Unit 3: Where are we heading?

Unit 1: What’s in your food?
Unit 2: How does your body use food?
**Unit 3: What is metabolic disease?**
Unit 4: How do I identify ‘good’ and ‘bad’ food?
Unit 5: How does this knowledge apply to me?

In this unit we will focus on the question: What is metabolic disease? We will first define and investigate the metabolic and physiologic causes of obesity. Once we understand what obesity is, we can relate it to diseases like diabetes and atherosclerosis, which are both linked to obesity.
**LESSON 3.1 WORKBOOK**

**What is obesity and how does BMI relate?**

In this unit we will focus on the question: What is metabolic disease? We will first define and investigate the metabolic and physiological causes of obesity. Once we understand what obesity is, we can relate it to diseases like diabetes and atherosclerosis, which are both linked to obesity.

This lesson focuses on obesity. We will discuss the obesity trends in the United States over the past thirty years and explore how obesity is measured. We will also touch upon what causes obesity from societal and cellular levels.

**Increasing obesity is a recent trend**

The rates of obesity around the world have been steadily rising and there seems to be no end to their growth. In the United States, obesity rates began to rise in the 1970s and have been steadily increasing since, although some researchers speculate that we may have reached the highest rates of obesity that we will see in the U.S.

**Obesity is associated with economic growth**

If we were to compare a graph of obesity in any given country to a graph of the same country’s economic growth, chances are the two graphs would look similar. Although this does not mean that economic growth causes obesity, we can speculate as to why these two measurements are linked. As citizens of a country become more prosperous, they likely have more food choices and can afford more calorically dense foods.
like meat and dairy. Additionally, large food chains offering cheap and convenient food become more available to consumers, making calories easier to consume. Other lifestyle changes may also occur with economic growth that makes obesity more prevalent, such as occupation; as the typical jobs shift from actively working with one’s hands to sitting at a computer, a decrease in physical activity becomes normal. What other technologies can you think of that make eating easier, but exercising more challenging?

It is important to note that even though obesity tends to be more prevalent in first-world countries than third-world countries, obesity rates are growing nearly everywhere around the globe. Additionally, within many developed countries obesity is more likely to affect impoverished populations than the wealthy members of society.

How did all of this start?

In the United States the rapid rise in obesity rates began in the 1970s. Many theories have surfaced regarding what caused the initial increases in obesity. As we learned in Unit 1, post World War II was a time of technological innovation in the food industry. The industrialized food supply that we have now is rooted in the 1940s and 1950s, when food was becoming more plentiful and processed. Some data suggests that our modern methods of food production increased caloric intake per person, leading to weight gain. Others believe that changes in activity are more to blame, although the increased incidence of obesity it likely caused by a combination of both.

1. The wealthier a person is in the U.S., the more likely they are to be obese:  
   a. True.  
   b. False.  

2. Which of the following is NOT a cause of global increases in obesity?  
   a. Technologies that reduce physical activity.  
   b. Availability of calorie-dense food.  
   c. Genetic mutations.  
   d. The industrialized food system.
Why is obesity a problem?

There is not an organ system in the human body that is not adversely affected by obesity. See the table (Figure 3) below for some of the diseases that are associated with obesity.

<table>
<thead>
<tr>
<th>Organ System Involved</th>
<th>Disease(s)</th>
</tr>
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<tbody>
<tr>
<td>Digestive System</td>
<td>Colon cancer; Gallstones; Hepatic (liver) cancer</td>
</tr>
<tr>
<td>Cardiovascular System</td>
<td>Coronary heart disease; Stroke; Hypertension</td>
</tr>
<tr>
<td>Neurological System</td>
<td>Mental health conditions like depression; Alzheimer's Disease; Dementia</td>
</tr>
<tr>
<td>Skeletal System</td>
<td>Osteoarthritis</td>
</tr>
<tr>
<td>Reproductive System</td>
<td>Infertility; Endometrial cancer; Prostate Cancer</td>
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</table>

**Figure 3:** Organ systems affected by obesity and the related diseases.

Measuring obesity

You probably have an idea of what obesity looks like, but how can we determine who is a healthy weight, overweight or obese? There are very specific criteria used to categorize people as a healthy weight, overweight and obese. Knowing this is important because when people talk about health problems linked with obesity we can know who and what are they referring to.

What is a BMI?

BMI stands for Body Mass Index, and is based on weight-per-height. To calculate your BMI use this equation:

\[
\text{BMI} = \frac{\text{Body weight (in kg)}}{\text{Height}^2 \text{ (in m)}}
\]

The concept of BMI is convenient to use because the values apply to both men and women. A BMI from 18 – 24.0 is considered normal, 25 – 29.9 is considered overweight, and greater than 30 is obese. BMI is the measurement that is most commonly used by physicians and researchers to classify someone as healthy, overweight or obese, because at the population level weight-per-height is closely related to body fat content. There are however some limitations to using only BMI as a measurement of health for an individual.
4. BMI is:
   a. A useful tool for measuring the health of a population.
   b. The definitive measurement of an individual’s health.
   c. Calculated using height, weight, gender and age.
   d. A score that can easily fluctuate from day-to-day.

Problems with BMI: Population vs. the individual

BMI tables have been compiled from studies of large population groups, so when these tables are applied to a population they provide good estimates of the weight range associated with health and longevity. If you look at the BMIs of thousands of people, individuals with higher BMIs are almost always heavier due to excess fat, not muscle. However, they do not necessarily indicate the healthiest body weight for each individual. For example, athletes often have extra lean body mass and little body fat so they will weight more than average. Just using BMI to evaluate health, an athlete may be obese even though little of their body weight is from fat. Ideally, establishing a healthy weight for an individual would take into account that person’s body composition, family history of weight-related diseases, and ethnicity.

Other measurements of obesity

Measuring the percentage of someone’s total weight from fat is a good way to determine if an individual is healthy. Body fat can range from 2 to 70% of one’s total body weight, with the desirable levels being between 21 to 35% for women and 8 to 24% for men. In this regard, individuals with a body fat percentage above these levels are considered overweight or obese.

There are multiple ways to measure body fat composition. Some commonly used methods include:

- **Skinfold thickness** — Uses calipers to measure the fat layer directly under the skin at multiple sites. (See Figure 6.)
- **Bioelectrical impedance** — Measures body fat content using a low-energy electrical current. The more fat a person has, the greater the resistance to electrical flow through the body.
- **Dual energy X-ray absorptiometry (DEXA)** — Measures both body fat and bone mass density using low-energy X-rays.

**Figure 5:** Someone with excess muscle mass may have the same BMI as someone with excess fat.

**Figure 6:** A skinfold caliper can estimate fat mass.
LESSON READINGS

Where fat is located matters!

Not only how much fat, but also where the fat is stored can predict health risks. Some people store fat in the upper body areas, resulting in an apple-shaped body. Others store fat lower in the body, resulting in a pear-shaped body. Excess fat in either place generally spells trouble, but upper-body obesity brings higher risks for obesity health associated diseases. For example, people that are apple-shaped are at higher risk for cardiovascular disease, hypertension and type 2 diabetes.

5. Which of the following is an example of how ‘nurture’ may contribute to obesity?
   a. Being born with a ‘fast’ metabolism.
   b. Mindless eating.
   c. Leptin deficiency.
   d. All of the above.

What causes obesity?

Energy in and energy out

You may have heard the law ‘energy is neither created nor destroyed’. Therefore, you can think of energy balance as an equation: Energy Input = Energy Output, which can be translated as the amount of energy you consume through food must equal the amount of energy used for metabolism, digestion, physical activity and all cellular functions requiring ATP. If your energy intake from food exceeds your output, you will gain weight over time as you store excess energy as fat. To maintain your weight, you must match energy input to energy output. This may seem simple, but managing ones weight can be challenging for reasons that we will explore in the following lessons.

Nature versus nurture

Both genetic and environmental factors can increase a person’s risk of obesity. Experts in the field of obesity research are at odds over the relative importance of nature and nurture. Studies in pairs of identical twins give us some insight into how genetics contribute to obesity. Even when identical twins have been raised apart from one another, they tend to show similar weight gain patterns both in overall weight and in weight distribution. These studies suggest that nature (genetics) has more to do with obesity than nurture (lifestyle habits: nutrition and exercise).
There are few rare examples of single gene mutations or polymorphisms that lead to an increased risk of obesity. One example is a leptin deficiency that is associated with severe early-onset obesity. Leptin is a hormone released from the adipose tissue and that signals the brain when we are full. The brain in turn tells us to stop eating. In cases of leptin deficiency the patient will overeat because they never feel full. Simply administering leptin to these patients helps them lose weight. However, leptin deficiency only affects very few people and is not the cause of weight gain for most individuals. Conversely, leptin levels typically increase in obese people.

Some researchers argue that body weight similarities between family members stem more from sharing learned behaviors than from genetic similarities. Even couples with no genetic link often behave similarly toward food and eventually assume similar degrees of leanness or fatness. These proponents of nurture propose that environmental factors such as high-fat diets and inactivity literally shape us. Perhaps the best argument to this point is that our gene pool has not changed much in the past 50 years, but the number of obese people has grown in epidemic proportion. Hence, the obesity epidemic is most likely related to nurture (life style changes), or an interaction between nurture and nature.

How does our environment contribute to obesity?

Our everyday surroundings have a lot to do with the lifestyle choices we make. You have probably noticed that you are more likely to eat food if it is sitting next to you. Have you ever sat down to watch a movie with some popcorn, and before you realize it you’ve eaten the whole bag? This mindless eating is a documented response to not being actively engaged with the act of eating. To tackle this it’s a good idea to keep sweets and snacks outside of arms reach if you are working at a desk or watching television. There are several other aspects of our environment that make eating well and getting enough physical activity challenging. In fact, some researchers have coined the term ‘obesogenic environment’ to describe this problem. If you live in a neighborhood where walking is difficult because of safety concerns or lack of sidewalks, then you may live in an obesogenic environment. Similarly, our easy access to cheap, calorie dense food instead of nutritive, healthy foods promotes the obesogenic environment.
If someone wanted to lose weight how could they do it? List three environmental changes they could make. Discuss changes in energy balance that would be needed for weight loss (both in energy input and energy output).
## TERMS

<table>
<thead>
<tr>
<th>TERM</th>
<th>DEFINITION</th>
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<tbody>
<tr>
<td>BMI</td>
<td>Body Mass Index — a measurement of relative body shape based on an individual's weight and height.</td>
</tr>
<tr>
<td>Mindless Eating</td>
<td>The act of eating food without mentally thinking about it. Usually happens when you're distracted by work or entertainment.</td>
</tr>
<tr>
<td>Nature</td>
<td>The contribution of genetics to an individual's health.</td>
</tr>
<tr>
<td>Nurture</td>
<td>The contribution of lifestyle and environmental factors to an individual's health.</td>
</tr>
<tr>
<td>Obesity</td>
<td>The condition of being severely overweight due to excess fat.</td>
</tr>
<tr>
<td>Polymorphism</td>
<td>A mutation in a gene that results in abnormal function of the protein the gene encodes.</td>
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For a complete list of defined terms, see the [Glossary](#).