CVD has been the leading cause of death in the United States for almost a century.\(^1\) High triglyceride levels are an independent risk factor for death from CVD.\(^2\) It’s estimated that 33% of men aged 40 to 59 and nearly 33% of women aged 60 years and older have high triglyceride levels.\(^3\)

This continuing education course examines current research on triglycerides and provides recommendations and strategies RDs can use when counseling their clients on management and prevention of CVD.

**Triglyceride Basics**

A triglyceride is composed of glycerol and three fatty acids. The structure of a triglyceride can vary based on the length of the fatty acid chains.\(^4\) Most of the fat in the body exists in the form of triglycerides, and most of the saturated fat in food also is in triglyceride form.\(^5\)

Triglycerides store excess energy from the diet.\(^6\) Excess calories are converted to triglycerides, transported to fat cells, and stored as a source of energy that the body can later use between meals or snacks. Bile salts emulsify the triglycerides. The pancreatic enzyme lipase then hydrolyzes the ester bonds in each triglyceride, allowing the fatty acids to separate from the glycerol molecule. The free fatty acids and the glycerol molecule are transported across the intestinal membrane of the duodenum and recombined to form triglycerides.\(^7\)

Once inside the intestinal cells, triglycerides are packed inside chylomicrons (small lipoprotein particles consisting of triglycerides, cholesterol, and protein). These chylomicrons carry the water-insoluble lipids from the intestine through the lymphatic and circulatory systems. Once in the bloodstream, the lipids go to the liver to be used for energy immediately or to adipose tissue to be stored for future energy use.\(^7\)

When more energy than the body’s glycogen stores can provide is needed, the release of these triglycerides into the bloodstream is determined by the body’s hormones: epinephrine, norepinephrine, glucagon, growth hormone, adrenocorticotropic hormone,
and thyroid-stimulating hormone. Each of these hormones stimulates lipolysis at different rates.\(^8\)

Triglycerides, when combined with HDL, LDL, and other types of cholesterol in the blood, form plasma lipids. Most goals for CVD prevention or management involve raising HDL levels while lowering LDL and triglyceride levels to recommended ranges. However, more and more research is showing that triglyceride levels are an independent risk factor for CVD, greatly increasing the chances of heart disease and stroke.\(^2\)

Triglyceride levels are measured by a blood test. Often, triglycerides are included as part of a lipid panel that measures total cholesterol, LDL, and HDL. For an accurate measurement, patients must fast for nine to 12 hours before their blood is drawn.\(^9\)

According to the ATP III guidelines from the National Cholesterol Education Program, triglycerides are classified as normal at <150 mg/dL, borderline high at 150 to 199 mg/dL, high at 200 to 499 mg/dL, and very high at 500 mg/dL or higher. LDL is classified as optimal at less than 100 mg/dL, near optimal at 100 to 129 mg/dL, borderline high at 130 to 159 mg/dL, high at 160 to 189 mg/dL, and very high at ≥190 mg/dL. Total cholesterol is classified as desirable at less than 200 mg/dL, borderline high at 200 to 239 mg/dL, and high at ≥240 mg/dL. HDL is classified as low at <40 mg/dL and high at ≥60 mg/dL.\(^10\)

**Prevalence of High Triglycerides**

The National Health and Nutrition Examination Survey (NHANES) compared trends in cholesterol and triglyceride levels among US adults between 1976 and 2002.\(^11\) Results showed that while mean LDL cholesterol levels decreased, mean serum triglyceride levels steadily increased over the years.

Prevalence of hypertriglyceridemia varies among ethnicities within the US population. The prevalence of triglyceride levels at ≥150 mg/dL in Mexican Americans, non-Hispanic whites, and blacks is 34.9%, 33%, and 15.6%, respectively. Within each ethnicity classification, the prevalence of triglyceride levels at ≥150 mg/dL was higher in men than in women.\(^3\) Lifestyle factors such as disrupted circadian rhythms can also cause high triglycerides. Studies performed on mice showed that those with normal circadian rhythms experience the normal fluctuation of triglyceride levels throughout the day—highest during the day and lowest at night. Mice with disrupted circadian rhythms experience a constant high serum level of triglycerides rather than a normal fluctuation. This research suggests that populations who stay up until 2 AM (a benchmark set beyond conventional bedtime hours), frequently travel to different time zones, or work overnight shifts may be particularly susceptible to high triglyceride levels.\(^12\)

High triglycerides are more prevalent in people who have sedentary lifestyles, as well as those with diabetes, obesity, hypothyroidism, and many other diseases.
Risks Associated With High Triglyceride Levels
In addition to heart disease, high triglyceride levels also may increase a person’s risk of developing sexual dysfunction, pancreatitis, prostate cancer, diabetic nerve loss, and stroke.

Heart Disease
Although studies have been unclear as to exactly how high triglycerides may cause the arteries to harden and the artery walls to thicken (known as atherosclerosis), it’s clear that these effects greatly increase the risk of heart disease, heart attack, and stroke.9

Sexual Dysfunction
Corona and colleagues studied 1,687 men attending an outpatient clinic for sexual dysfunction. They found that high triglyceride levels were associated with an increased risk of arteriogenic erectile dysfunction, impaired penile flow, and biochemical hypogonadism. Men taking lipid-lowering agents or who had diabetes were excluded from the analysis.13

Pancreatitis
High triglyceride levels are also associated with acute pancreatitis. When serum triglyceride levels exceed 900 mg/dL, chylomicrons are present in the bloodstream. These large particles obstruct the pancreatic capillaries and lead to increasing levels of free fatty acids and free radicals, resulting in inflammation, edema, and necrosis.14

Prostate Cancer
The American Association for Cancer Research published a study connecting high triglyceride levels (>150 mg/dL) with a 35% increased risk of recurrence of prostate cancer in men who underwent radical prostatectomy. The 843 men included in the study never took statins prior to surgery.15

Other types of lipids also influenced risk of prostate cancer recurrence. For total cholesterol levels >200 mg/dL, each 10 mg/dL increase resulted in a 9% increase for recurrence. For men with HDL <40 mg/dL, each 10 mg/dL increase resulted in a 39% lower risk of recurrence.15

Diabetic Nerve Loss
Studies also show that high triglyceride levels can significantly worsen neuropathy in patients with diabetic neuropathy. A year-long study from the University of Michigan Health System examined the peripheral nerve myelinated fiber density in the legs of 427 participants with mild to moderate diabetic neuropathy. They found that patients with elevated triglycerides had significantly more decline in nerve fiber density, regardless of age, diabetes control, or disease duration. Other types of lipids didn’t appear to be significant.16

Stroke
According to a study by the American Heart Association (AHA), high triglycerides have a strong correlation with an increased risk of stroke, regardless of other cholesterol
types and levels (LDL, HDL, total cholesterol). The six- to eight-year study included 11,177 patients with coronary heart disease with no history of stroke or transient ischemic attack (a “mini stroke” that causes stroke-like symptoms but no long-term damage). Of these participants, 487 had an ischemic stroke or transient ischemic attack. These participants had greater than average levels of triglycerides, with one-fourth having triglyceride levels ≥200 mg/dL, increasing their stroke risk by almost 30%.

It's believed this increased risk is due to the excess triglycerides increasing concentrations of chylomicrons and very low-density lipoproteins. These types of fat particles may play a role in obstructing blood flow, leading to an ischemic stroke. High triglycerides also cause abnormalities in the body's clotting system, increasing the risk of atherosclerosis or blood clots.

These findings may prompt health care providers to include triglycerides in routine stroke risk assessments, since elevated triglycerides can occur in people whose other cholesterol types are within healthy ranges. The study also found that high triglycerides posed the same stroke risk regardless of age, gender, and other characteristics.

Another study found that triglyceride levels had a significant impact on the risk of a stroke in postmenopausal women. Researchers compared 972 postmenopausal women who experienced an ischemic stroke while participating in the Women's Health Initiative Observational Study with a control group of 972 postmenopausal women who hadn't had a stroke. Triglyceride levels showed a significant association with stroke occurrence. Women with triglycerides ranging in the highest quartile were almost twice as likely to have suffered a stroke compared with women with triglyceride levels in the lowest quartile. LDL cholesterol and total cholesterol levels, surprisingly, weren't associated with stroke risk in this population.

Causes of High Triglycerides
A variety of factors influence triglyceride levels. Research has connected high triglyceride levels with diabetes mellitus, sugar- and carbohydrate-rich diets, obesity, physical inactivity, hypothyroidism, excessive alcohol intake, and tobacco use. Having one or more of these risk factors greatly increases a person's likelihood of high triglyceride levels.

Diabetes Mellitus
High triglyceride levels are commonly seen in patients with both type 1 and type 2 diabetes mellitus. Other lipid abnormalities associated with diabetes include small, dense LDL particles and low HDL levels. Glucose is the body’s main energy source. When glucose levels are insufficient, triglycerides are the body’s next source of energy. Insulin allows the body to use triglycerides for energy by moving them from the bloodstream into the cells. Insulin resistance and poor glycemic control lead to increased chylomicron and very low-density lipoprotein production. Hyperglycemia also impairs removal of these triglyceride-rich lipoproteins, leading to low HDL levels. While the production of LDL cholesterol isn’t increased, the LDL cholesterol particles
become abnormal in size. When triglyceride levels rise above 200 mg/dL, LDL cholesterol particles become smaller, denser, and more atherogenic. The small size of the LDL cholesterol particles allows them to better penetrate blood vessel walls, where they lead to plaque formation.\textsuperscript{19}

The combination of high triglycerides, low HDL levels, and more atherogenic LDL cholesterol particles significantly increases the risk of CVD and death in patients with diabetes. Some studies show that diabetes patients with elevated cholesterol who receive no lipid-lowering therapy have a 1.5- to 1.7-fold greater risk of a major coronary event than do nondiabetic patients with elevated cholesterol levels.\textsuperscript{19}

A comparison study of nondiabetic patients and patients with noninsulin-dependent type 2 diabetes attempted to determine the effect of triglycerides and cholesterol on blood glucose. Results showed that participants with high glucose values (>110 mg/dL) exhibited elevated triglyceride levels but not always elevated cholesterol levels. One study group with glucose values >110 mg/dL had triglyceride levels >151 mg/dL and cholesterol levels >201 mg/dL. The other study group with glucose values >110 mg/dL had triglyceride levels >151 mg/dL but cholesterol levels <201 mg/dL.\textsuperscript{21}

**Sugar- and Carbohydrate-Rich Diets**

Diets in which carbohydrates comprise more than 55% of total calories also have been shown to increase triglyceride levels. High intake of refined carbohydrates and simple sugars, especially in those who are overweight or obese, can lead to a phenomenon called carbohydrate-induced hypertriglyceridemia.\textsuperscript{6}

One study looked at 6,113 adults from NHANES 1999–2006. Respondents were categorized into added sugar intake percentage of total calories as follows: <5% (reference group), 5% to <10%, 10% to <17.5%, 17.5% to <25%, and 25% or more. Results showed that as consumption of added sugars increased, HDL levels decreased and triglyceride levels increased. The study also found that the average daily consumption of added sugars was 3.2 oz (21.4 tsp or 359 kcal). This equates to 15.8% of total daily caloric intake.\textsuperscript{22}

Observational studies have linked the primary source of added sugars in the American diet to soft drinks and other sugar-sweetened beverages. Excessive consumption of added sugars in beverages has been linked to excessive caloric intake, higher body weight, and lower intake of essential nutrients. Therefore, the AHA recommends limiting added sugar intake to no more than 100 kcal per day for women and no more than 150 kcal per day for men.\textsuperscript{23}

**Obesity**

Further research supports the influence of body weight on hypertriglyceridemia. NHANES examined the relationship between BMI and triglyceride concentrations of 5,610 adult participants between 1999 and 2004.\textsuperscript{24} Of the participants classified as overweight or obese, approximately 80% had triglyceride levels ≥150 mg/dL. When
participants were classified by triglyceride level, 83% of the participants with triglyceride levels of ≥200 mg/dL were classified as overweight or obese.

The Framingham Heart Study examined the relationship between visceral adipose tissue (VAT), subcutaneous abdominal adipose tissue (SAT), and triglyceride levels. In both men and women, VAT and SAT were associated with high triglyceride levels (p<0.01). Furthermore, VAT showed a significantly stronger correlation with metabolic risk factors, such as hypertriglyceridemia, than did SAT (p<0.0001).

**Physical Inactivity**

Hypertriglyceridemia also has been attributed to sedentary lifestyles. Research shows physical activity has beneficial effects on cardiovascular risk factors, including reducing serum triglyceride levels, raising HDL cholesterol, reducing systolic blood pressure, and promoting glucose homeostasis.

Aadahl and colleagues evaluated 1,693 men and women ranging from 33 to 64 years of age over a three-year period. All participants had a sedentary activity level, and none of the participants in the study were taking lipid-lowering medications at the time. Physical activity was measured in metabolic equivalents (METs), or a person’s metabolic rate. This is the amount of oxygen consumed at rest, which is approximately 1.2 kcal/min for a 70-kg (about 154 lbs) person. For example, 2 METs require activity at twice the resting metabolic rate (2.4 kcal/kg/min). For participants with an average daily physical activity level less than or equal to 45 METs, results showed a significant inverse association with triglycerides as well as waist circumference, BMI, and waist-hip ratio. A positive association was found with HDL levels in this group. This suggests that daily moderate physical activity, which corresponds to a 24-hour daily MET score of 45, is associated with a significant decrease in certain cardiovascular risk factors, including high triglycerides.

**Hypothyroidism**

Hypothyroidism significantly affects lipoprotein levels, causing a linear increase in total cholesterol, LDL cholesterol, and triglycerides and a linear decrease in HDL cholesterol. Hypothyroidism decreases metabolic rate, slowing the body’s use of triglycerides for energy. As a result, triglycerides remain stored in the fat cells.

Rizos and colleagues found that administration of L-thyroxine (a medication used to treat hypothyroidism) significantly improved the lipid abnormalities caused by hypothyroidism. A study of 60 patients with newly diagnosed hypothyroidism showed a decrease in total cholesterol, LDL cholesterol, and triglyceride levels after treatment with L-thyroxine.

Treating hypothyroidism with L-thyroxine over a period of four to six weeks lowered triglyceride levels in patients. However, if patients had high triglyceride levels before developing hypothyroidism, they may still need specific treatment to target these lipids, such as cholesterol medications and diet modifications.
**Alcohol Intake**
Excessive alcohol intake (more than three standard drinks per day for men or more than two standard drinks per day for women) also has been positively correlated with hypertriglyceridemia.\(^{31}\) One study showed that alcohol consumption, especially when accompanying a meal containing saturated fat, increased the postprandial triglyceride peak. Alcohol acutely inhibits lipoprotein lipase activity, resulting in a decrease in the breakdown of chylomicrons and very low-density lipoprotein remnants. Alcohol also increases the liver synthesis of large very low-density lipoprotein particles.\(^{32}\)

Bessembinders and colleagues studied the relationship between alcohol and triglyceride levels in 300 patients with severely high triglyceride levels (>1,000 mg/dL). Alcohol intake exceeding 210 g/week for males and 140 g/week for females resulted in significantly higher (p<0.001) triglyceride levels. While hypertriglyceridemia also can be attributed to obesity and/or diabetes mellitus, this study showed that combining these risk factors with excessive alcohol consumption greatly increases the risk of developing severe hypertriglyceridemia.\(^{31}\)

**Tobacco Use**
Gupta and colleagues performed a controlled study to evaluate the effect of habitual tobacco chewing on the prevalence of major cardiovascular risk factors. The control group consisted of 200 subjects who didn’t use tobacco in any form. The second group comprised 200 subjects who had a 10- to 55-year history of smoking bidis (smaller, less expensive cigarettes made from unprocessed tobacco wrapped in leaves) or cigarettes. The third group included 200 subjects who had a 10- to 60-year duration of isolated tobacco chewing history. Tobacco chewers had significantly higher (p<0.001) triglyceride, LDL, total cholesterol, and blood pressure levels compared with controls. The prevalence of hypertriglyceridemia, hypercholesterolemia, and hypertension also was significantly greater (p<0.01) in the tobacco-chewing group compared with controls. Prevalence of these cardiovascular risk factors among tobacco smokers and tobacco chewers was similar, suggesting that any tobacco use increases cardiovascular risk factors.\(^{33}\)

Rao studied the effects of tobacco smoking and chewing on serum lipid profiles of 75 male subjects over a 10-year period. The control group included 25 males who didn’t use tobacco in any form. The second group comprised 25 males who were tobacco smokers only. The third group consisted of 25 males who were tobacco chewers only. Compared with controls, tobacco smoking increased triglyceride levels about 25.4% (p<0.001), and tobacco chewing increased triglyceride levels by 33.4% (p<0.001). Total cholesterol and LDL cholesterol levels also were significantly increased in tobacco users compared with the control group. HDL cholesterol levels significantly decreased with tobacco use.\(^{34}\)

Since alcohol intake and tobacco use both have been linked to elevated triglyceride levels, clients who use either of these substances should be encouraged to restrict use or discontinue use altogether. Referring clients to a licensed professional counselor may be beneficial if they are believed to have an addiction to either of these substances.
Treatment and Medications
Various treatments and medications have been shown to help lower triglyceride levels.

Niacin
In addition to the diet recommendations discussed above, clients can discuss with their doctors drug and supplement approaches to lowering triglyceride levels. Statins and other cholesterol-lowering drugs have been shown to lower triglyceride levels. However, if triglyceride levels remain high after statin use, alternative therapies, such as niacin use, may be recommended. Niacin lowers triglyceride and LDL cholesterol levels by reducing synthesis of very low-density lipoprotein. Niacin is available as a high-dose supplement or in tablet form combined with statins.

According to Lloyd-Jones, niacin raises HDL cholesterol, modestly reduces LDL cholesterol levels, and substantially reduces triglyceride levels. Niacin, however, is contraindicated in patients with hypertriglyceridemia and type 2 diabetes because it causes insulin resistance, thereby precipitating or aggravating hyperglycemia. Other side effects include gastric irritation, flushing of the skin, hepatotoxicity development, and hyperuricemia. New formulations of niacin may be better tolerated in patients with diabetes. Lloyd-Jones suggests reserving niacin therapy for patients at a very high risk of heart attack and stroke (due to uncontrolled lipid levels) who cannot take statins. Clients should talk to their doctors about which form of therapy is best for them.

Fibrates
For people who are unable to tolerate statins, fibrates (a class of medications derived from fibric acid) are an option. Fibrates reduce triglyceride levels by decreasing the liver’s production of very low-density lipoprotein (the lipid particle that transports triglycerides in the blood) and increasing the speed at which triglycerides are removed from the blood.

Fibrates have been shown to lower triglyceride levels up to 40% to 60%, thereby decreasing the risk of cardiovascular events in patients with CVD and hypertriglyceridemia. Fibrate therapy also decreased the progression of coronary heart disease in patients with type 2 diabetes. Keech and colleagues studied 9,795 patients with type 2 diabetes and elevated lipid profiles and found that Tricor (fenofibrate) decreased the total number of nonfatal myocardial infarctions, stroke, and revascularization.

Potential Treatments
Recent studies have explored the use of antisense therapy as a potential treatment for hypertriglyceridemia. Antisense therapy involves synthesizing a strand of DNA that will bind to a specific disease-causing gene and inactivating it. This therapy has been studied as a potential treatment for certain genetic disorders and infections.

Gaudet and colleagues studied the effects of ISIS 304801, an antisense inhibitor, on apolipoprotein C-III (APOC3), a key protein involved in regulating plasma triglyceride
levels. They found that blocking the expression of the APOC3 gene inhibited the creation of APOC3, leading to a decrease in plasma triglyceride levels. During the 13-week study, no safety concerns were identified.\textsuperscript{39}

**Prevention and Management of High Triglycerides**

A variety of therapies have been shown to be effective at preventing or lowering high triglyceride levels.

**Increasing Physical Activity**

The Centers for Disease Control and Prevention and the American College of Sports Medicine recommend that adults engage in moderate-intensity physical activity for 30 minutes per day on most days of the week or 150 minutes total per week to reduce triglyceride levels.\textsuperscript{26}

As previously noted, research by Aadahl suggests that daily moderate physical activity, which corresponds to a daily MET score of 45, is associated with a significant decrease in triglyceride levels.\textsuperscript{28}

The Task Force on Community Preventive Services identified effective strategies to promote active lifestyles for whole communities. Social support programs (eg, buddy systems), physical education programs in schools, improved access to locations suitable for physical activity, and point-of-decision prompts (eg, signs encouraging people to use the stairs instead of the elevator) were some of the most effective strategies for getting people to increase their physical activity amounts.\textsuperscript{26}

Even small increments of physical activity can make a difference. Clients who are significantly out of shape should be encouraged to start with small changes in everyday activities, such as taking the stairs instead of the elevator or parking farther away at the grocery store. Three 10-minute segments of exercise are just as effective as one 30-minute segment.

If your clients are unwilling to decrease the amount of time spent doing sedentary activities such as watching television or playing video games, encourage them to find ways to incorporate physical activity into their favorite hobbies. For example, clients can do jumping jacks during commercial breaks or play more active video games from a standing position.

**Reaching a Healthy Body Weight**

Given the significant prevalence of obesity among US adults (35.5% among men and 35.8% among women in 2009–2010)\textsuperscript{40} and the link between obesity and hypertriglyceridemia, emphasis should be placed on reaching and maintaining a healthy body weight.

Losing just 5% to 10% of one’s body weight (if overweight or obese) can decrease triglyceride levels by 20%.\textsuperscript{3} Physical activity and balanced caloric intake are the necessary components for successful weight loss.
Young and Nestle attributed the growing prevalence of overweight people to the larger portion sizes of higher-calorie foods. Most marketplace portions are at least twice as large as recommended serving sizes, and fast food and restaurant portions are even larger. Clients should be educated on correct portion sizes and encouraged to replace higher-calorie foods with lower-calorie fruits and vegetables.

RDs should remind clients about added calories, as well. Mayonnaise, salad dressings, sauces, gravies, and other condiments can add a significant number of calories to their dishes. Portion control, or switching to lower-calorie versions of these foods, should be encouraged.

**Limiting Saturated and Trans Fats**

Although there’s no research directly linking saturated and trans fats to triglyceride levels, it’s recommended to limit them for overall heart health. The AHA recommends limiting saturated fat intake to less than 7% of total calories, trans fat to less than 1%, and cholesterol intake to less than 300 mg/day. Clients can accomplish these goals by choosing plant-based protein or lean meats (skinless poultry, fish, lean beef, lean pork, or lean veal) over processed, high-fat meats such as bacon, sausage, and hot dogs. Visible fat from meat and poultry should be removed to decrease fat intake. In addition, fat-free (skim) or low-fat dairy products should be encouraged over full-fat choices.

Since both trans fat and refined sugar are found in many commercial pastries such as cookies, snack cakes, pies, and donuts, clients should be encouraged to reduce intake of these items. On food labels, trans fat might be listed as “partially hydrogenated vegetable oil.” RDs can educate their clients to look for this term when purchasing packaged foods.

**Adding Omega-3s**

Omega-3 fatty acids, specifically DHA and EPA, have been shown to significantly decrease serum triglyceride levels and even lower blood pressure.

Skulas-Ray and colleagues compared the effects of a nutritional dose of EPA+DHA (0.85 g/day) with those of a pharmaceutical dose (3.4 g/day) on serum triglycerides in patients with moderately elevated triglycerides. The pharmaceutical dose of EPA+DHA lowered triglycerides by 27% compared with the placebo, but the nutritional dose showed no significant effect on lipids.

EPA and DHA types of fatty acids are found in fatty cold-water fish. The AHA recommends eating at least two servings of fatty fish, such as salmon, albacore tuna, halibut, herring, mackerel, lake trout, or sardines, per week.

The AHA also recommends daily supplementation of 2,000 to 4,000 mg EPA+DHA for people who are trying to lower their triglyceride levels. Supplementation of more than 3,000 mg per day should be done only under the supervision of a physician, since high intakes of omega-3 have caused excessive bleeding in some individuals.
The third type of omega-3 fatty acid, alpha-linolenic acid (ALA), hasn’t been shown to have as significant an impact on cardiovascular health as DHA and EPA.46 Our bodies can make limited amounts of EPA and DHA from ALA, but we need more to receive the heart health benefits. Clients who follow strict vegetarian or vegan diets should be encouraged to consume a variety of ALA-containing foods such as avocados, flaxseed, walnuts, and soybeans. Small amounts of DHA and EPA are found in seaweed, which often is the source of DHA and EPA in vegan omega-3 supplements.

Avoiding Sugars and Choosing Healthful Carbohydrates
Replacing refined carbohydrates and simple sugars with whole grains and high-fiber foods is another way to lower triglyceride levels. Large portions of high-sugar beverages such as regular sodas, fruit punches, and sweetened tea and coffee should be discouraged. Sugary desserts and candies may be consumed in moderation.

In addition to limiting carbohydrate intake to ≤55% of total calories, clients should opt for high-fiber carbohydrates such as beans, lentils, fruit, vegetables, and whole grains. Filling at least one-half of the plate with fruits and vegetables can ensure that one obtains the recommended amount of fiber (25 g to 35 g per day).

Dietary Patterns
The Dietary Approaches to Stop Hypertension (DASH) dietary pattern has been shown to lower triglyceride levels and blood pressure. The diet pattern focuses on fruit, vegetable, and low-fat dairy consumption.47 Chiu and colleagues studied the effects of a modified, high-fat DASH diet on the lipid profiles of 36 adults. In this modified, lower-carbohydrate, high-fat DASH diet, full-fat dairy foods were included and simple carbohydrates such as fruit juices and other sugars were reduced. The three-week study consisted of three groups: a control diet, a standard DASH diet, and a higher-fat DASH diet. Compared with both DASH diets, the control diet contained more red meat and less fiber, fruits, and vegetables. The high-fat DASH diet significantly reduced triglyceride levels in comparison with the DASH diet, presenting an effective, less stringent alternative to the standard DASH diet.47

Many studies also have associated the Mediterranean diet with a decreased risk of CVD. This diet is characterized by a high intake of monounsaturated fats, such as those found in olive oil. Other characteristics include high intakes of fiber (from legumes, whole grains, and other complex carbohydrates), weekly fish consumption, and daily consumption of dairy products, often cheese and yogurt.48

Putting It Into Practice
Acknowledging the prevalence of CVD in the United States and the significance of triglycerides as a risk factor for cardiovascular death and understanding the many different causes of high triglycerides can help dietitians know how to counsel their clients appropriately. Dietitians should tailor their nutrition messages to individual clients, helping them understand how they can easily adhere to the diet and lifestyle recommendations discussed herein.
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Quiz

1. What percentage of Mexican Americans in the US population has triglyceride levels ≥150 mg/dL?
   A. 15.6%
   B. 21.5%
   C. 34.9%
   D. 48.8%

2. Consuming more than what percentage of total calories from carbohydrates has been shown to increase risk of high triglycerides?
   A. 20%
   B. 45%
   C. 50%
   D. 55%

3. What are noted in this article as the main sources of dairy products in the Mediterranean diet?
   A. Fat-free milk
   B. Cheese and yogurt
   C. Butter and cheese
   D. Cottage cheese and sour cream

4. What is typically the source of DHA and EPA in vegan omega-3 supplements?
   A. Kale
   B. Avocados
   C. Seaweed
   D. Soybeans

5. Statins and other cholesterol-lowering drugs have no effect on triglyceride levels.
   A. True
   B. False

6. According to the ATP III guidelines from the National Cholesterol Education Program, what is considered borderline high triglyceride levels?
   A. 100 to 149 mg/dL
   B. 150 to 199 mg/dL
   C. 200 to 499 mg/dL
   D. 300 to 499 mg/dL
7. Which of the following statements regarding omega-3 fatty acids is true?  
A. Omega-3 fatty acids have been shown to have no correlation with serum triglyceride levels.  
B. The American Heart Association recommends eating at least two servings of fatty fish per week.  
C. High intakes of omega-3 fatty acids have caused excessive blood clotting to occur.  
D. Daily supplementation of 5,000 mg of EPA+DHA is recommended to lower triglyceride levels.

8. What percentage of US adult women is obese?  
A. 31.3%  
B. 35.5%  
C. 35.8%  
D. 37.9%

9. Which of the following is considered a fatty fish?  
A. Cod  
B. Albacore tuna  
C. Flounder  
D. Mahi-mahi

10. According to one study discussed in this article, combining alcohol intake with what type of fat increases the postprandial triglyceride peak?  
A. Trans fat  
B. Saturated fat  
C. Monounsaturated fat  
D. Polyunsaturated fat