



CHAPTER 2: HEALTH EFFECTS OF OBESITY AND EXERCISE GUIDELINES FOR COMORBIDITIES

Objectives

After completing this section, the health and fitness professional will be able to:

- Define the different comorbidities that come with obesity.
- Understand the effects common medications have on exercise.
- Follow basic exercise guidelines when working with a client who has certain comorbidities that can come with obesity.

Introduction

Obesity is linked to several diseases, which are often referred to as comorbidities. Often, these comorbidities are found in combination, meaning that more than one health problem may be present when working with an overweight or obese client. A thorough medical history and medical clearance are necessary when working with these clients. It is important to note that the following conditions are not only associated with obesity, but oftentimes with each other. The following information is not meant to be used in place of a medical diagnosis but to provide an introduction to a sample of health problems associated with obesity. It is important for health and fitness professionals to have a basic understanding of these diseases because the medical community often recommends lifestyle modifications

that include eating a healthy diet and participating in regular exercise to either lose weight or maintain a healthy weight. Keep in mind that risk factors are not necessarily causes, but they do have a relationship with negative health issues. Some of the most common comorbidities found in obese individuals include:

- Type 2 diabetes mellitus
- Heart disease
- Hypertension
- Stroke
- Respiratory complications
- Certain cancers
- Dyslipidemia
- Metabolic syndrome
- Musculoskeletal issues
- Depression

When a negative health issue occurs, a physician diagnosis followed by an individualized treatment plan — often including lifestyle modifications, such as diet, exercise, and pharmacology — is the favored approach. Therefore, it is the responsibility of the health and fitness professional to inquire about the medications that clients may be taking because many medications can influence how the body responds to exercise. Health and fitness professionals should be sure that clients check with their physicians to

determine the exact effects that prescribed medications may have on exercise response, and have clients inform them of any changes to prescriptions (Table 2.1).

Clients who have health challenges probably will need extra encouragement and guidance through the initial phases of exercise because they may be unfamiliar with how their bodies will respond. Remember, the ultimate goal is to restore the client to the highest level of function possible. The exercise guidelines provided in this section are those currently recommended by the American College of Sports Medicine (1, 2).

Type 2 Diabetes Mellitus

Diabetes mellitus is a significant health problem in the United States, with approximately 25.6 million people suffering from it; it is estimated that nearly 90-95% of those cases are type 2 diabetes mellitus (3).

Diabetes is a disease in which the body does not produce or properly use insulin. Insulin is a hormone produced by the pancreas that facilitates the uptake of glucose from the blood to various cells. When a person has diabetes, one of two things is occurring in the body: 1) not enough insulin is being produced by the pancreas, or 2) the glucose can't be taken up

by the tissues and used for energy. The exact cause of diabetes is not fully understood, but some known risk factors include obesity, physical inactivity, poor diet, older age, ethnicity, pregnancy, and family history (4). Excess body fat is a general concern, but individuals who have an android (apple) shape are at a greater risk for type 2 diabetes. Obesity — and to a further degree, abdominal obesity — contributes to insulin sensitivity. In general, type 2 diabetics cannot use the insulin that the pancreas is sufficiently producing. Over time, the pancreas cannot produce enough insulin to compensate for the initial insulin resistance, which leads to hyperglycemia (high blood glucose levels).

Approximately 8.3% of the U.S. population has diabetes (3), and this number is expected to increase dramatically in coming decades. This number represents approximately 18.8 million diagnosed individuals and approximately 7 million undiagnosed people. Unfortunately, many people do not know that they have the disease, making prediabetes detection important during routine health care. Prediabetes can be determined by a higher-than-normal blood glucose or glycosylated hemoglobin A1c levels, which is an indicator of blood glucose over a 2-3 month period.

Table 2.1 Common Medications and Possible Effects on Exercise

Medication	Possible Effect on Exercise
Beta blockers	Decrease heart rate and blood pressure at rest and during exercise
Calcium channel blockers	Heart rate response depends on specific medication Blood pressure decreases at rest and exercise
Diuretics	No effect on heart rate; may decrease rest and exercise blood pressure
Anti-arrhythmic agents	In general, no effect on exercise capacity
Bronchodilators	Some may increase heart rate, increase exercise capacity in people limited by bronchospasm
Anti-depressants	Increase or no effect on resting or exercise heart rate Decrease or no effect on resting and exercise blood pressure
Hypoglycemic agents (Insulin and oral)	No effect on exercise capacity
Appetite suppressants (Sibutramine)	Possible increase in heart rate during exercise
Lipase inhibitors (Orlistat)	No effect on exercise capacity

Fortunately, early detection and treatment through weight loss and increasing physical activity are known to delay or prevent the onset of type 2 diabetes mellitus. The treatment for type 2 diabetes mellitus includes medication and exercise, and the benefits of exercise have been well documented (5). Regular exercise works to improve daily glucose control and improve insulin sensitivity.

Cardiorespiratory Recommendation	
Frequency	3-7 days/week, no more than 2 days between bouts
Intensity	Moderate to vigorous (50 to 80% HRR)
Duration	20-60 minutes, depending on intensity
Resistance Training Recommendation <i>Include all major muscle groups</i>	
Sets	2-3 sets
Repetitions	8-12 repetitions at 50-80% 1RM
Frequency	2-3 days/week, with at least 48 hours between sessions

Physical activities can include any movements that involve the large muscle groups, such as walking, jogging, swimming, cycling, or stair-climbing. The main goal for many patients should be to exercise at moderate to vigorous intensity (50% to 80% of VO_{2max}) for 20 to 60 minutes per day, 3 to 7 days per week. Exercise sessions should begin with a 5- to 10-minute warm-up and stretching of the muscles to be exercised, and conclude with a 5- to 10-minute cool-down period. Strength training also can be beneficial. Most of the research documenting the benefits of exercise among patients who have diabetes involves aerobic exercise, but resistance training is also recommended (1, 5). Resistance training should take a progressive approach,

with patients starting with light weights (60-80% of 1 rep max), doing 2-3 sets of 8-12 repetitions, using all major muscle groups. Individuals who have type 2 diabetes mellitus also are encouraged to increase physical activity throughout the day, and the use of step counters can serve as a way to set additional daily activity goals (5).

Specific recommendations for patients who have peripheral neuropathy (nerve damage that often causes numbness in the hands and feet), diabetic retinopathy (damage to blood vessels of the eye), and nephropathy (kidney disease) should be given when indicated. These recommendations can include avoiding extreme environments, proper foot care, avoiding the Valsalva maneuver (exhaling with a closed glottis), and paying special attention to hydration. All initial exercise sessions should be supervised if possible, the diabetic client should avoid exercising alone at any time, and those nearby should be informed of the possible complications of diabetes and exercise.

Heart Disease

Heart disease is still the leading cause of death in the United States among men and women (6). It accounts for about 25% of all deaths in the United States, with men accounting for more than half of all deaths related to heart disease (6). The term “heart disease” is a term often used to refer to a number of conditions involving a diseased heart, including myocardial infarction and coronary artery disease. A myocardial infarction is a heart attack, and coronary artery disease is caused by the narrowing of the vessels that supply blood and oxygen directly to the heart. This narrowing is usually caused by a condition called atherosclerosis, which occurs when cholesterol, in the form of plaque,

Effect of Exercise on Diabetes

Exercise has been shown to improve blood sugar control and increase insulin sensitivity for type 2 diabetics, and it can prevent or delay the onset of type 2 diabetes while improving lipids, blood pressure, and overall quality of life.

According to the Centers for Disease Control and Prevention, almost 616,000 people die of heart disease in the U.S. each year. That is about 25% of all U.S. deaths.

builds up on the walls of the arteries. As the coronary arteries narrow, blood flow to the heart is reduced, which is myocardial ischemia, or it can stop, which is myocardial infarction. Any disruption of the blood flow to the heart can cause discomfort, including chest pain and shortness of breath.

There are several factors that contribute to heart disease, including obesity, physical inactivity, family history, high cholesterol, smoking, hypertension, diabetes, high-fat diet, emotional stress, and type A personality traits (competitive, aggressive, impatient). The cardiovascular system can be compromised by a number of risk factors. Obesity is a risk to the system because not only is it a single risk factor for heart disease, but it also contributes to the development of hyperlipidemia, hypertension, and type 2 diabetes mellitus. If a client has heart disease, any exercise recommendation needs to be prescribed and monitored by the client's physician. The health and fitness professional should not deviate from recommendations.

Hypertension

Hypertension is commonly referred to as high blood pressure. Current estimates show that approximately 33.5% of U.S. adults older than 20 are hypertensive (7). Blood pressure readings are measured in millimeters

of mercury (mm Hg) and are recorded as two numbers, for example: 120/80. The top number is systolic pressure, which is the pressure exerted on the arteries during ventricular contraction. Systolic blood pressure is considered high if it is consistently greater than 140 mm Hg at rest. The bottom number is diastolic pressure, which is the pressure exerted on the arterial walls during ventricular relaxation. It is considered high if it is consistently greater than 90 mm Hg. For hypertension to be diagnosed, either or both of these numbers are too high. Heavier individuals have a greater volume of blood to deliver the necessary oxygen and nutrients to the tissues. As the volume of blood circulated through blood vessels increases, so does the pressure on the arterial walls.

Individuals do not typically jump from being normotensive (healthy blood pressure) to hypertensive (high blood pressure) overnight. Prehypertension is when systolic blood pressure is between 130 and 139 mm Hg and/or diastolic blood pressure is between 80 and 89 mm Hg on multiple readings (Table 2.2). If someone has prehypertension, he or she is more likely to develop high blood pressure at some point if lifestyle modifications are not implemented. Hypertension risk factors include being overweight or obese, physical inactivity, family history of hypertension, certain ethnicities, and older age.

Uncontrolled hypertension can lead to stroke, heart attack, heart failure, or kidney failure. This is why high blood pressure is often referred to as the "silent killer."

Table 2.2 Pressure Categories for Adults

Category	Systolic (top number)		Diastolic (bottom number)
Normal	Less than 120 mm Hg	and	Less than 80 mm Hg
Prehypertension	120-139 mm Hg	or	80-89 mm Hg
High blood pressure			
Stage 1	140-159 mm Hg	or	90-99 mm Hg
Stage 2	160 mm Hg or higher	or	100 mm Hg or higher

The health and fitness professional also needs to be aware of the possible side effects of commonly prescribed medications for hypertension. For example, anti-hypertensive medications such as beta blockers and diuretics disrupt the body's ability to regulate body temperature during exercise. Additionally, beta blockers reduce the heart rate, which can adversely affect the percent of maximum heart rate at which clients should train. Alpha blockers, calcium channel blockers, and vasodilators may cause hypotension following exercise, making a cool-down very important (8). The specific guidelines for resistance training and the hypertensive client are not as clear as for aerobic physical activity. Acute bouts of resistance training will actually increase systolic and diastolic BP with only a small increase in heart rate, making exaggerated BP responses one concern about resistance exercise. A physician's clearance is advisable before prescribing intense resistance training.

Cardiorespiratory Recommendation

Frequency	3-7 days/week (daily exercise may be best for managing BP)
Intensity	Moderate (40 to 60% HRR)
Duration	30-60 minutes, depending on intensity, continuous or intermittent

Resistance Training Recommendation

Include all major muscle groups, focus on circuit training

Sets	1 set
Repetitions	8-12 repetitions
Frequency	2-3 days/week

Stroke

A stroke is similar to coronary heart disease except a cerebral artery becomes blocked and leads to a stroke. A stroke occurs when blood supply to part of the brain is blocked, or when a blood vessel in the brain bursts. Whichever part of the brain that does not receive adequate blood supply will suffer the damage. Stroke is the fourth most common cause of death in the

United States (9). Although obesity alone may not be a primary risk factor for stroke, several diseases that are linked to obesity are. It is the combination of these conditions and lifestyle factors that increase the risk of a stroke. These risk factors include hypertension, heart disease, diabetes, tobacco use, hyperlipidemia, genetic factors, and alcohol abuse.

A stroke survivor may have limited motor skills, making a regular exercise routine difficult. Physician recommendations should always be followed. The recommendations following a cardiovascular event such as a stroke are as follows:

Cardiorespiratory Recommendation

Frequency	4-7 days/week
Intensity	40 to 80% HHR or RPE of 11-16 on 6-20 scale
Duration	20-60 minutes, depending on intensity (or multiple 10-minute sessions)

Resistance Training Recommendation

Include all major muscle groups

Sets	2-4 sets
Repetitions	12-15 repetitions that can be lifted comfortably
Frequency	2-3 days/week

Respiratory Complications

Similar to its effects on the cardiovascular system, obesity also places stress on the respiratory system. Carrying around excess fat leads to additional work that has to be done by the muscles just for activities of daily living and can interfere with breathing mechanics. Respiratory complications can range from shortness of breath with mild exertion to exercise-induced asthma to obstructive sleep apnea.

In terms of obesity and its connection to asthma, research shows a general association, but the exact physiological mechanisms remain unclear (10-12). Some mechanisms that may explain the relationship are that lung volume and tidal volume

are reduced, which leads to airway narrowing along with an increase in inflammation affecting the ventilation-perfusion ratio (13, 14). Studies are still needed to establish a direct relationship, but evidence is mounting that obesity occurs before asthma symptoms are present, and that weight loss results in improvements in symptoms (12, 15). Even though more research needs to be done regarding obesity and asthma, it is thought that obesity affects the severity of asthma and a patient's ability to control the asthma (16).

Obesity is a well-recognized risk factor for obstructive sleep apnea (10, 17, 18). In sleep apnea, increased fat tissue and reduced lung volumes in people who are obese act together to cause airway closures during sleep. Nearly 70% of people with sleep apnea are obese, and the prevalence of sleep apnea among people who are obese is approximately 40% (10). Those living with sleep apnea routinely do not get enough rest and suffer further from a host of issues associated with fatigue, in some cases including being unable to exercise. Ironically, one of the most effective ways to correct sleep apnea is to reduce body mass, creating yet another challenge for the health and fitness professional. Physical activity recommendations are, in general, the same for people who have respiration problems, but those clients may find exercise unusually uncomfortable, and a low-intensity program should be prescribed in the early stages of training.

Cardiorespiratory Recommendation	
Frequency	3-5 days/week
Intensity	<i>Optimal intensity has not been established, but general guidelines apply to tolerance</i>
Duration	20-60 minutes, depending on intensity (may need to start at 10 to 30 minutes)
Resistance Training Recommendation	
<i>Include all major muscle groups</i>	
Sets	1 set
Repetitions	3-20 repetitions
Frequency	2-3 days/week, at least 48 hours between sessions

Cancer Risks

The relationship between obesity and certain cancers is not fully understood, but there is growing evidence that obesity is a factor. People who exercise regularly and eat healthy foods are less likely to develop adverse health issues, but there are exceptions because no one factor causes any one disease. Research has identified obesity as a risk factor for cancers of the colon, breast, endometrium, kidney, and esophagus (19). Obese people have 1.5 to 3.5 times increased risk of developing these cancers compared with people of normal weight, and 15-45% of these cancers are attributed to being overweight or obese. According to the American Institute for Cancer Research, obesity

Effect of Exercise on Cancer

Research involving observational studies has found a connection between exercise and colon and breast cancer. A study in 2002 found that exercise reduced colon cancer risk by 50%. In a study from the Women's Health Initiative, just 30 minutes a day of walking was found to reduce the risk of breast cancer by 20% in postmenopausal women.

McTiernan A, Kooperberg C, White E, et al. Recreational physical activity and the risk of breast cancer in postmenopausal women: The Women's Health Initiative Cohort Study. *Journal of the American Medical Association* 2003;290(10):1331-1336.

either is or may be a cause of a number of cancers, and maintenance of a healthy weight throughout life may be one of the most important ways to protect against cancer (20). Further, all forms of physical activity protect against some cancers. Unfortunately, weight gain, being overweight, and obesity also independently cause some cancers regardless of the level of physical activity (20).

Cardiorespiratory Recommendation	
Frequency	3-5 days/week
Intensity	40-60% HRR
Duration	20-60 minutes per session
Resistance Training Recommendation <i>Include all major muscle groups</i>	
Sets	1-3 sets
Repetitions	8-12 repetitions
Frequency	2-3 days/week, at least 48 hours between sessions

Dyslipidemia

Dyslipidemia is often referred to as high cholesterol, but it is actually a disorder of lipoprotein metabolism. A lipoprotein is made up of lipid and protein. Dyslipidemia can be caused by an increase of total cholesterol, low-density lipoprotein (LDL) cholesterol, and in triglyceride concentrations, or a decrease in high-density lipoprotein (HDL) cholesterol concentration in the blood. The dyslipidemia associated with obesity consists of high triglycerides, decreased HDL (good cholesterol), and abnormal LDL (bad cholesterol) levels (21, 22).

A person is more likely to have high cholesterol that can lead to heart disease if any of the following risk factors are present: obesity, physical inactivity, poor diet, hypertension, smoking, diabetes, and family history of heart disease.

Exercise recommendations have varied considerably, and research has not yet determined the exact levels of physical activity that will maximally increase HDL, lower LDL and triglycerides, and slow or reverse atherosclerosis. However, lifestyle modifications, such as losing weight and eating a healthy diet, can improve one's lipid profile. Along with a healthy diet, losing as little as 5 to 10 pounds can help lower total cholesterol levels. Research has demonstrated a dose response relationship between improved lipid profiles and increasing total exercise time and caloric expenditure. Additionally, it has been shown that diet and exercise are effective when combined for treatment, and both aerobic and resistance training are helpful for improving dyslipidemia. Therefore, exercise and diet should be prescribed together, and the current exercise guidelines for the general population are appropriate for patients who have dyslipidemia (22).

Cardiorespiratory Recommendation	
Frequency	At least 5 days/week
Intensity	40-75% of HRR
Duration	30-60 minutes, depending on intensity
Resistance Training Recommendation <i>Include all major muscle groups</i>	
Sets	1 set
Repetitions	3-20 repetitions
Frequency	2-3 days/week

Research has connected high blood cholesterol and cardiovascular disease. The landmark Framingham Heart Study indicated that the higher the cholesterol level, the higher the risk.

Framingham Heart Study, <http://www.nhlbi.nih.gov/about/framingham/index.html>

Metabolic Syndrome

Metabolic syndrome, also called Syndrome X, is when several cardiovascular disease risk factors exist in combination. With these risks comes an increased chance of developing type 2 diabetes, cardiovascular disease, and stroke (23, 24). It's estimated that approximately 34% of the people in the United States have metabolic syndrome (25). There is a known relationship between increased adiposity and increased prevalence of metabolic syndrome (26). Metabolic syndrome exists if a person has three or more of the following: abdominal obesity, dyslipidemia (high triglycerides, low HDL-C, or small LDL particles), elevated blood pressure, elevated fasting glucose, prothrombotic state (forming clots), or proinflammatory state (increased CRP levels) (25). Of these six components, abdominal obesity and insulin resistance (elevated fasting glucose) are thought to be the principal traits of metabolic syndrome as seen in a type 2 diabetic client (27). Other factors associated with the syndrome are age, hormone imbalances, genetics, and physical inactivity.

Once again, the key to managing metabolic syndrome is lifestyle modification, with exercise and diet playing integral roles (23, 24, 27).

Cardiorespiratory Recommendation

Frequency	5 days/week (depending on present comorbidities)
Intensity	Moderate (40-60% HRR) and progress to higher intensity
Duration	20-60 minutes, depending on intensity Accumulate more than 300 min/week, 50-60 min/day when appropriate

Resistance Training Recommendation

Include all major muscle groups

Sets	1 set
Repetitions	10-15 repetitions, work up to 20
Frequency	Minimum 2 days/week

Musculoskeletal Issues

Musculoskeletal issues can affect the body's muscles, joints, tendons, and ligaments, and they can be quite debilitating. Common symptoms of musculoskeletal disorders include pain, weakness, stiffness, and decreased range of motion. Inflammation, which can cause pain, swelling, tenderness, and decreased function, may be one cause. One of the main causes of musculoskeletal issues is an injury, but problems also can be more chronic, stemming from being overweight, having poor posture, or repetitive movements. Common causes of musculoskeletal irritation are bruises, tendinitis, sprains, bursas, arthritis, and fibromyalgia. Another common problem that is experienced by many people is low-back pain caused by muscle imbalances.

Musculoskeletal injuries amount to approximately \$120 million in lost work time due to back, knee, shoulder, and various other joint problems.

Low-back pain (LBP) is the second-most common condition treated by primary care physicians today; cardiovascular issues are the first (28). It is, however, the No. 1 cause of disability in the working population, and it is considered a global problem (29). Low-back pain alone is a symptom, not a diagnosed condition, making prevalence difficult to determine. However, evidence suggests that women and people aged 40-80 years may be more prone to report low-back pain (29). The causes of LBP can vary widely between individuals. Some common causes are trauma to the region, poor posture, improper lifting technique, obesity, smoking, muscle imbalance, and musculoskeletal weakness. Although many medical professionals think that overweight and obese individuals are at an increased risk of developing LBP, evidence supporting the exact cause is inconclusive. Overweight and obese people, particularly those who have abdominal obesity,

place an enormous amount of stress on the low-back muscles by pulling the lumbar spine “forward.” Obese people, due to the additional load carried, are more susceptible to bone spurs in the thoracic and lumbar spine, and possibly to disc degeneration; a disc rupture or herniation; spondylolisthesis, which is an anterior displacement of a vertebra; and spondylolysis, which is a fracture in the vertebrae. Additionally, if a person is not exercising, flexibility deteriorates, and muscles atrophy. When this happens to the muscles in the low back and pelvis, it can cause the pelvis to tilt anteriorly, which also can lead to LBP, and the compromised structure is at a greater risk of injury.

Weight loss is often recommended for overweight and obese people who have musculoskeletal issues, but care should be taken because certain exercises or exercise in general can be contraindicated. Low-impact physical activity may be an option for many in an effort to maintain low-back function. It is important that blood continues to be delivered to the discs and surrounding tissues to keep them healthy.

Cardiorespiratory Recommendation	
Frequency	3 days/week, symptoms dependent
Intensity	Low to moderate (40-80% HRR)
Duration	20-30 minutes, symptoms dependent
Resistance Training Recommendation	
<i>Focus on core musculature</i>	
Sets	1-2 sets
Repetitions	10-15 repetitions
Frequency	Minimum 2 days/week

Depression

Depression is related to obesity, but research has yet to determine whether obesity is a firm cause of depression or whether depression is a cause of obesity. Either way, with the prevalence of both conditions, it is not uncommon for them to occur at the same time (30). Recent data show that individuals who have abdominal obesity are more likely to have major or moderate-to-severe depressive symptoms (31). Although depression is a mental disorder that can be diagnosed only by a medical doctor, some of the common symptoms include feeling sad, guilty, or worthless; disturbances in appetite and sleep; low energy; and loss of interest in activities. Overall, U.S. adults who are obese are more likely to be diagnosed as depressed (32). Research has shown that obese women tend to suffer from depression more than obese men, and that women’s depression may be linked to perception of body size rather than a measure of body fat (33). Also, depression and anxiety are the most common psychopathological diagnoses for morbidly obese people about to undergo weight loss surgery (34). Although there is still much to learn about obesity and its association with depression, exercise remains a popular option for treatment of depression, and a number of studies have shown this to be an effective modality (35).

Cardiorespiratory Recommendation	
Frequency	3-5 or more days/week
Intensity	Moderate to vigorous (50-85% HRR)
Duration	At least 20-30 minutes/day
Resistance Training Recommendation	
<i>Include all major muscle groups</i>	
Sets	1 set
Repetitions	8-12 repetitions
Frequency	2 days/week

There is some scientific evidence that suggests exercise raises the levels of certain mood-enhancing neurotransmitters in the brain. In addition, exercise also may boost endorphins (a feel-good chemical), release muscle tension, help individuals sleep better, and reduce levels of cortisol, the stress hormone. All of these changes in the mind and body may improve symptoms such as sadness, anxiety, irritability, stress, fatigue, anger, self-doubt, and hopelessness.

Summary

Being overweight and being obese have been readily linked to a number of debilitating conditions and diseases. If an individual does not take steps to improve factors that are in his or her control, not only will overall quality of life decline, but an early and unnecessary death can result. In many cases, symptoms will improve with the initiation of physical activity even before significant results are realized on the scale or with the measuring tape. This positive and independent effect of exercise on the health status of an overweight or obese person is reason enough to start and stick with an exercise program.

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