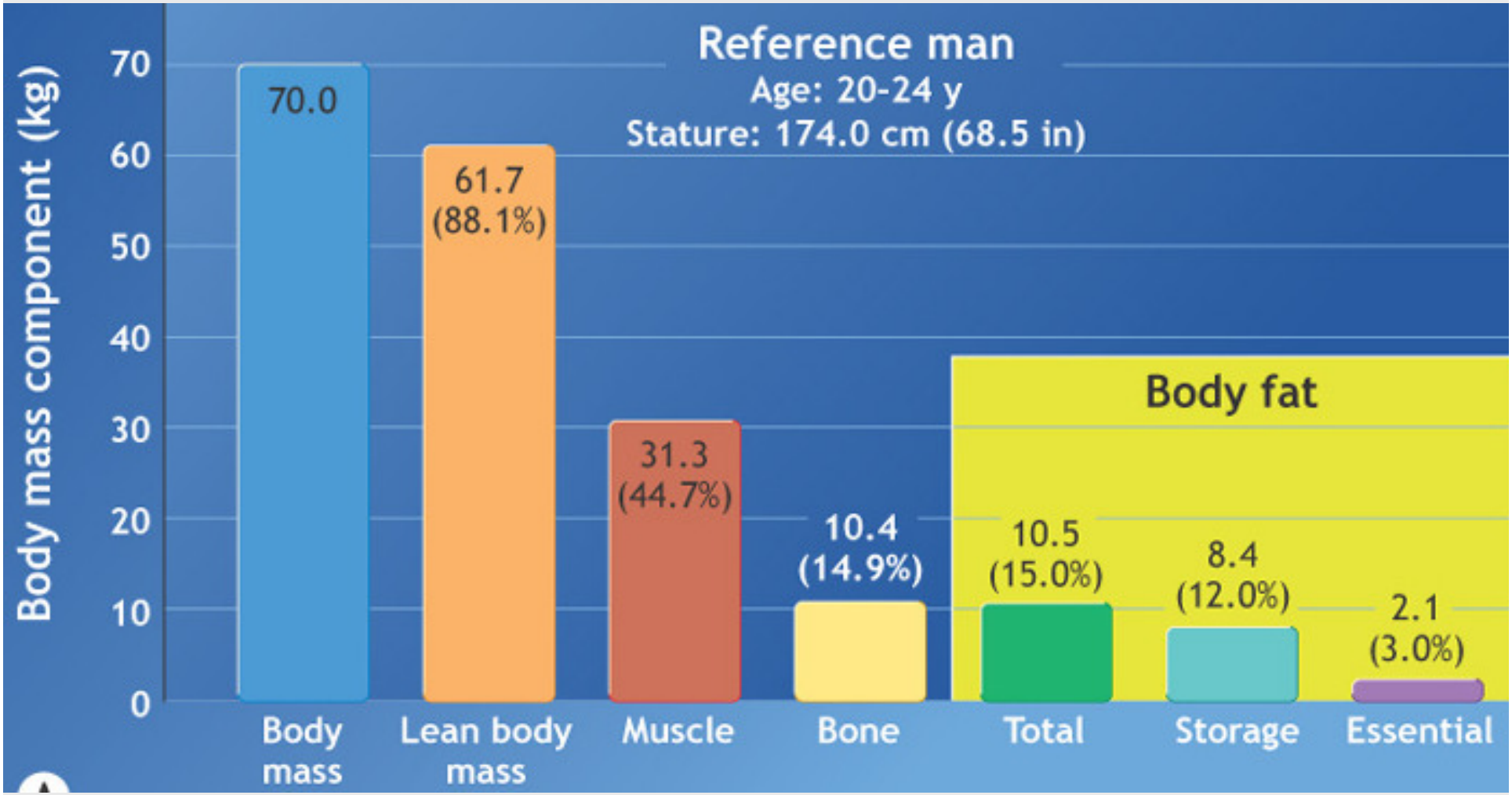
Reference Female

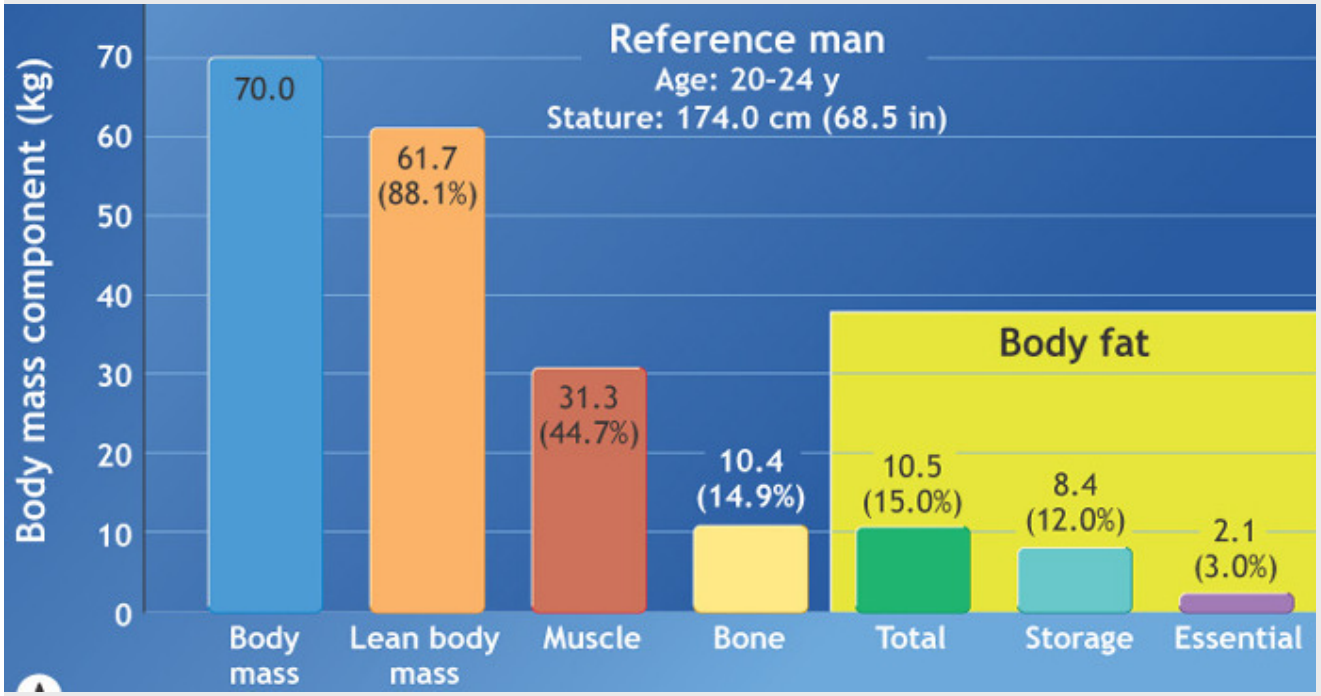


Reference Female



Reference Male

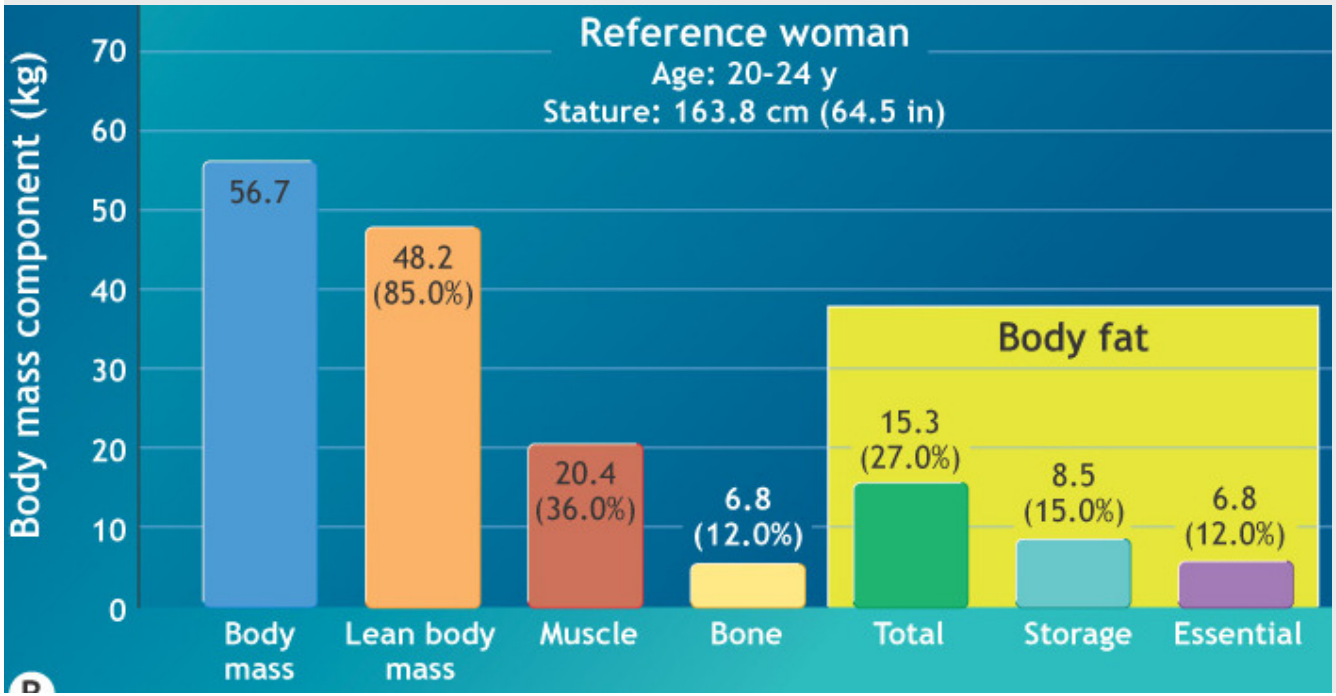




Male

vs

Female



(note differences in fat and muscle content)

What is Essential Fat?

- **Consists of fat stored in major organs, muscles, and central nervous system**

- **Important for childbearing and hormone-related functions**
- **Required for normal physiological functioning: reducing essential fat below some minimal amount can impair overall health. Extremes in dieting (and exercise) can reduce essential fat stores)**

Sex Differences in Essential Fat

Men

3%

Women

12%

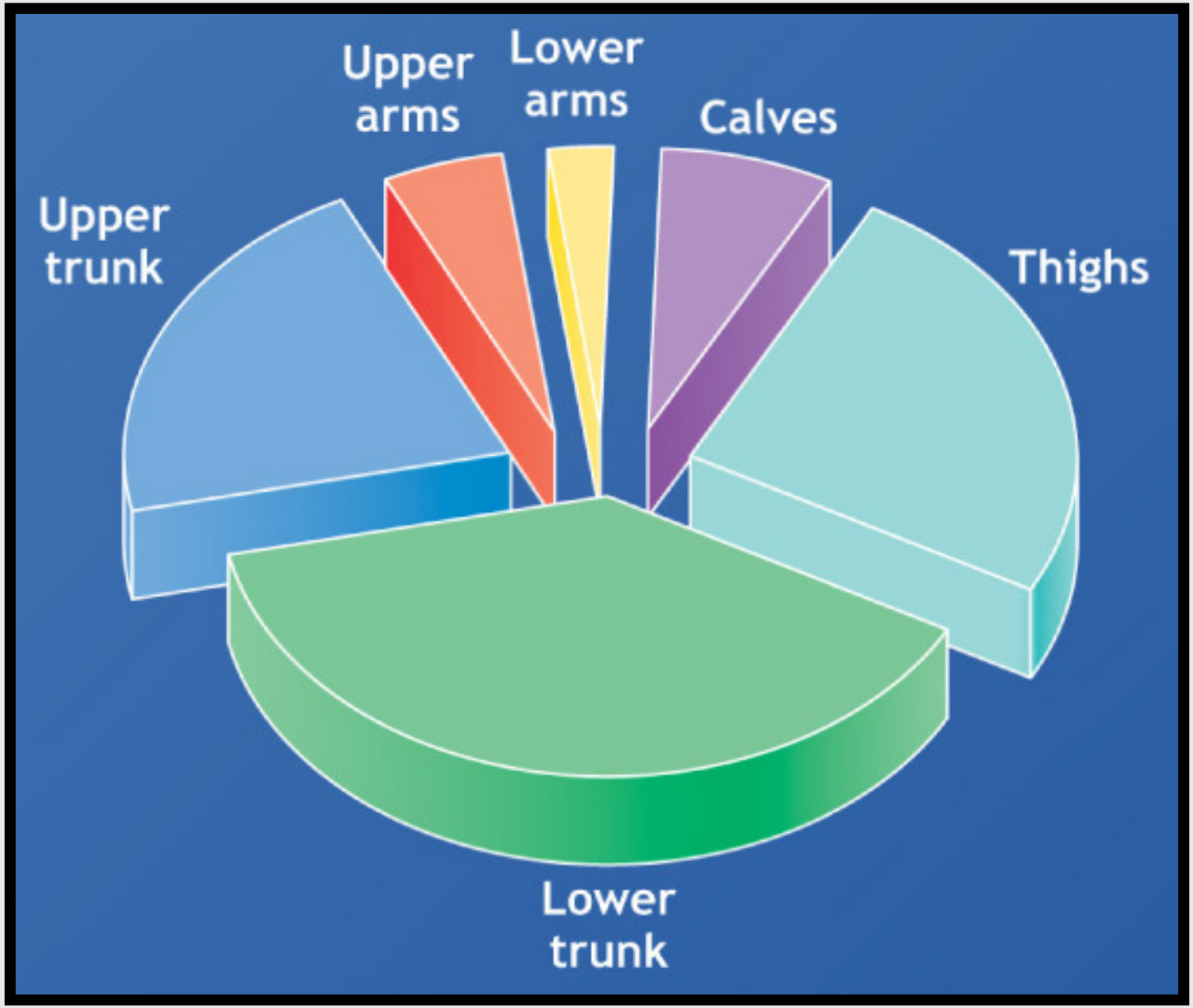
Of this amount, 5 to 9% is called *sex-specific, reserve storage fat* contained in breast and genital regions, lower body subcutaneous fat, and intramuscular depots

Sex Differences in Storage Fat

Storage fat accumulates mainly in adipose tissues. This fat depot includes visceral fatty tissues and adipose tissue deposited beneath the skin's surface called *subcutaneous fat*

Men	Women
12%	15%

Distribution of Adipose Tissue



Fat-Free Body Mass (FFM)

Defined as body mass devoid of all extractable fat

Body mass = 75.1 kg Body fat = 23.6%

Fat mass = Body mass * % body fat

FFM = Body mass - fat mass

What is the FFM for this person?

Answer: 57.4 kg

Lean Body Mass (LBM)

In men, FFM includes 3% essential fat
In females, FFM includes 12% essential fat

When you compute LBM (body mass minus fat mass), the LBM component includes the "lipid-rich" essential fat stores in bone marrow, brain, spinal cord, and internal organs. LBM and FFM yield the same result, but the interpretation of their tissue composition distinguishes between the two concepts

The Concept of Minimal Weight

Lowest you can weigh before compromising FFM stores

Males:

Females: Includes about 4%-7% essential fat + sex-specific fat (5%-9%) = 12%
[probably around 48.5 kg (105 lbs) for reference female]

How Lean is Too Lean?

In males, the lower limit of leanness equals about about 3% body fat. Long distance runners typically have such low values. This level of fatness is compatible with efficient heat dissipation during intense prolonged aerobic exercise.

Leanness, Exercise, and Menstrual Irregularity

Society places an extreme focus on body weight and need for weight loss through dieting. The effects are felt in the general adult population, many athletic endeavors, and unfortunately in grade school. For example, 55% of 8th grade girls and 28% of 8th grade boys believed they were too fat and required dieting. The facts revealed the contrary. Only 13% of both populations needed to reduce. Sadly, 50% of the 8th grade girls and 15% of the boys had already begun dieting regimens.

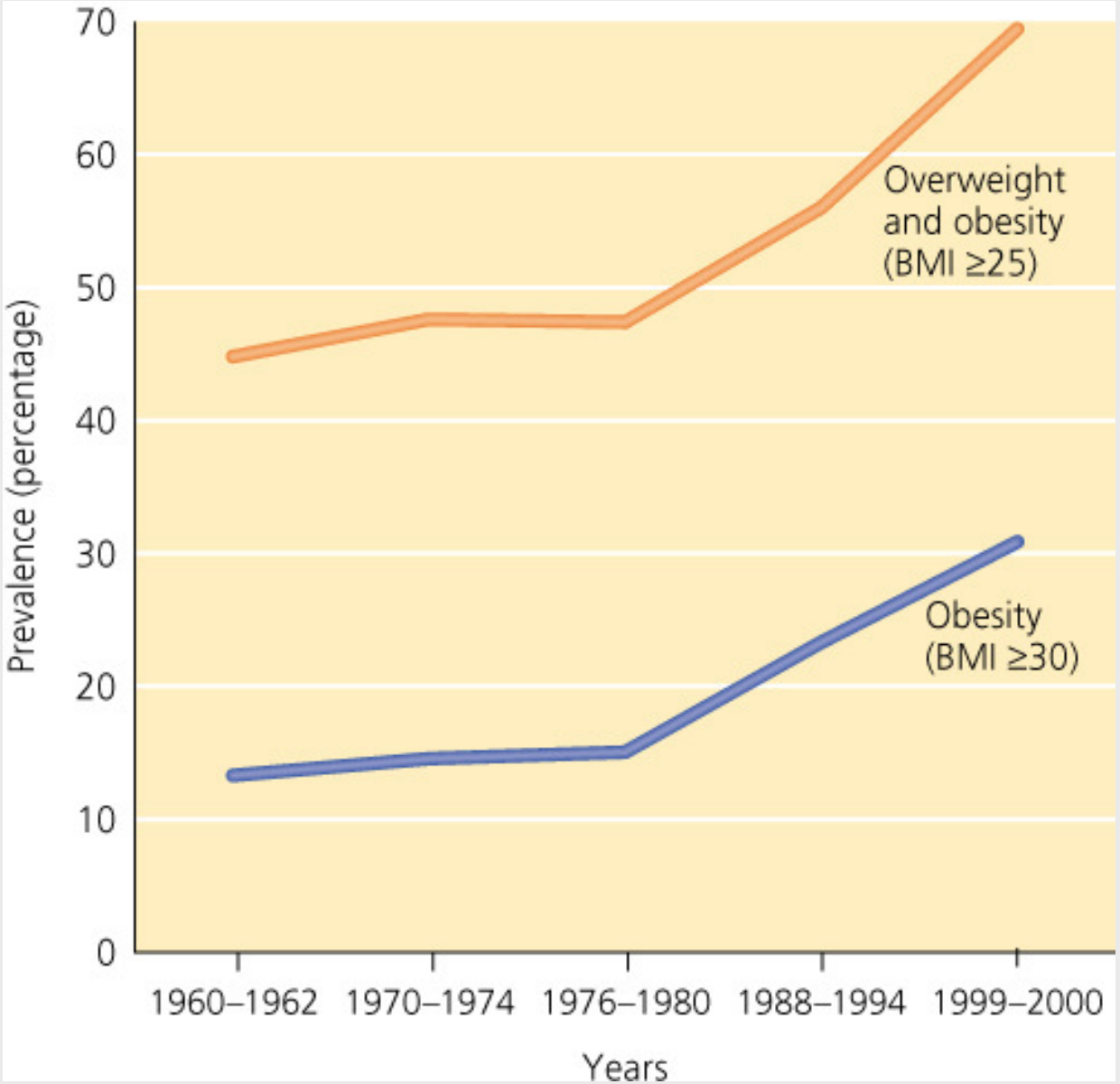
Health Consequences of "Thinness"

- ✓ **Ammenorrhea (completion cessation of menses) occurs in 2 to 5% of women of reproductive age, and 40% of female athletic groups such as dancers, skaters, cheerleaders, gymnasts, cross-country runners**
- ✓ **Oligomenorrhea (irregular menstrual cycles) or amenorrhea increases the risk of bone loss and musculoskeletal injury in premenopausal women**

Overweight and Obesity

- The most important consideration in evaluating body weight and composition is the proportion of total body weight that is fat (percent body fat)
- Overweight = total body weight above a recommended range for good health
- Obesity = severely overweight and overfat; characterized by excessive accumulation of body fat

Prevalence of Overweight and Obesity



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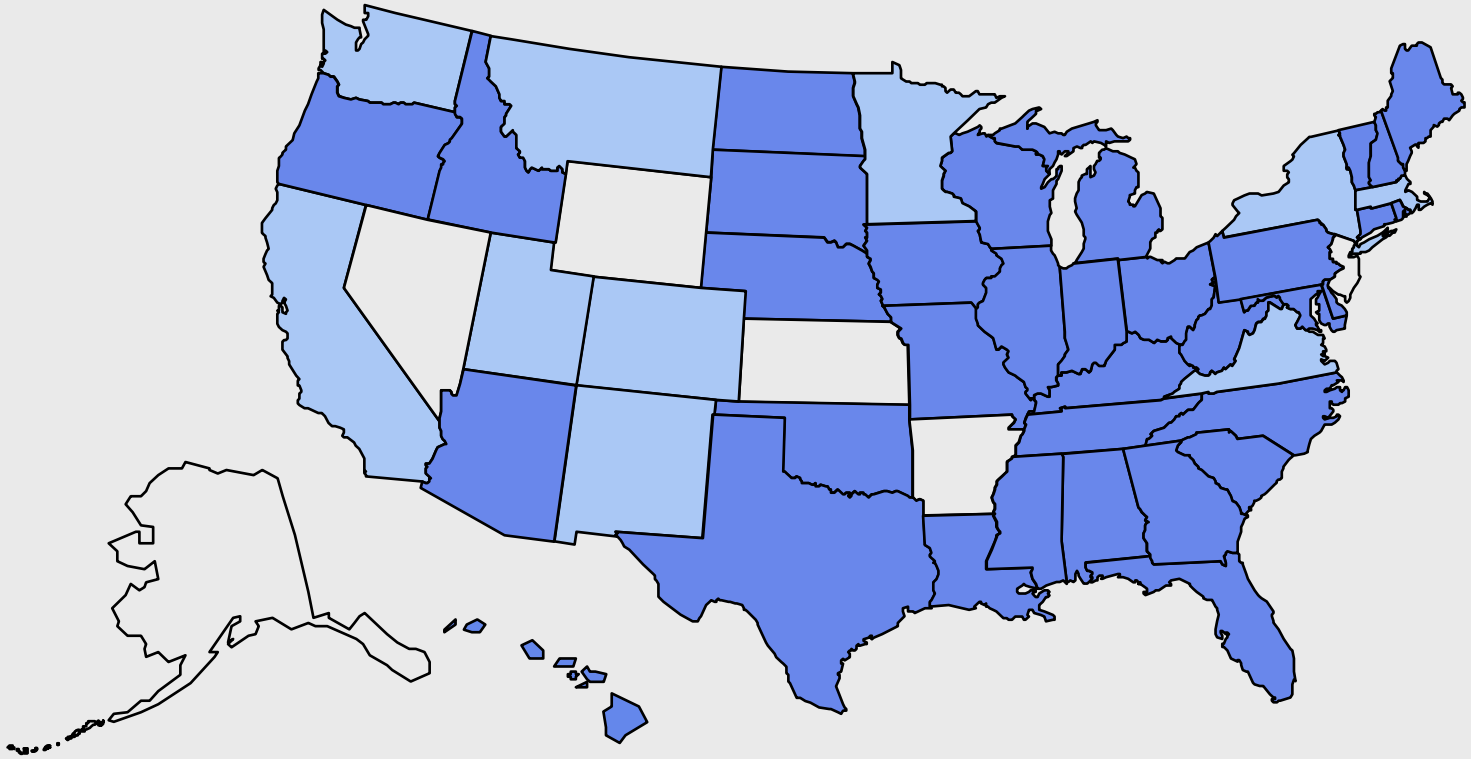
Obesity Trends* Among U.S. Adults

1990

(*BMI ≥30, or ~ 30 lbs overweight for 5’ 4” woman)



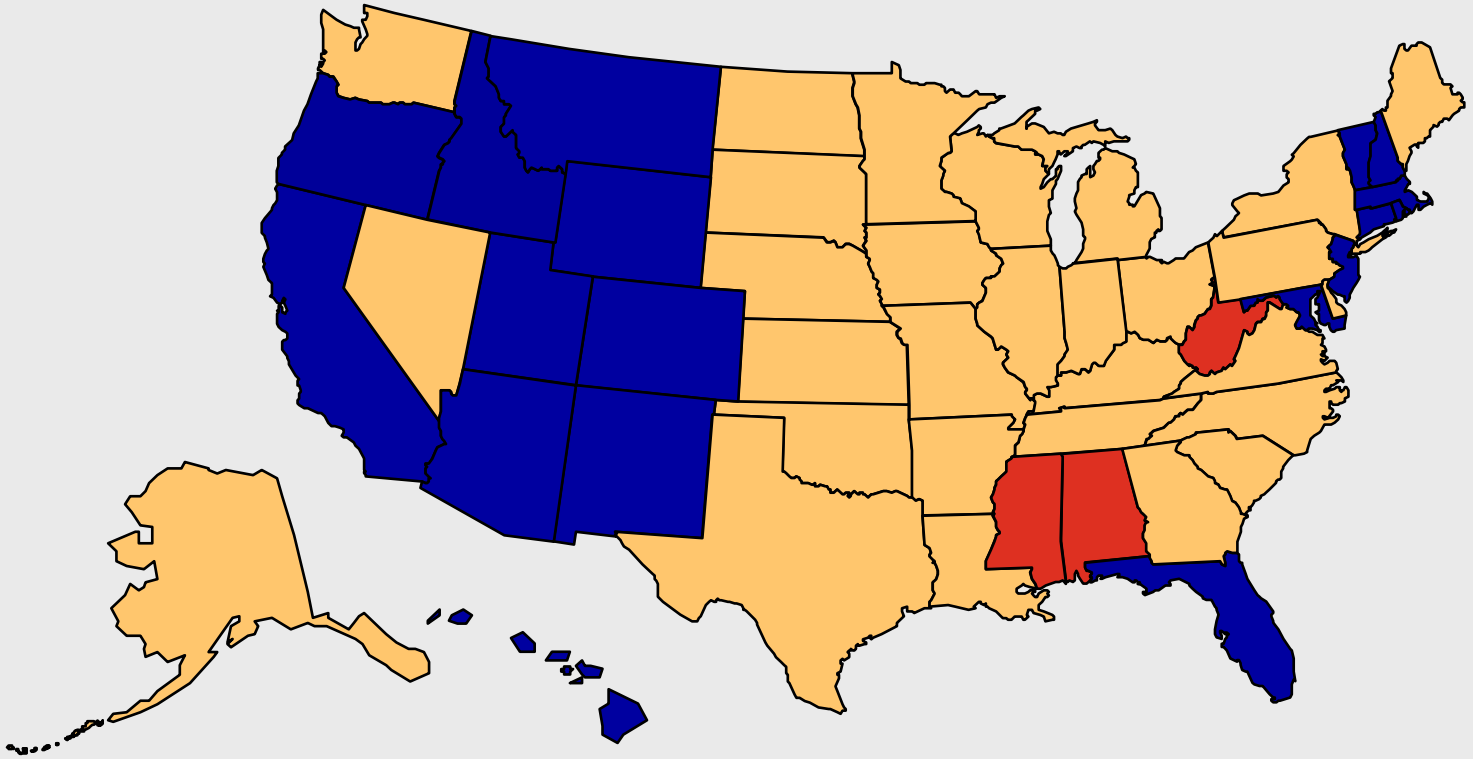
No Data | <10% | 10%–14%

Source: Behavioral Risk Factor Surveillance System, CDC

Obesity Trends* Among U.S. Adults

2002

(*BMI ≥30, or ~ 30 lbs overweight for 5’ 4” woman)



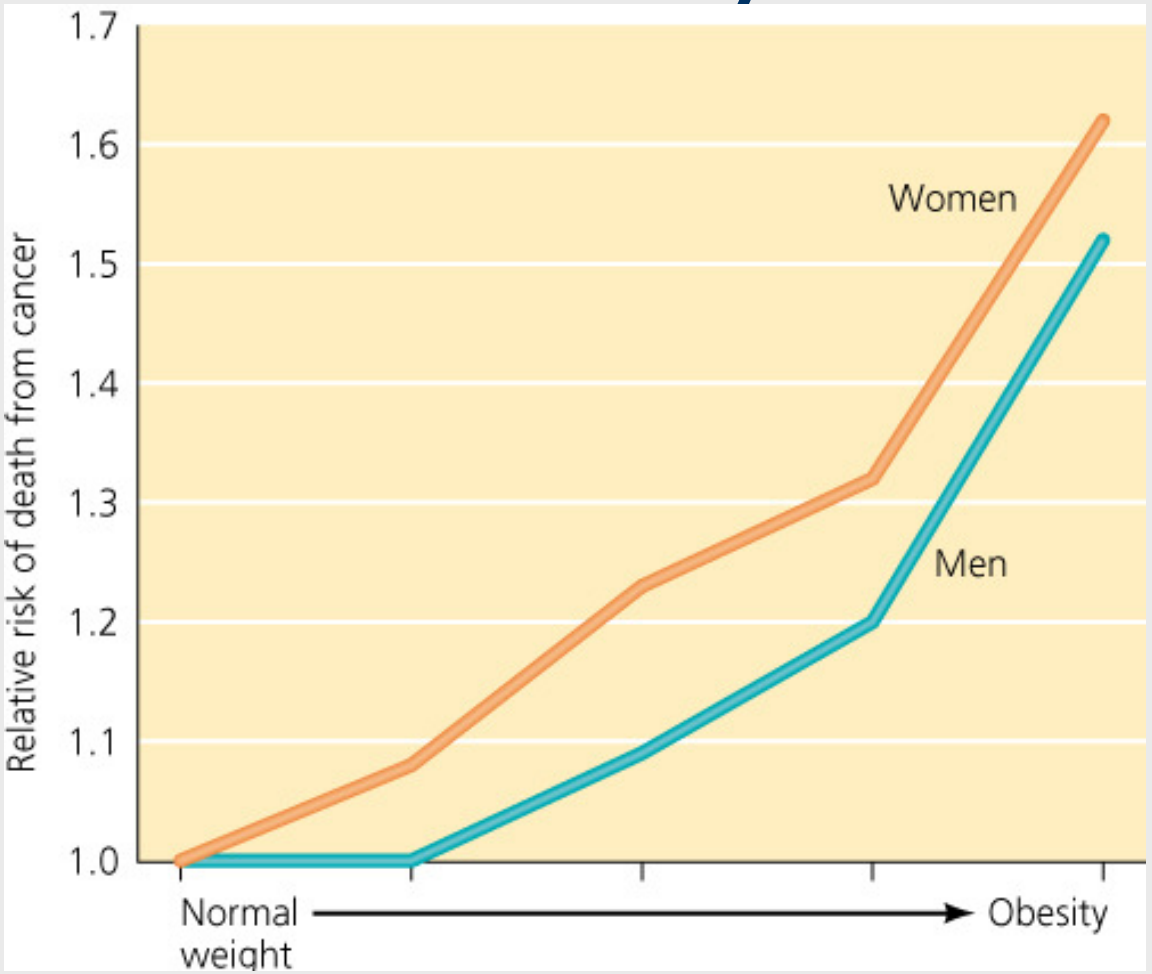
Source: Behavioral Risk Factor Surveillance System, CDC

No Data | <10% | 10%–14% | 15%–19% | 20%–24% | ≥25%

Excess Body Fat and Wellness

- Increased risk of chronic disease and premature death; associated health problems include
  - Unhealthy blood fat levels
  - Impaired heart function
  - Heart disease and hypertension
  - Cancer
  - Impaired immune function
  - Gallbladder disease
  - Kidney disease
  - Skin problems
  - Sleeping problems

Body Composition and Cancer Mortality



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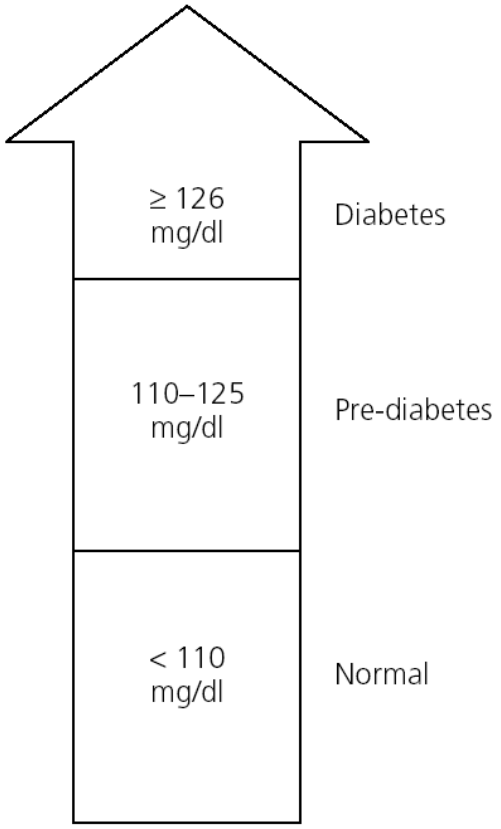
Body Composition and Diabetes

- Obese people are more than three times as likely as nonobese people to develop diabetes
- Excess body fat is a key risk factor for the most common type of diabetes

Diabetes

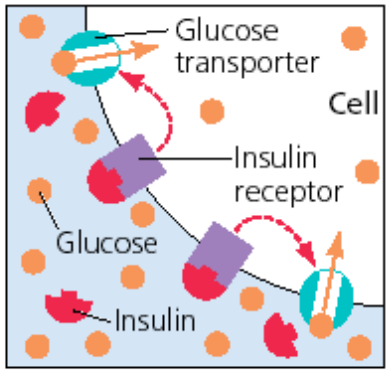
- Diabetes mellitus = disruption of normal glucose metabolism
  - Type 1 diabetes = the pancreas produces little or no insulin
  - Type 2 diabetes = the pancreas doesn't produce enough insulin, cells are resistant to insulin, or both
  - Gestational diabetes = develops in 2–5% of pregnant women
  - Pre-diabetes = elevated blood glucose levels

Diabetes

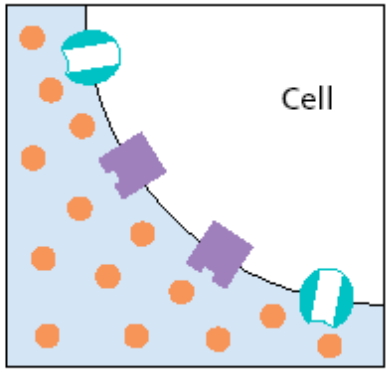


Fasting Glucose Levels

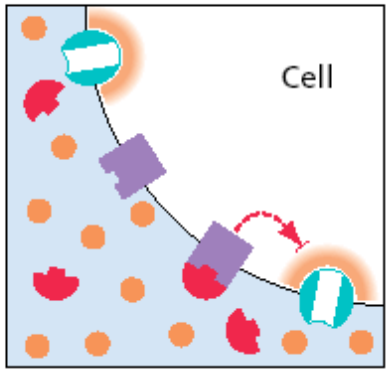
Normal:
Insulin binds to receptors on the surface of a cell and signals special transporters in the cell to transport glucose inside.



Type 1 diabetes:
The pancreas produces little or no insulin. Thus, no signal is sent instructing the cell to transport glucose, and glucose builds up in the bloodstream.



Type 2 diabetes:
The pancreas produces too little insulin and/or the body's cells are resistant to it. Some insulin binds to receptors on the cell's surface, but the signal to transport glucose is blocked. Glucose builds up in the bloodstream.



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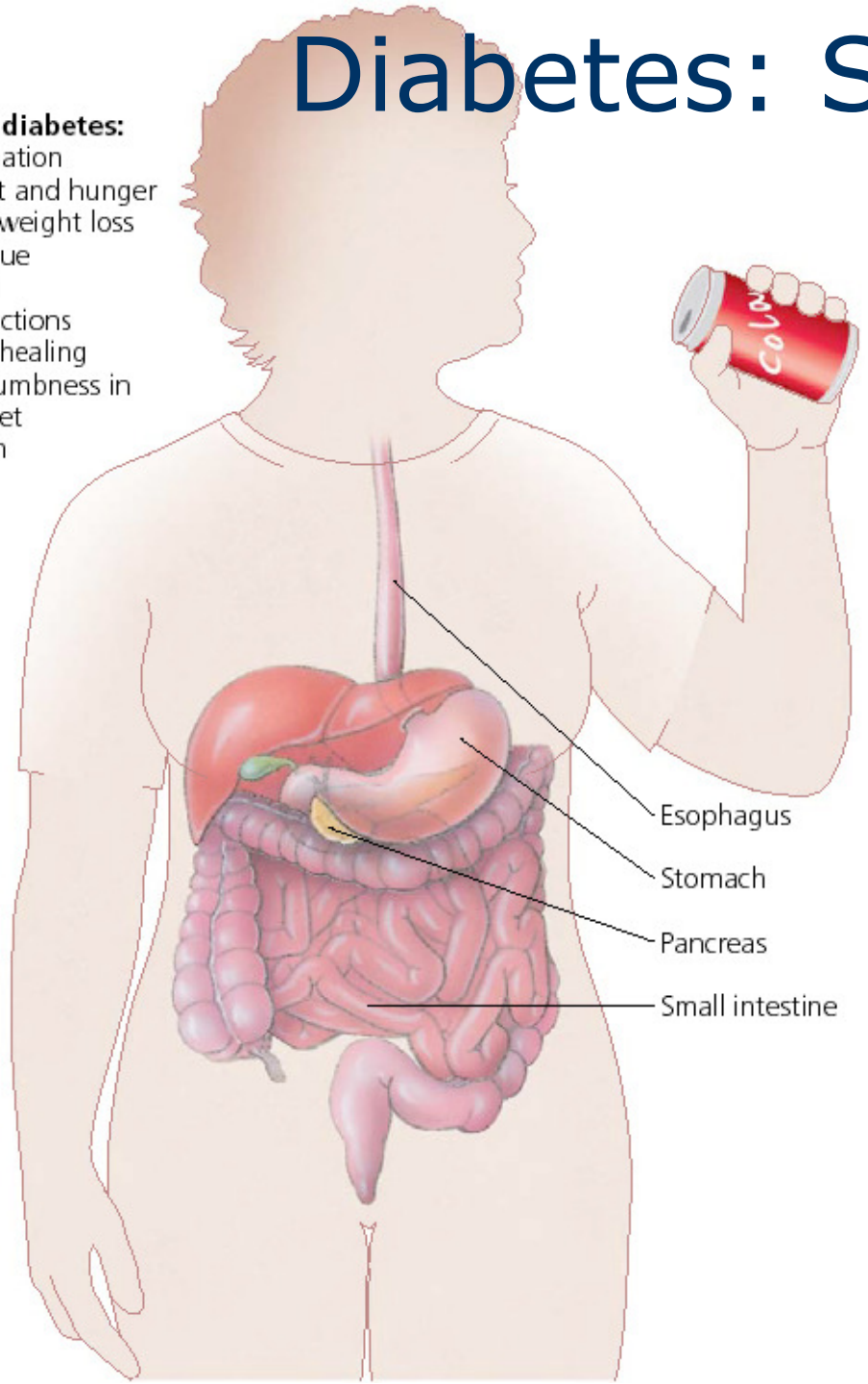
Diabetes: Symptoms

Symptoms of diabetes:

- Frequent urination
- Extreme thirst and hunger
- Unexplained weight loss
- Extreme fatigue
- Blurred vision
- Frequent infections
- Slow wound healing
- Tingling or numbness in hands and feet
- Dry, itchy skin



Diabetes: Prevention

- Regular physical activity including endurance exercise and weight training
- Moderate diet rich in whole grains, fruits, vegetables, legumes, fish, and poultry
- Modest weight loss
- For people with pre-diabetes, lifestyle changes are more effective than medication in preventing diabetes

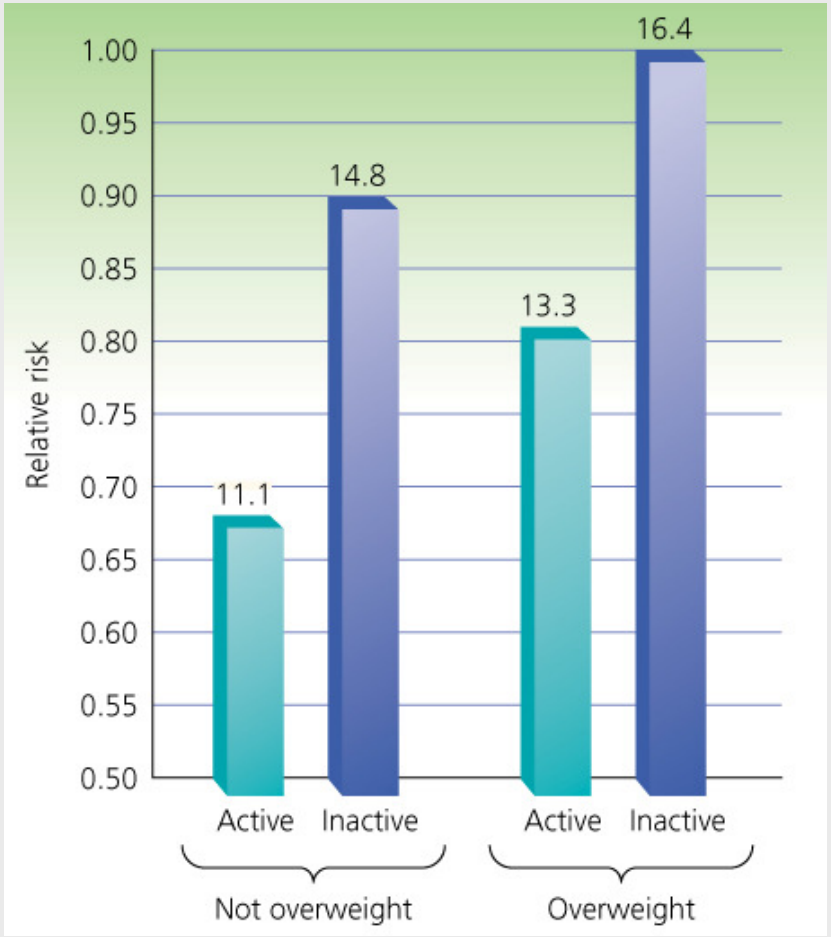
Diabetes: Treatment

- Keep blood sugar levels within safe limits through diet, exercise, and, if needed, medication
- Monitor blood sugar levels with a home test
- Lose weight if overweight

Body Fat Distribution and Chronic Disease

- Location of fat is important to health
  - People who gain weight in the abdominal area = “apples;” this group has an increased risk of coronary heart disease, high blood pressure, diabetes, and stroke
  - People who gain weight in the hip area= “pears”

Physical Activity, Overweight, and Risk of Death



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Body Composition and Wellness

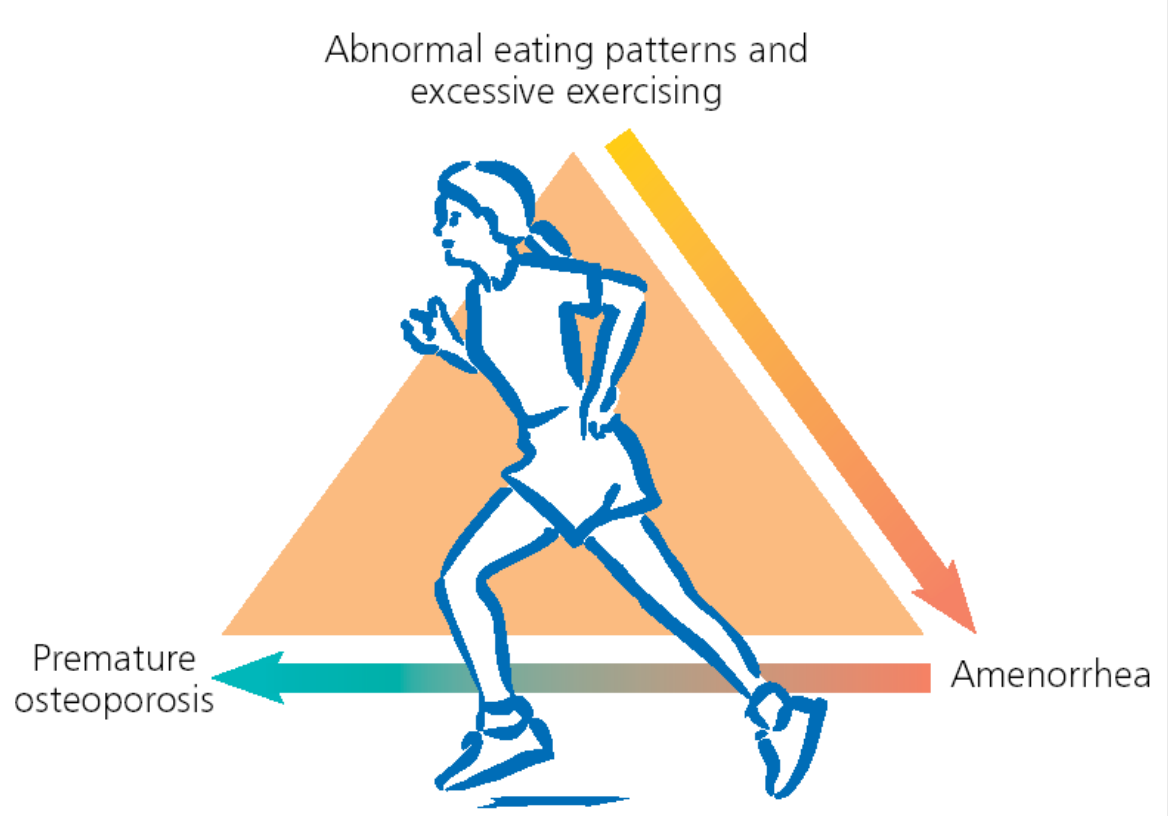
- Excess body fat decreases the ability to perform physical activities
- Unrealistic expectations about body composition can hurt self-image; exercise improves body image
- Set a realistic goal and maintain a wellness lifestyle to develop a healthy body composition

Problems Associated with Very Low Levels of Body Fat

- Too little body fat is associated with reproductive, circulatory, and immune system disorders
  - Less than 10–12% for women
  - Less than 5% for men

Female Athlete Triad

- A condition consisting of three interrelated disorders



Body Mass Index

- A rough assessment based on the concept that a person's weight should be proportional to height
- Body weight in kilograms is divided by the square of height in meters
- Elevated BMI is linked to increased risk of disease, especially if associated with large waist circumference

Body Mass Index

	<18.5 Underweight		18.5–24.9 Normal						25–29.9 Overweight					30–34.9 Obesity (Class I)					35–39.9 Obesity (Class II)					≥40 Extreme obesity
BMI	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Height	Body Weight (pounds)																							
4' 10"	81	86	91	96	101	105	110	115	120	124	129	134	139	144	148	153	158	163	168	172	177	182	187	192
4' 11"	84	89	94	99	104	109	114	119	124	129	134	139	144	149	154	159	163	168	173	178	183	188	193	198
5'	87	92	97	102	108	113	118	123	128	133	138	143	149	154	159	164	169	174	179	184	190	195	200	205
5' 1"	90	95	101	106	111	117	122	127	132	138	143	148	154	159	164	169	175	180	185	191	196	201	207	212
5' 2"	93	98	104	109	115	120	126	131	137	142	148	153	159	164	170	175	181	186	191	197	202	208	213	219
5' 3"	96	102	107	113	119	124	130	136	141	147	153	158	164	169	175	181	186	192	198	203	209	215	220	226
5' 4"	99	105	111	117	122	128	134	140	146	152	157	163	169	175	181	187	192	198	204	210	216	222	227	233
5' 5"	102	108	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198	204	210	216	222	229	235	241
5' 6"	105	112	118	124	130	136	143	149	155	161	167	174	180	186	192	198	205	211	217	223	229	236	242	248
5' 7"	109	115	121	128	134	141	147	153	160	166	173	179	185	192	198	204	211	217	224	230	236	243	249	256
5' 8"	112	118	125	132	138	145	151	158	165	171	178	184	191	197	204	211	217	224	230	237	244	250	257	263
5' 9"	115	122	129	136	142	149	156	163	169	176	183	190	197	203	210	217	224	230	237	244	251	258	264	271
5' 10"	119	126	133	139	146	153	160	167	174	181	188	195	202	209	216	223	230	237	244	251	258	265	272	279
5' 11"	122	129	136	143	151	158	165	172	179	187	194	201	208	215	222	230	237	244	251	258	265	273	280	287
6'	125	133	140	148	155	162	170	177	184	192	199	207	214	221	229	236	243	251	258	266	273	280	288	295
6' 1"	129	137	144	152	159	167	174	182	190	197	205	212	220	228	235	243	250	258	265	273	281	288	296	303
6' 2"	132	140	148	156	164	171	179	187	195	203	210	218	226	234	242	249	257	265	273	281	288	296	304	312
6' 3"	136	144	152	160	168	176	184	192	200	208	216	224	232	240	248	256	264	272	280	288	296	304	312	320
6' 4"	140	148	156	164	173	181	189	197	206	214	222	230	238	247	255	263	271	280	288	296	304	312	321	329

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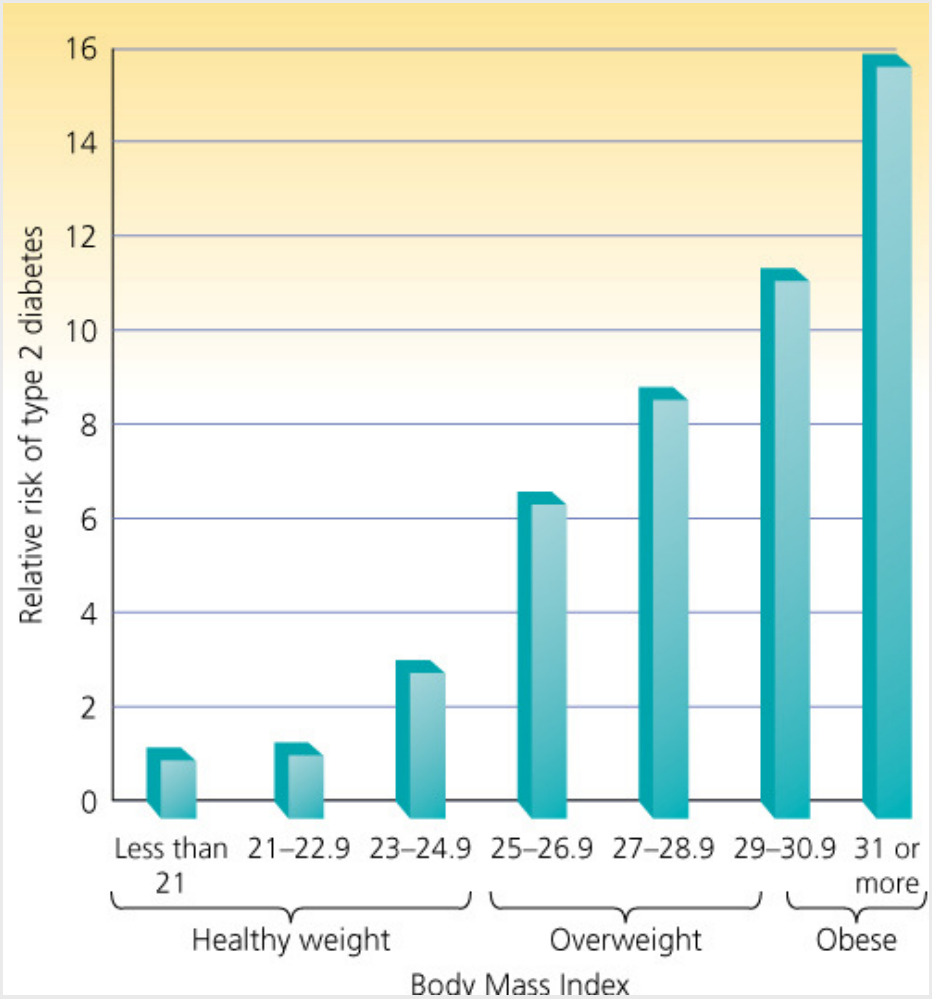
Body Mass Index and Risk of Type 2 Diabetes



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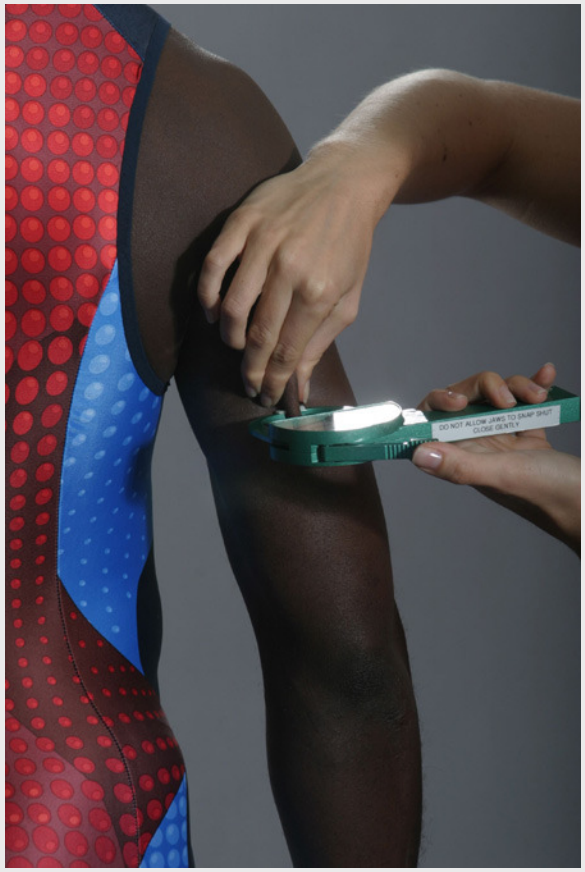
Estimating Percent Body Fat

- Skinfold measurements: Folds of skin are measured with a caliper. The measurements are used in equations that link the thickness of skinfolds to percent body fat calculations made from more precise experiments.



Estimating Percent Body Fat

- Underwater weighing: An individual is submerged and weighed under water. Percentages of fat and fat-free weight are calculated from body density.
- The Bod Pod: The amount of air displaced by a person in a small chamber is measured by computerized sensors.
- Bioelectrical impedance analysis (BIA): A small electrical current is sent through the body, and the resistance of the body to it is recorded. The resulting estimates of how much water is in the body can be used to determine body composition.

Assessing Body Fat Distribution

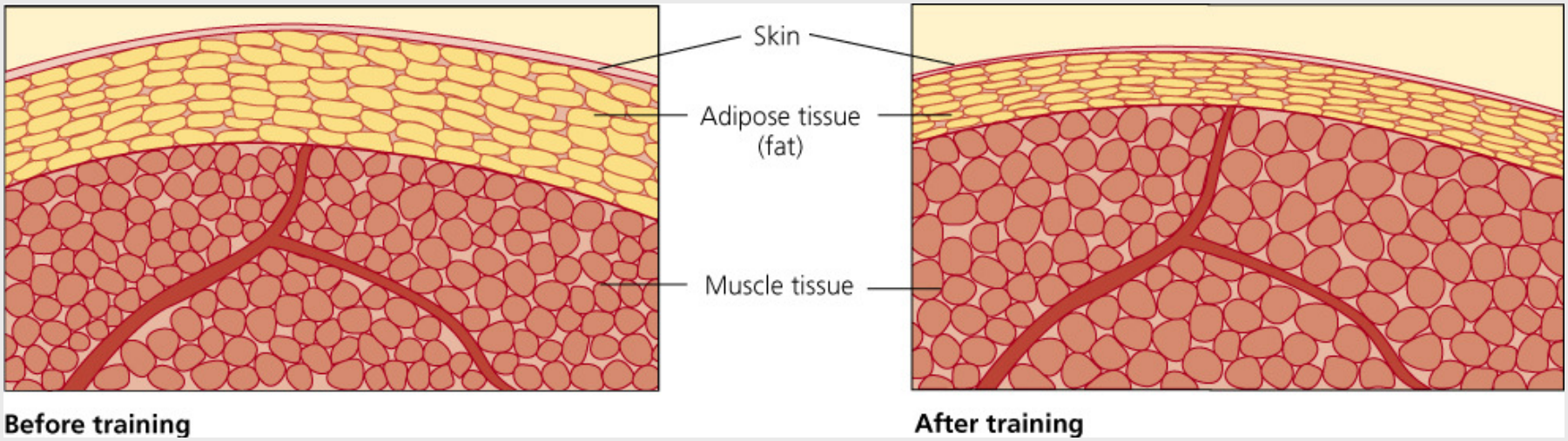
- Disease risk increases with total waist measurement of more than
  - 40 inches for men
  - 35 inches for women
- Disease risk increases with total waist-to-hip measurement above
  - 0.94 for young men
  - 0.82 for young women

Setting Body Composition Goals

- If fat loss would benefit your health, set a **realistic** goal in terms of percent body fat or BMI
- If you have underlying health issues, check with your physician before setting a goal
- A little weight loss at a time can be very beneficial; focus on a healthy lifestyle including proper diet and exercise

Making Changes in Body Composition

- Lifestyle should focus on:
  - Regular physical activity, endurance exercise, and strength training



Making Changes in Body Composition

- Lifestyle should focus on:
  - Moderate energy intake
  - Physical activity is the key to long-term success